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On the cover: Dean Moran, of Cregg Sweeney Artisan Builders, makes pocket-screw holes for site-built kitchen cabinets in Orleans, Mass. See the story on page 41. Photo by Dave Holbrook.

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The Journal of Light Construction,
Hanley Wood LLC
One Thomas Circle NW, Suite 600
Washington, DC 20005
202.452.0800

INFORMATION DIRECTORY

CONTACT INFORMATION

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Since its launch nationwide earlier this year, many builders have made the switch to AdvanTech™ subfloor adhesive for its greater yield[1] and ease of application over traditional cartridge adhesive. The speed and ease of AdvanTech subfloor adhesive was recently put to the test in a third-party study conducted by Home Innovation Research Labs.

The study revealed that when AdvanTech subfloor adhesive is applied using the new long-reach 28" gun applicator, the subfloor adhesive application process is 40 percent faster compared to the conventional polyurethane-based cartridge adhesive method.

"Builders consistently give feedback that AdvanTech subfloor adhesive saves time on the job," said David Wescott, accessories product director for Huber Engineered Woods. "This study provides substantial evidence that our spray-foam adhesive and new long-reach gun applicator are the fastest choice, compared to cartridge adhesive options."

Home Innovation Research Labs timed simulated subfloor adhesive application on 2×10 joists at 16" on center (OC) with adhesives at room temperature and at 40 degrees Fahrenheit. Timed tests were recorded for AdvanTech subfloor adhesive with the standard 12" spray foam gun applicator and the new long-reach 28" gun applicator. For comparison, timed tests were also recorded for a popular polyurethane-based cartridge adhesive and a common solvent-based traditional cartridge adhesive. Tests were conducted with third-party installation crews who are familiar with commonly used subfloor adhesive application methods and tools.

"Builders appreciate the gun applicator because it saves the extra work for forearms that cartridge application requires — especially under cold conditions," Wescott said. "We found through this study that the new long-reach AdvanTech subfloor adhesive gun not only provides greater efficiency by extending the installer's reach and a safer option to avoid stepping out on joists, but it also recorded the fastest application times."

For more information about AdvanTech™ subfloor adhesive, visit TryAdvanTechSFA.com.

[1]Coverage: One 24 oz. can of AdvanTech™ subfloor adhesive yields approximately 400 linear feet of gel adhesive at 1/2" bead compared to applying a 28 oz. cartridge adhesive at 3/8" bead. Coverage will vary based on bead size and weather conditions.

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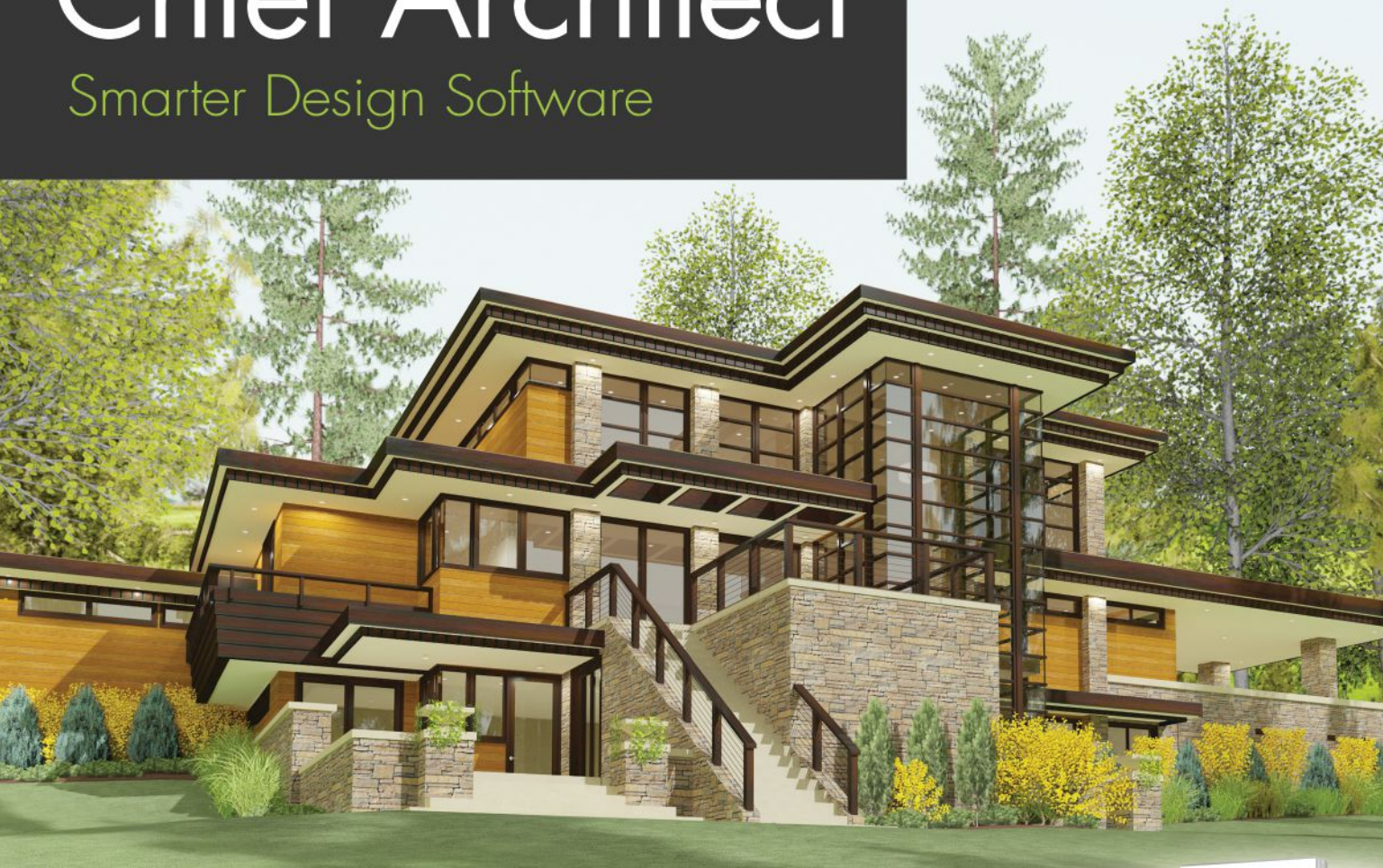

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BY TIM UHLER

Squeak-Free Floor Sheathing

My dad started building in the late 1970s, and for as long as I can remember, I've worked on the jobsite. As a teenager, I screwed down the subfloor right before carpet went in. Dad would always come in and try and find squeaks. He said that a squeaky floor sends a negative message about the quality of the builder. A squeak-free floor is not difficult to achieve, and it doesn't require a lot of thinking, just the right approach to putting down the subfloor (aka sheathing). Here is the process that has worked well for my framing partner and me for years.

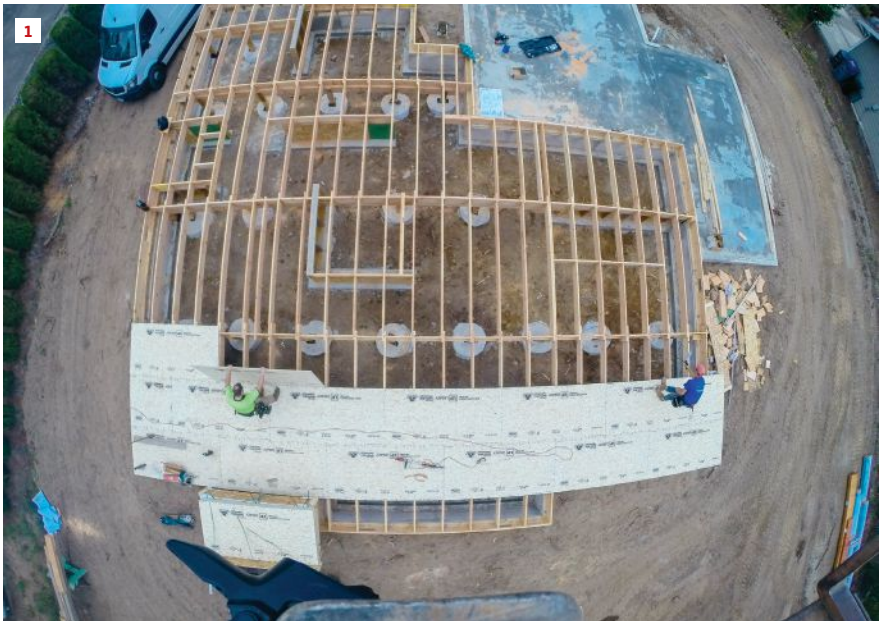
Before you begin, check your floor framing. Whether you've framed the floor with I-joists or with dimensional lumber, be sure that all blocking between joists has been nailed well. Some framers use glue in addition to nails to secure the blocking. Also, joists need to be nailed tightly to any walls or girders that they extend over.

GLUE AND SCREW

The basic principle for creating a squeak-free floor boils down to using good glue and the right fasteners. Some glues have trouble bonding the sheathing to the joists if the lumber is wet or frozen. PL Premium is a great glue that I've had good luck with over the years, but the instructions specifically say that the gluing surface must be dry and free of frost.

Lately, we have come to rely on the latest generation of "foam-to-gel" glues, such as Dap Smartbond and AdvanTech Subfloor Adhesive. These glues go on as foam but quickly turn to an adhesive gel that forms a tenacious bond to just about any material in any condition **(2)**. I like to think of fasteners as clamps that hold the sheathing to the joist while the adhesive cures. The adhesive forms the primary bond. The foam-to-gel formulations dispense onto the joist surfaces faster, and they don't fall off wet or frozen wood. Also, a can of foam-to-gel adhesive goes a lot further than the old caulking-gun cartridges, so I have to reload only about one-sixth as often.

Regardless of the type of glue you use, dirt or dust on the joists will interfere with any glue's ability to properly bond the two surfaces. Get in the habit of knocking excess dirt off your shoes before you walk on the joists.



At right is a bird's eye view of the floor sheathing process. A crew of two works in harmony to sheathe this floor quickly and efficiently. The crew member on the right spreads glue on the joists while the crew member on the left takes sheets from the stack, drops them into place, and tacks them on layout. When the glue is spread for one course, the person gluing will take over dropping and tacking while his partner fastens the sheets with a screw gun.

Photos by Tim Uhler

Most of these adhesives have a working time of about 15 minutes, so apply only the amount of glue that you can cover with sheathing in that amount of time. Once you've spread the glue on the joists, it's important to put the sheathing down and fasten it as quickly as possible. Put glue on all framing members—including joists, beams, and blocking—except the rims. (You will fasten the rims later as you straighten them). Always drive fasteners wherever you have spread glue to hold the sheathing fast to the framing while the glue cures.

When it comes to fasteners, avoid using plain-shank nails to fasten sheathing. As joists dry out over time, plain-shank nails can loosen enough to allow the sheathing to move up and down slightly and squeak. If you choose to nail your floor sheathing, always use ring-shank nails **(3)**. Many manufacturers put a coating on their nails that helps keep them in place. In the past, I've had success with good-quality ring-shank nails to attach sheathing to I-joist floors.

That said, I think that screws are much better for fastening floor sheathing, and stand-up screw guns, such as the PamFast system, make for pretty painless fastening **(4)**. The screws for these guns (made by Pam Fastening, Simpson Quik Drive, Grabber, and Senco) are designed to drive quickly, and they hold well. With 3/4-inch-thick sheathing, we drive 1 3/4-inch screws specifically made for fastening subflooring.

While there are nail-gun options (like Scrail fasteners, which have a twisted-thread shank so they drive faster and hold better), we have found that sheathing a floor with a stand-up screw gun is just fast as using a nailer. It's true that a screw gun delivers a screw slower than a nailer fires a nail, but for a two-person crew, the work flow for the entire job turns out to be the same in the end.

Fasteners should be spaced 6 inches on-center along the edges of the sheathing and 12 inches on-center in the field. Many sheathing manufacturers print marks for spacing fasteners along the 4-foot edges **(5)**. They also print marks for aligning joists on the proper on-center layout, but I rely on actual measurement for putting the joists on the proper layout (more on that process later).

FINDING A RHYTHM

The procedure for sheathing a floor involves steps that are repeated continuously until the floor is done. The first step, which we call "packing the floor," is bringing sheets of sheathing to where they will be installed. The next step is spreading glue on the joists. The sheets then drop into place and are tacked into proper position, and finally, the sheets are fully attached.

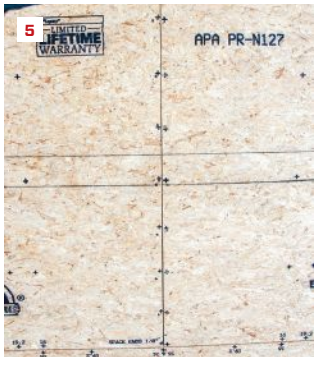
We usually work with a two-person crew in which crew member one has the primary responsibility of gluing and crew member two does most of the fastening. We begin by snapping a line for the first course of sheathing **(6)**. Then, while crew member one spreads glue for the first sheets, crew member two packs the sheets. (Our crew uses a telehandler to bring a pile of sheets to the edge of the foundation, which speeds up the packing process considerably).

Crew member two drops the sheets into place **(7)** and tacks them with a hand-nail at each corner. At this point, he also pulls a measurement and tacks the joists at the proper spacing along the long edge of the sheathing, usually at either 16 or 24 inches on-center. Special attention is paid to any joist or framing member that might not fall on the even spacing, such as around a stair opening. When the first few sheets are tacked in place, crew member two drives screws in the field to complete the fastening process while crew member one continues spreading glue and tacking in the last sheets.

As the sheets go down for the next rows, the crew taps them against the previous row with a beater board and sledgehammer **(8)**, and tacks them in place as before. The process continues with packing, gluing, and fastening each row until the floor is finished. As you might expect, there is some overlap between the duties of the two crew members. A jammed glue gun can slow down the process, and likewise, if the gluer gets far enough ahead of the fastener, he may put down the glue gun and help pack sheets for the next row. That way, the rhythm and flow continue at an even pace until the entire floor is sheathed.

SHEET SPACING

Manufacturers of both plywood and OSB floor sheathing recommend that installers leave a 1/8-inch gap between sheets along the 4-foot edges to allow for swelling. Directions are often printed at the ends of every sheet **(9)**. Some framers use nails or strips of wood



Foam-to-gel glues work on wet or dry wood **(2)**. If fastening sheathing with a nail gun, be sure to use ring-shank or twist-shank nails **(3)**. A stand-up screw gun takes longer to drive each fastener, but is just as fast for the job overall **(4)**. Manufacturers often print the fastener layout on the sheets **(5)**.

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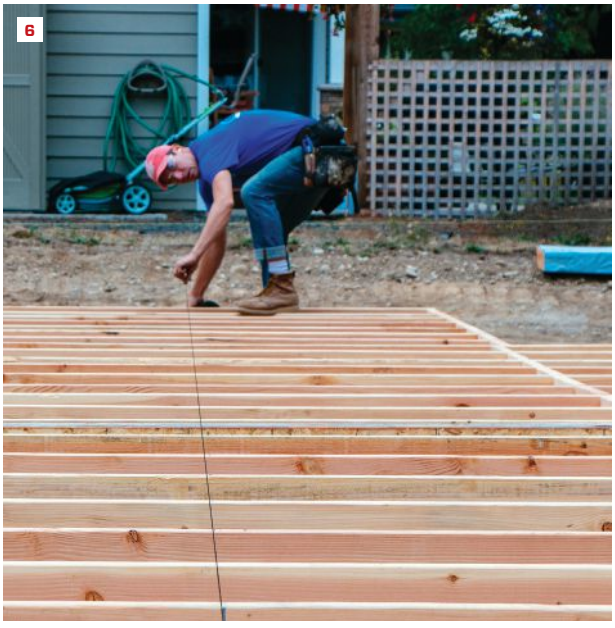

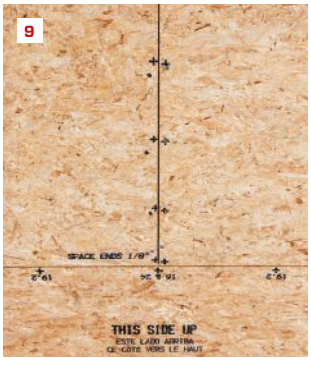

The first course starts with a snapped line to keep the course straight **(6)**. A crew member drops a sheet into place, using one foot to keep it from sliding away **(7)**. A sledgehammer and block drive the sheets together **(8)**. Spacing instructions are printed on every sheet **(9)**.

for spacers, but after a while, it's pretty easy to just eyeball the gap. The 8-foot T&G edges are self-spacing, so we tap them tight as they go in. Also, we never put glue along the groove. Many sheathing manufacturers have designed their products to drain at that joint and glue would prevent draining.

Stagger the seams of the sheathing between rows. The starting piece for each row should alternate between a full sheet and a half sheet so that the end seams are staggered between rows. In other words, if you start the first row of sheathing with a full, 4x8 sheet, then the next row should start with a 4x4.

When placing the sheets for the first row, you should always face the tongue toward the perimeter of the building. That way, when you tap the second-row sheets against the first row, the beater block hits against the groove, which is less subject to damage than the tongue.

PREVENTING SQUEAKS

Squeaks can happen—even when you have done a good job installing the sheathing. Here are some tips to help reduce squeaks from other causes.

- Put glue in joist hangers prior to installing the joist, and toenail the top of the joist into the supporting member, such as a beam or girder.
- In this part of the country, we use a lot of top-flange joist hangers to hang joists inside concrete stem walls. Whenever possible, we add a treated 2x6 ledger under the joists after they're installed, pinning the ledger to the concrete with a split-drive fastener under each joist.
- When nailing down wall plates, always make sure the nails hit a solid joist or blocking. On an exterior perimeter wall parallel to the joists, I drive nails every 6 inches along the outside edge to hit the rim.
- When nailing interior walls that land between joists, put down a bead of glue prior to lifting the wall, and then nail the wall to the line.
- For I-joists 14 inches or larger that sit in hangers, spray in gap-filling foam (from a can or gun) on either side to act as a cushion and to prevent minute deflections of the I-joist web.
- Use gap-filling spray foam around pipes and ductwork that run through holes in the joists.

Tim Uhler is a lead carpenter for Pioneer Builders in Port Orchard, Wash. He is a contributing editor to JLC *and* Tools of the Trade. *Follow him on Instagram @awesomeframers.*

For a more detailed discussion on installing squeak-free floor sheathing, go to **www.jlconline.com/training-the-trades/squeak-free-floor-sheathing**.

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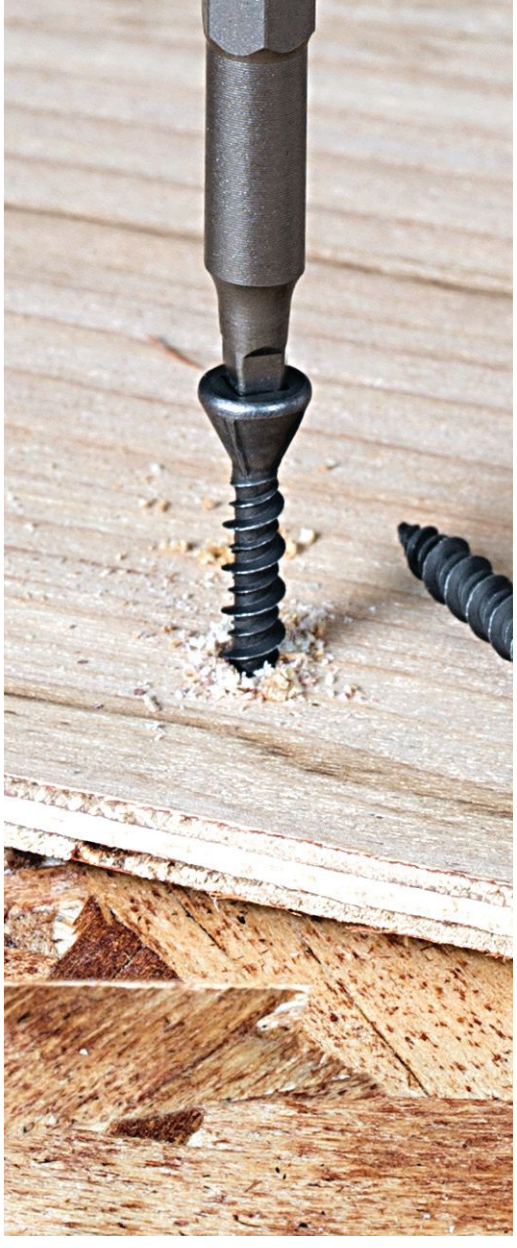

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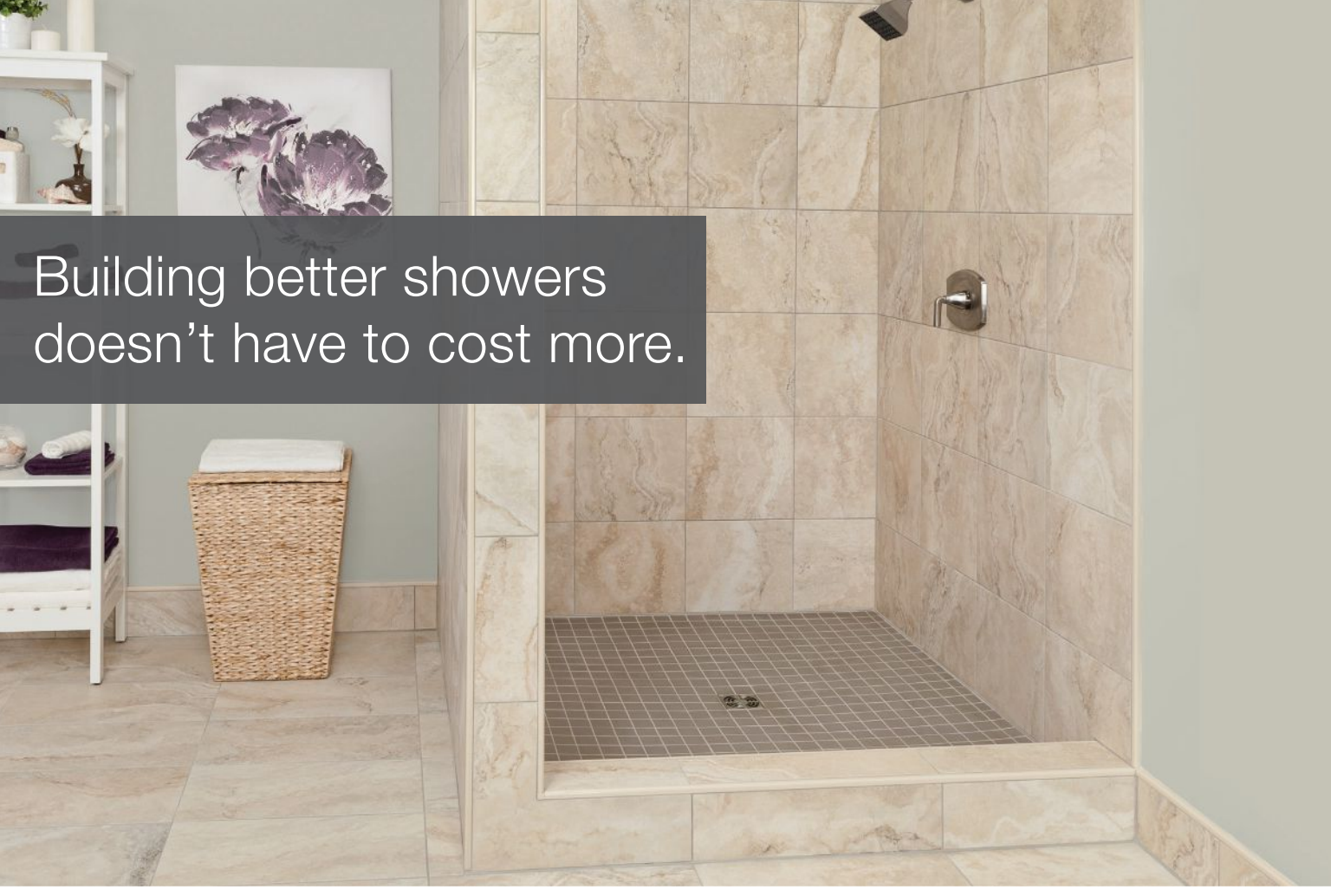

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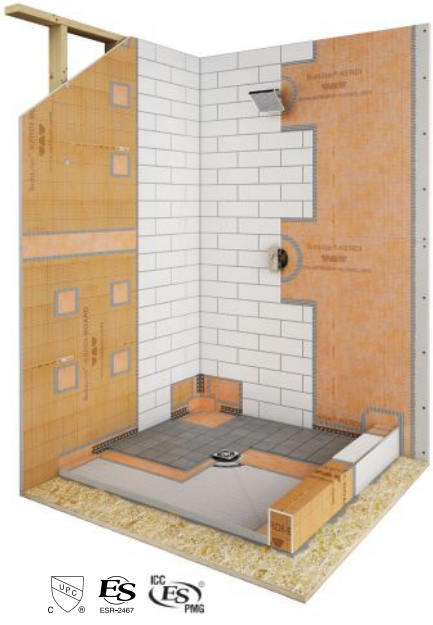

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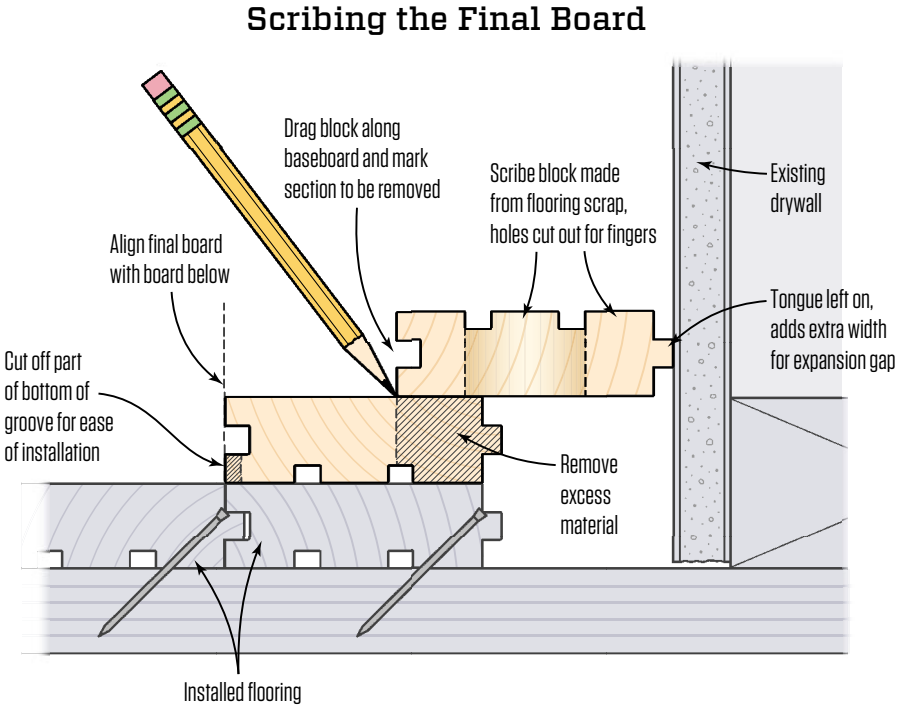
Q Can you provide more detail about how to scribe the final board on a strip floor?

A Roe Osborn, senior editor at *JLC*, responds: In "Installing Strip Flooring" (*Training the Trades*, Jul/18), the final photo shows a scribing block made by Howard Brickman, a wood-flooring specialist. The block is simply a scrap of the flooring being installed (in this case, 2 1/4-inch-wide oak), with finger holes drilled in it for holding it during the scribe. The block is

Illustration by Tim Healey; photo courtesy Howard Brickman



A scrap of flooring with two finger holes makes a convenient scribe block, as shown in the photo above. The trick is using the same material for the block as the flooring that is being installed, in this case 2 1/4-inch-wide oak boards. The board being scribed should sit directly on top of the next-to-last board, with the edge of the final board aligned with the seam below (see illustration, above). With a pencil against the block, and the tongue of the block against the drywall, scribe the entire length of the board. The tongue on the block creates expansion room for the final board. For ease of installation, cut off part of the bottom leg of the groove. After slipping the final scribed board into place, lever or wedge it tight against its neighbor and secure it with face nails.

used upside down so that the width of the full finished face can be traced directly on top of the board being scribed.

The exact scribing process varies slightly depending on the flooring material, as well as on whether you are scribing the board to the drywall before the baseboard goes in, or you are scribing to an existing baseboard, as in the project Brickman describes in the article "Installing Prefinished Strip Flooring" (Nov/15). In both scenarios, set the board to be scribed directly on top of the next-to-last board. Align the edge of the board being scribed precisely with the seam between the boards below (a square on edge can help with the alignment).

If you are scribing to the drywall, place the block on top of the board (again, upside down), with the tongue against the wall. Pull the scribe block along the wall while holding a pencil against the edge of the block. Do this along the entire length of the wall. Most installation instructions call for an expansion space along the edge of the board that will be covered by the baseboard. The width of the tongue on the scribe block automatically provides that space. Saw along the scribe line, giving the cut a slight back bevel to make installation easier.

If you are scribing to existing baseboard, where a tighter fit is required, first remove the tongue from the scribe block. Then follow the same scribing procedure, but with the groove against the baseboard. As before, cut the scribe line with a back bevel and fine-tune the scribe cut with a block plane if necessary. To let the board slip into place more easily, remove about half of the bottom of the groove.

Using a scribe block achieves the same results that you would get with a compass scribe, except that you need to hold a compass scribe perfectly level and perpendicular to the wall while you make your scribe line, which can be challenging. The beauty of the scribe block is that it is made from the same readily available material that you are installing and it positions the pencil accurately and automatically.

After cutting the last board, slip it into place and draw it tightly against the next-to-last board using a flat bar. Align the flat bar with a stud to keep it from damaging the drywall.

Photo: Roe Osborn

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Dealing With Out-of-Level Kitchen Ceilings

BY DOUG HORGAN

Photos by Doug Horgan

Sometimes, trim above a cabinet can accentuate an out-of-level ceiling, as with the ceiling in this kitchen **(1)**. The solution was removing the trim, leaving open space between the top of the cabinets and the ceiling. Uplighting was added above the cabinets to further disguise the discrepancy **(2)**. When cabinets end short of the ceiling, another strategy for hiding an out-of-level ceiling is varying the topography of the cabinets—using some cabinets that are deeper and some that are shorter than others **(3)**.

When you're remodeling a kitchen, it's rare to find a floor that's actually level—stranger still if the walls are plumb and the ceiling is level as well. While it's normal for carpenters and cabinet installers to adjust for some variations in a room, we sometimes need to work with rooms that aren't even close to level. I recently presented a conference on this topic at JLC Live. In that session, I covered floors, ceilings, and walls that were out of level and plumb, but here I'll focus on ceilings.

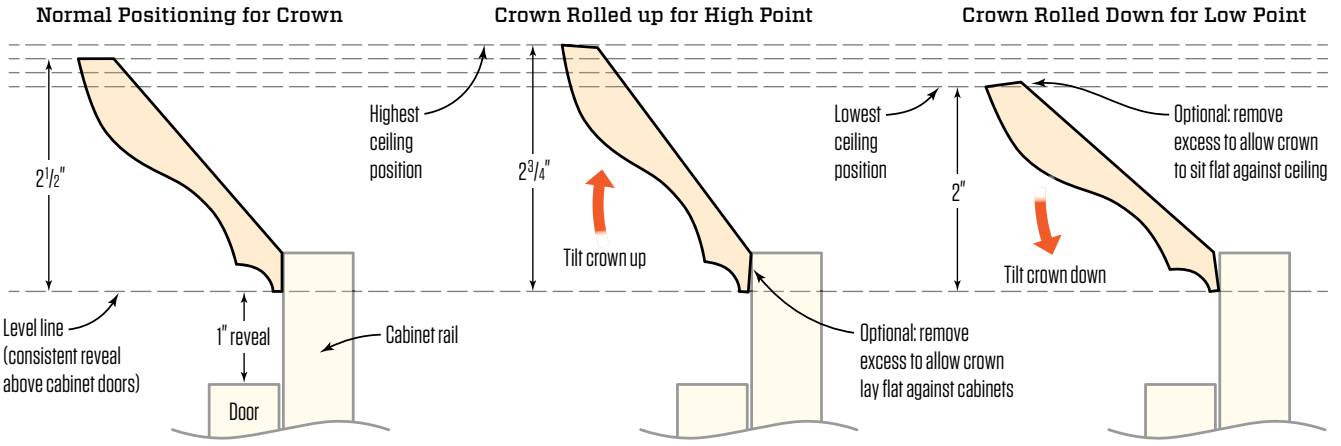
Leave the cabinets short. One line of attack with an out-of-level ceiling is to keep the cabinets well below the ceiling plane. An open space of 6 or more inches can hide a lot of variation. We recently went this route in a kitchen where the plans called for a vertical fascia above the cabinets. We initially installed the fascia but discovered a 1 1/2-inch drop in one corner of the ceiling **(1)**. Completing the fascia would have accentuated the drop. After consulting with the architect and the client, we removed the fascia and installed uplighting above the cabinets **(2)**. This hid the out-of-level problem, and the clients liked the uplighting.

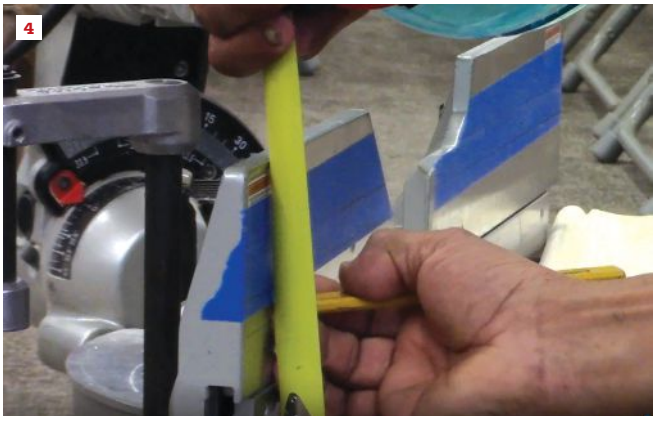
In this first example, the variation was a wavy 1 1/2 inches in 6 feet, which is too much to handle visually in a soffit. But in situations with a gradual, even slope, a wide vertical soffit or trim can actually be used to hide an out-of-level ceiling. An even change of as much as an inch over 10 feet can be hidden in an 8-inch-tall soffit face without it being too obvious.

Another trick that can work for either an unlevel or a wavy ceiling is varying the topography of the wall cabinets **(3)**. Using some deeper cabinets and some shorter ones and then wrapping the tops with crown can hide variations in the ceiling.

Crown-base trickery. Leaving the cabinets 6 inches short of the ceiling is a great solution if the kitchen has a high ceiling. But with lower ceilings, we need other solutions. In these cases, designers frequently extend the crown molding and trim all the way to the ceiling. I often ask designers to include a wide vertical surface for the crown base, which can help with problem ceilings.

Depending on how sharp an observer's eye is, a flat trim (or crown base) that is 4 inches wide can hide





When the crown molding lands within an inch of the tops of the cabinet doors, an out-of-level condition can often be dealt with by rolling the crown. For this 2 1/2-inch crown, draw lines on the miter saw fence at 2, 2 1/4, 2 1/2, and 2 3/4 inches (see illustration and photo **4**). For crown that is only 2 inches high, set the edge at the 2-inch mark and cut the miters at 45 degrees **(5)**.

about 1/4 inch in 4 feet. The bottom of the base follows the cabinets, and the crown follows the slope of the ceiling, often without the variation being noticed.

Rolling the crown. One of the most skilled carpenters I've ever worked with, Abidan Muñoz, taught me how to "roll" crown molding to make up for an out-of-level ceiling. This technique is fairly simple and can hide a surprising amount of unevenness—up to 1/4 inch in 2 feet (see illustration, above).

This approach is most useful when there is no crown base to come to your rescue, such as where the crown attaches directly to the cabinet face frames. If there's only an inch of frame above the cabinet door openings, you won't be able to hide a half inch of ceiling slope by just sliding the crown up and down on the face frames—almost any variation will show in a one-inch space.

So let's say the natural height (the vertical distance down from the ceiling) of the crown molding is 2 3/8 inches, and the distance between the ceiling and the 1-inch line on the cabinets above the doors varies from 2 1/4 inches at one end of a run to 2 3/4 inches at the other end. Start by marking the fence on the miter saw at 2 1/4 inches and 2 3/4 inches. Draw the line all the way across the fence **(4)**. (Muñoz applies tape on the fence to make the lines more visible.)

Now place the crown nested upside down against the miter saw fence (as normal). When you make the two cuts for the joint at the 2 1/4-inch end, slide the crown down the fence until the crown's bottom edge (against the saw fence) touches the 2 1/4-inch line on the fence **(5)**. The miter angles are cut normally, so for a 90-degree corner, set the blade at 45 degrees. Cut both intersecting pieces, and when they join, they will sit against the cabinet face frame exactly 2 1/4 inches down from the ceiling with a perfect miter.

For the other end, cut the joints at the standard angle, but this time, slide the bottom edge of the crown up the fence, so that the edge touches the 2 3/4-inch line as you miter the pieces for both sides of the joint. Install the crown with the bottom edge on the 1-inch line on the cabinets and the crown will be snug to the ceiling at both

The difference in crown angle can be seen between the wall cabinet in the foreground and the one in the background **(6)**. But when viewed from across the room, the difference is hardly noticeable **(7)**. Slight variations in the ceiling can often be remedied by floating drywall compound down to the level of the crown molding **(8)**.

ends **(6)**. Continue with this technique around the rest of the kitchen, cutting inside and outside miters at the normal miter angle, and "rolling" the crown up or down so that it meets the vertical height needed to maintain the proper reveal **(7)**.

If the crown is difficult to twist to fit tightly against the ceiling (as can happen with beefier hardwood profiles), try kerfing the back of the crown to make it more flexible (a tip I picked up from attendees at JLC Live 2018 in Providence, R.I.).

This rolling technique works like magic and is easy to do, and the result looks great. Because you are looking at the face of the crown, the subtle change in angle is hard to pick up visually, and the installer can make up for a lot of discrepancy in a relatively short distance. Depending on how much you tilt the crown, you may need to remove a bit of material from the back of the profile to allow the crown to sit tight against the surface of the cabinet.

Rolling the crown can be combined with changing the reveal on the crown backer, if the slope is extreme and you have the luxury of a wide backer. As you try to cheat some of the ceiling slope by attaching the crown higher and higher on the backer, you may run out of vertical space. Before that happens, mark the bottom edge of the crown on the backer. Measure to this mark, then keep the bottom edge of the crown at this measurement and roll the crown to handle the rest of the slope.

Floating drywall. Occasionally, a small gap remains between the ceiling and the trim, no matter what you do with trim, cabinets, or caulk. In these rare cases, a skilled drywall finisher can "float" the surface of the ceiling down, to fill the gap and to meet the trim **(8)**. In our area, we resort to this method only within reason—maybe 1/4 inch to 3/8 inch before it becomes prohibitively expensive. I've heard that in some parts of the country, there are good plasterers who can float larger gaps than that.

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

Taking the Slack Out of Subcontractor Bids

Note: This article is the last in a four-part series adapted from David Gerstel's new book, *Nail Your Numbers: A Path to Skilled Construction Estimating and Bidding*.

In recent years, general contractors have increasingly relied on subcontractors. Now GCs are subbing out not only specialty trades, such as plumbing, drywall, and tile work; they are subcontracting even carpentry work, from foundations through finish. Most striking, the heavy use of "trade partners"—as subs are now sometimes called, thereby giving them their due respect—is prevalent not only for large projects but also for small jobs, like kitchen and bath remodels. I know builders who do work at both ends of the spectrum. The only work they kept in-house on recent projects was project management, pick-up (aka "completion") work, and site cleanup.

Most striking, the heavy use of "trade partners"—as subs are now sometimes called, thereby giving them the respect they deserve—is prevalent not only for large projects but also for jobs as small as bath remodels. There are powerful forces driving this change.

When I began my building career a few decades back, the sub-everything model hardly existed outside the world of large-scale development. Small-volume builders and remodelers who used it were scorned as mere "paper contractors." They had a hard time getting insurance because their heavy use of subs was taken as a sign that they did not know how to build.

That might have been true then. In some cases, it's true now. However, there are powerful forces driving the move to building with trade partners.

- **Complexity.** Each of the trades has become increasingly complex. Each makes use of an ever-expanding array of tools to install an ever-growing array of materials. Each deals with more complex specifications. A building shell once involved merely sheets of plywood, wood planks or shingles, or lathe with plaster attached to the studs over a layer of felt. Now it can involve shear panel, numerous hardware items, water resistant barriers, staggered layers of insulation, rainscreens, cladding, special water management details, and ... well, you fill in the blanks for items I have left out.
- **Labor challenges.** A shortage of skilled labor plagues much of the construction industry. With a variety of factors having sharply reduced the number of skilled tradespeople available for hire in the U.S., building a crew that can handle all phases of carpentry, never mind other trades as well, is especially hard. It's tempting to off-load the recruiting and hiring struggles to trade partners.
- **Scope of estimates.** With the ever-increasing complexity of work, more and more items must be captured in an estimate. But, as I learned when I did the research for my new book, *Nail Your Numbers: A Path to Skilled Construction Estimating and Bidding*, even many experienced builders struggle with estimating. So, again, it's tempting to off-load the responsibility and let your trade partners crunch the numbers and take on the challenge of trying to nail down on-site production costs.

All in all, subcontracting would appear to be a way to reduce the pressures inherent in operating as a builder. But it turns out this silver lining comes with a cloud. I heard about it repeatedly as I interviewed builders for *Nail Your Numbers*. As one builder put it, "Stuff constantly gets missed." Subcontractors fail to cover all work in their trades when they submit bids. Items fall between trades.

Some builders are philosophic about the missed stuff. Several told me that they do the best they can to alert subs to all work in their trades that is called for in project plans and specs. So what happens if a sub overlooks something that they should have included in their bid? One builder says he will then go "hat in hand" to the client and request extra compensation for the sub. Should that not be an option, then the builder picks up the tab, or at least part of it. "We are always splitting the difference with subs," he says with an accepting shrug.

Other builders are not so sanguine. "Our framers are always missing things," complains one general contractor who largely does big remodels. He says his carpenters regularly have to complete the last 5% of the framing. That angers him because there is no way he can get compensated for the work. A builder who specializes in custom homes is hard-nosed with his subcontractors.

His position with them: "If it's on the plans or in the specs, and it's in your trade, then it is yours to install. And don't come back to me begging for help. You missed it. That's on you and it's your loss, not mine and not our client's."

But, of course, that hard-nosed approach can have a hidden cost that may exceed the cost of splitting the difference. It can leave subs feeling burned. Then they may be inclined to drop you in favor of other builders who are more generous.

None of the many general contractors I interviewed for *Nail Your Numbers* had a solution to the problem of omissions that protected everyone: trade partners, clients, and builder. The only solution I have ever seen was developed by Jim Lunt, an outstanding plumbing contractor with whom I worked for years. Jim created an Included/Not Included (NIC) form specific to his trade. I have adapted that form into the more generalized form shown at left. It can be used for all trades—though it would be best used as a means of nudging subs into creating their own trade-specific forms.

Whoever creates the form, it should include these key components:

- A stipulation that all work regularly, though not necessarily always, done by a trade is included in that trade's bid.
- A checklist of specific items that regularly fall between trades.
- A space for the trade partner to list any items not included in their bid that aren't covered by the checklist.

Of course, even a good Included/NIC form will not prove foolproof. Oversights can occur, especially when an item of work is merely implied by the plans and specs rather than explicitly called out. For example, plans may call for a skylight but make no mention of flashing at its curb because the designer assumes that any competent builder will know that a skylight curb must be flashed to the roofing. In that case, the flashing may get overlooked during estimating because the trade that is installing the skylight assumes the roofing sub will provide the flashing, the roofers assume they will install it but not provide it, and the sheet-metal guys figure someone else has flashing in their scope of work.

Technically, in such a situation, the "regularly though not necessarily always" stipulation in the Included/NIC form could be invoked by a builder. Relying on it once construction is underway and you realize that no one has taken responsibility for the flashing, you could insist that the roofer provide and install it. Or you could demand that several subs split the cost. For the sake of good, long-term relationships, however, you want to avoid jamming unanticipated costs down your trade partners' throats. As a result, even after you have converted your subs to using Included/NIC forms, you may still end up chipping in on the overlooked costs now and then. But the forms should go a long way to reducing the frequency with which items fall between the trades during estimating.

While an included/NIC form may help you winnow omissions down to near zero, it won't eliminate another problem—redundancy. You may end up with two or more subs including the same item of work in their bids. I have never come up with a solution to that problem other than to be on the lookout for redundancy when I am building an estimate. If you have a more systematic solution, we would love to hear about it in the comments section for this article at JLConline. Drop us a note!

David Gerstel has been a builder for over four decades and is the author of Running a Successful Construction Company, *long regarded as an industry "bible." David's new book,* Nail Your Numbers: A Path to Skilled Construction Estimating and Bidding, *is available from Amazon and your local bookseller. You can contact David via his website, DavidGerstel.com.*

Included/Not Included Form

Subcontractor: _____ Sub's Signature: _____

Project: _____

Our bid is based on the following plans and specifications for the above-named project:

Architectural Plans, pages _____ Date: _____

Engineering Plans, pages _____ Date: _____

Specifications, pages _____ Date: _____

Addenda, pages _____ Date: _____

Our bid includes **all** work and costs regularly, *though not necessarily always*, covered by our trade **excepting items checked below** to indicate they are not included (NIC).

Building permit	____	Provide roof jacks	____	Touchup paint	____
Shop drawings	____	Provide straps	____		
Liability insurance	____	Provide roof caps	____	Other items of work and costs NIC in our bid:	
Workers Comp Insurance	____	Install jacks, caps, & straps	____		
Trench & backfill	____	Material handling	____		
Off-haul excess soil	____	Remove waste	____		
Demolition	____	Recycle	____		
Concrete cut/core	____	Protect (E) work	____		
Cut and patch	____	Blocking	____		
Scaffolding/Staging	____	Firestops	____		
Ramps	____	Insulation	____		
Ladders	____	Sealants & caulk	____		
Damage repair	____				
Utility hookups	____	Touchup drywall	____		
Flashing	____	Daily cleaning	____		
		Final cleanup	____		

A subcontractor form that spells out items NIC (not included) in subcontractor bids can go a long way toward preventing items from slipping between the trades during estimating.

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BY EMANUEL SILVA

The main girder for the house was sitting in an oversize beam pocket with cracked parging around it **(1)**. But the real issue was that the beam was not long enough and provided insufficient bearing **(2)**. A house jack temporarily lifted and supported the girder for the repair **(3)**.

Photos by Emanuel Silva

Fixing a Poorly Supported Beam

This summer, a homeowner called me because she was concerned about the main girder in her 1960s home. She said that an area in her kitchen floor seemed to have dropped slightly over the past year. Close examination revealed a 4-foot-long crack in the floor tiles in that area.

The homeowner had done her homework. She had gone into the basement to examine the floor framing below the dropped area. The end of the girder that supported the ends of all the floor joists seemed to drop down where it ran into the foundation wall. The girder had been mortared into the beam pocket and that mortar had cracked and was falling out on one side. Her first call was to a structural engineer, who came and checked out the problem.

Weighing options. After assessing the issue, the engineer determined that the main girder was too short and did not have enough bearing on the foundation. He provided a number of solutions, which the homeowner explained to me when I arrived at the house. The first option was to install a 4-inch concrete-filled Lally column below the end of the girder, with a 2-foot-square, 1-foot-deep footing. This is what I would have usually done, but in this situation, the heating system had been installed close to where the girder met the foundation wall. Digging out for the footing would have been impossible without first moving the heating system.

An option that had crossed my mind when I first heard about the problem was to replace the girder or sister in a section at the bad end. I've done that on previous remodeling projects and I know the huge scope of that task. With the girder holding up the entire floor system as well as having both plumbing and electrical work connected to it, this option would have meant a long and costly repair.

The next option suggested by the engineer was having a steel bracket fabricated and installed to support the end of the girder. This seemed to be the least invasive and most cost-effective way to solve the problem, so we decided on this approach.

An engineer recommended supporting the girder with a steel bracket, which the author had fabricated locally **(4)**. He dry-fit the bracket and removed any unevenness in the concrete so that the bracket sat perfectly flat against the foundation wall **(5)**. Next, the author replaced the parging around the girder with small stones and Type N mortar **(6)**. The mortar filled in the pocket beside the girder to help prevent it from rolling or twisting under load.

Investigation. After clearing away stored items and debris from where I needed to work, I finally was able to check out the specifics of the problem more closely. The girder terminated in a beam pocket, but that pocket seemed to be much wider than the 6x10 beam needed. At some point, the pocket around the girder had been parged, and I could see a pair of wooden wedges sticking out below the girder **(1)**. The parging was cracked and loose on one side, so I started pulling some of it away.

With the material removed, I looked into the pocket and saw that the end of the girder was just inside the plane of the foundation **(2)**. To make matters worse, the bottom edge of the beam pocket had broken away, probably from having the load of the girder concentrated there. A makeshift solution had been to drive wedges below the girder. Over the years, the wedges had compressed and the parging cracked, allowing the girder to drop down. Luckily, the girder had dropped only a short distance instead of failing completely.

A beefy bracket. The engineer had tossed out the bracket option without offering any specific guidelines for sizing. So after inspecting the girder and taking some measurements, I went to my steel fabricator's shop to have the bracket made.

The fabricator and I sat down and went over the structural requirements for the bracket. He told me that the beam pocket would still be carrying most of the weight of the girder, but the bracket would be there to add supplemental support at the end. (In some jurisdictions, a structural engineer's stamp might be required for the design). The steel bracket that the fabricator made was most likely oversized and more than was needed to provide the additional support for the girder, but even then, it wasn't that expensive (around $75).

The L-shaped bracket was made from 1/2-inch-thick steel stock 6 inches wide. The vertical leg, which would rest against the foundation wall, was 12 inches long, and the horizontal leg that attached to the girder was 4 inches long. To make the bracket even stronger, the fabricator welded a diagonal steel gusset to both legs. Holes for fasteners completed the bracket.

Temporary lift and support. Back at the house, my first task was to jack up the girder and support it temporarily. To keep tabs on exactly how high I raised the girder,

Because the bracket would be bolted into the existing concrete, the author was able to install it before the parging had cured completely. He began by driving structural screws through predrilled holes in the bracket and up into the girder **(7)**. Next, he drilled the proper-size holes for concrete wedge anchors in the existing concrete foundation **(8)** and tightened the nuts to the required torque **(9)**. When the bracket was fastened in place, the author removed the jack temporarily supporting the girder.

I measured down from the girder and made a witness mark on the foundation wall.

I set a 4x4 post on top of a heavy-duty screw jack to do the lifting. After plumbing the post, I screwed it temporarily to the underside of the girder to keep it in place during the lift.

With everything set up, I slowly turned the jack screw to raise the girder **(3)**. Raising the girder too high could be as bad as having it dip down, so at this point I made sure to raise the girder only enough to remove the rest of the loose material, using my witness mark to gauge the lift.

Securing the girder. After confirming that the girder was still at the level that I wanted, I dry-fit the L-bracket and chipped away any excess concrete to make sure the bracket lay completely flat against the foundation **(5)**. I mixed a batch of fairly stiff Type N mortar with water and added a bonding additive to help it adhere to the concrete of the foundation wall. I pressed mortar along with some small stones into the voids around the beam pocket, with a margin trowel **(6)**. After smoothing the mortar flush with the foundation wall, I evened the surface with a stiff brush.

Because the anchors for the bracket were going into the existing foundation, I was able to install the bracket before the parging around the girder had dried completely. I first secured the bracket to the girder, with 3-inch-long Simpson Strong-Tie SDWS timber screws **(7)**. With the screws holding the bracket in position, I turned my attention to anchoring the bracket to the foundation.

I chose to anchor the bracket to the wall with 1/2-inch-diameter Simpson concrete wedge anchors 4 inches long. Using a masonry bit chucked in a hammer drill, I bored the proper-size holes in the foundation for the anchors **(8)**. I used a 5-inch-long bit to ensure that the anchors didn't bottom out.

Wedge anchors have a nut and bolt at one end, and turning the nut expands a circular wedge on the other end that tightens the bolt in the hole. I inserted the three wedge anchors into their holes and tightened them (Simpson specifications require 60 foot pounds of torque) to secure the bracket in place **(9)**. With the girder then safely secured at the proper level, the final step was removing the jack.

A contributing editor to JLC, *Emanuel Silva owns Silva Lightning Builders, in North Andover, Mass.*

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BUILT TO SERVE

Air-to-Water Heat Pumps

These advanced systems come with a steep learning curve

BY TED CUSHMAN

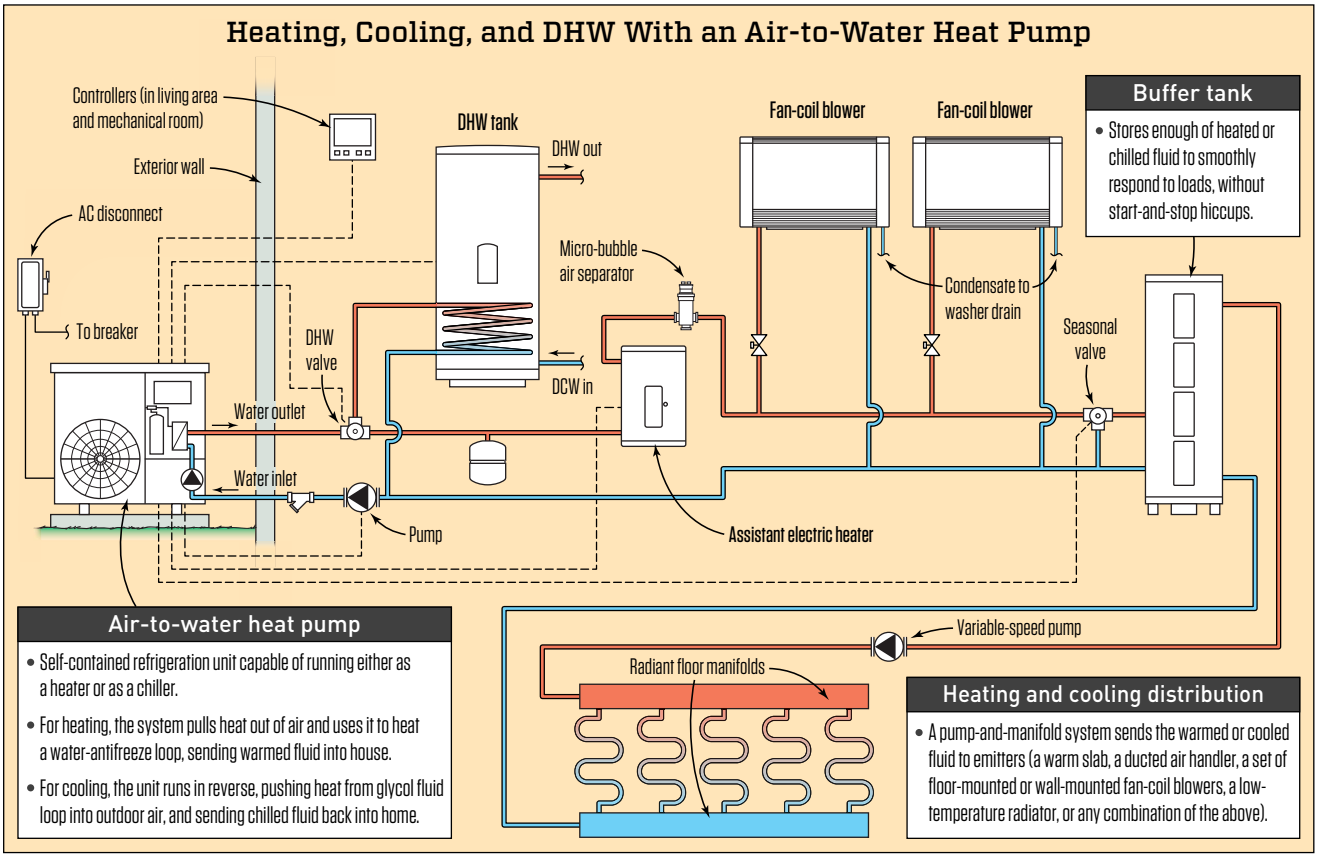
Heat pumps, like air conditioners, are a well-established and well-known technology. Most builders are familiar with some form of heat pump. As an alternative to gas furnaces, split-system heat pumps have been popular in mixed climates in the United States for years, where they do double duty, supplying heating in winter and cooling in summer. More recently, gains in efficiency and in cold-weather performance are helping mini-split heat pumps become a go-to solution for high-performance homes in the colder parts of the United States.

There's another flavor of heat pump you probably haven't heard as much about: "air-to-water" heat pumps, sometimes called "chillers." Large-scale versions of these systems are widely used in commercial construction, where they supply heated and chilled water to heat or cool living and working spaces in mid-rise and high-rise apartment and office buildings. Small, highly efficient systems sized for one-family homes are relative newcomers to the U.S. market, but these smaller systems have a growing toe-hold, especially among high-performance builders.

Air-to-water heat pumps aren't for the faint of heart. The concept is proven in large buildings, but miniaturizing the method for use in single-family homes has proven to be a challenge, even for big companies trying to develop the market niche. Contractors who have tried the systems report a variety of glitches, from software issues to component availability to difficulty finding qualified trade contractors to install and maintain the equipment. Still, the technology offers so much promise that early adopters have been working hard to master the learning curve and bring air-to-water heat pumps into the mainstream.

JLC talked this year with manufacturers, HVAC contractors, and builders who have tried out the air-to-water solution. Here's

Photos by Ted Cushman



Pieces of the puzzle. The schematic above shows the primary components of a typical air-to-water-heat-pump setup. There are many ways to configure a system, but in this example, the outdoor system provides heated or chilled water to satisfy three types of demand: domestic hot water, a radiant floor, and a pair of wall-mounted fan-coil units that can cool as well as heat.

what we learned about the technology's potential and about the practical complications you'll want to be ready for.

THE TECHNOLOGY

So what are air-to-water heat pumps, and how do they work? The principle is simple: A self-contained refrigeration unit capable of running either as a heater or as a chiller sits on a pad on the ground outside a building. When heating is called for, the system pulls heat out of the air and uses it to heat a water-antifreeze loop, sending the warmed fluid into the house. When the house calls for cooling, the unit runs in reverse, pushing heat from the glycol-fluid loop into the outdoor air and sending the chilled fluid back into the home.

Inside the house, a buffer tank stores enough of the heated or chilled fluid to smoothly respond to loads, without start-and-stop hiccups. A pump-and-manifold system sends the warmed or cooled fluid to emitters, which could be a warm slab, a ducted air handler, a set of floor-mounted or wall-mounted fan-coil blowers, a low-temperature radiator, or any combination of the above. In winter, the warm slab and the hydro-air blowers or radiators heat the house; in summer, the blowers and perhaps even a chilled slab cool the same spaces. Systems can also be configured to heat domestic water.

ARRANGING THE COMPONENTS

The muscle of an air-to-water-heat-pump system is the outdoor unit, a self-contained compressor, condenser, and evaporator that can produce either heated or chilled water. For builders, installers, or even do-it-yourselfers, one big advantage to this concept is that all the refrigerant for the system is contained inside the package unit. Installers just have to place the unit and hook up the hot and cold water-antifreeze loops, which, unlike handling refrigerant, requires no special license from the Environmental Protection Agency (EPA). Seattle-area builder Ted Clifton, who handles his own installations, comments, "With refrigerant, there's a little

Tight squeeze. Here, workers for ReVision Energy install a SpacePak air-to-water heat pump at a custom home in southern Maine. ReVision's Chris Blaisdell checks the unit's dimensions **(1)**, and then he checks the headroom **(2)** and support frame width **(3)**. All the refrigerant in the system is contained within the package unit, but planning and coordination are needed to make sure the pad is correctly sized and power hookups and shutoffs are appropriately located.

bit of a hazard. You don't want to let that leak out into the air; you have to be careful. But running just supply and return water lines, it's no big deal. You could even puncture one of those and it's not going to cause any big problem besides a leak."

In a typical installation, the fluid from the outdoor unit is pumped to a buffer tank inside the house. This simplifies the control system. The chiller on its pad outside senses the temperature in the buffer tank and keeps it constant. Loops drawn off the buffer tank serve the heating and cooling output devices in the living spaces; if the house calls for heat and those supply loops activate, the temperature in the buffer tank changes, which signals the heat pump to kick in and restore the balance.

Next in the chain are the emitters. In this regard, houses we looked at in researching this story turned out to be similar. Each well-insulated home had a radiant slab on the ground floor. Besides the heated slab, all these homes also had some sort of hydro-air point heat source to heat upstairs zones or to provide cooling in summer, or simply as a quick-response supplement for the main heated slab.

Heat pumps provide relatively low-temperature water. That's ideal for radiant slabs; 95°F hydronic fluid in the slab is typical. Depending on the setup, the small hydro-air fan-coil units that serve some rooms or zones can be supplied with 120°F to 130°F water if needed; the fan-coil units, however, are also designed to squeeze useful heat out of lower temperature water in a way that ordinary radiant baseboard can't. Higher water temperature allows higher heat output per hydro-air emitter, but lower-temperature water allows the emitters to operate more efficiently.

The choice depends on the situation. Builder Ted Clifton has installed the systems himself on about a dozen houses. Clifton explains: "I'm running 90°F water through my fan-coil units. I'm using the same water that I'm using in my radiant-floor loop, and I would rather have my floor loop be at 85°F or thereabouts. So I kind of compromise at around 90°F. To have the fan blowing by that makes it effective. If I can make water with the heat pump at 90°F,

and use a tiny bit of electricity to blow that around with a fan, that is going to be more efficient and it's going to be less electricity than asking the heat pump to produce 120°F water."

But Mark Dwyer, who built a custom home in Bangor, Maine, last year, runs his fan-coil units straight off his heat pump at a higher water temperature than he draws off his buffer tank for his heated slab (for a look at Dwyer's house, see "Practical Net Zero," Feb/18). Dwyer notes that his fan-coil units can pump out 5,000 Btu/hr at 125°F, but less than 3,000 Btu/hr at 95°F. Dwyer's fan coils are mainly there for cooling during Bangor's 90°F-plus August weather; the warm slab by itself will probably handle his heating load. But if he does want a quick blast of extra heat in the winter, the hotter water in the fan-coil units can give him that.

EFFICIENCY AND CAPACITY

Heat pumps are rated for efficiency based on their "Coefficient of Performance," or COP. COP is the ratio of heat output to electric power input; so when an air-to-water heat pump is operating at a COP of 3, it's making three times the heat that the same amount of current would supply via a simple electric-resistance water heater. Air-to-water heat pumps on the market today have official COP ratings in the range of 4 to almost 6.

COP is a relative number, however, because it depends on outdoor ambient temperature. As temperatures outside drop, the heat pump has to work harder to pull heat out of the air, and its COP goes down. At the same time, the equipment's total output also drops. This means that as heating requirements increase, both the heat pump's capacity and its efficiency decline. At some point, the demand and supply curves cross, and the heat pump can't keep up with demand. And when that happens, the units are set up to fall back on backup heat, supplied by a simple resistance element in a backup water tank. As the resistance backup ramps up, shouldering a larger portion of the heating load, the COP drops sharply, bottoming out at 1, with the house relying on simple electric heat. So for houses heated with heat pumps (and this includes any kind of heat pump, not just the air-to-water variety), electric bills will be highest during the coldest part of the heating season.

In this regard, heat pumps have the opposite problem of conventional fossil-fuel equipment. Gas and oil heating equipment is sized to match peak heating loads, and it performs best during design conditions in the depth of winter. At lower loads, during the shoulder seasons of spring and fall, gas or oil heat cycles more, and tends to be relatively inefficient. Heat pumps, by contrast, shine during the shoulder seasons, when it's easy to make heat, but they fall off during the dead of winter when their heat source, the outdoor air, is cold. For that reason, when homeowners replace an existing furnace or boiler with a heat pump, they sometimes leave the original fossil-fuel equipment in place to serve as backup on the coldest days.

There are three factors that can cut the actual performance of a heat pump below its official rating, points out John Williams, the CEO of heat-pump manufacturer Chiltrix: a cycling penalty, a defrost penalty, and an altitude penalty. If units have to cycle on and off for part loads, if they have to warm up the coil to rid it of frost, or if they need to operate at high altitudes, performance will suffer slightly.

For colder-climate installations, Williams often recommends stacking two heat pumps together. In mild weather, Williams' Chiltrix, with its advanced variable-speed compressors and pumps, has a COP approaching 6; but even at its coldest operating temperature of -4°F, the unit's COP is about 2. "Don't confuse capacity with efficiency," advises Williams. While the unit's efficiency certainly drops in very cold weather, installing a second chiller can boost the setup's total capacity to the point where it can meet loads with very little reliance on electric resistance backup, even in deep winter months.

That choice depends on a case-by-case calculation. For many homeowners, a few hundred dollars in winter electric bills for resistance heating may be an acceptable price to pay for year-round total efficiency. But in other cases, the avoided cost of that backup electricity could be worth the investment in a second unit. "What I see," says Williams, "is that people who see a two-year or four-year payback on adding a second chiller will do it. That's a no-brainer. An eight-year payback? Half will, half won't. A 12- or 15- or 20-year payback? No one's going to do that. Because they'd rather have the money in their bank."

THE MARKET

So who's going to buy heat-pump hydronics for their home? John Williams, the Chiltrix CEO, says, "One of the sweet spots that we are seeing for this system is net-zero homes, Passive House homes, and in general, all-electric homes. Particularly in California, all-electric is becoming really important, because they have this net zero mandate. You can't get to net zero with gas or oil heat; there are no panels that you can install on your roof or out in the yard that will fill the oil tank up or make gas."

SpacePak's Jim Bashford says air-to-water systems have an edge over mini-split systems in larger homes. During his career as a contractor, says Bashford, he installed a lot of the systems in big spec houses where "it was best for them to use the heat pumps with water for the cooling, for microzoning, or just to cope with the sheer size of the house, where you wouldn't want to run high-pressure refrigerant lines and stuff through the wet walls."

Fortunat Mueller, an executive with solar and heating contractor ReVision Energy, says: "It's people who want hydronic distribution, because of the comfort advantage of warm floors and the zoning advantage of hydronic distribution, but who don't want fossil fuels. If those are your two goals, then air-source-to-hydronic heat pump is the answer. And many, many of our customers don't want any fossil fuels in their house—because of cost, and because of the environment, and because they can make electricity off the roof. But even those who can't make electricity off the roof, they can imagine electricity being made somewhere in a responsible way, in a way that they can't imagine oil or gas being made."

For Seattle-area builder Ted Clifton, the pairing of solar panels and air-to-water heat pumps is a no-brainer formula. The solar panels on Clifton's own house, on a net annual basis, do more than

Radiant floors team with hydro-air. ReVision Energy's Chris Blaisdell works on the hydronic tubing for a radiant slab in a custom house **(4)**. Behind Blaisdell is the hydronic buffer tank for the system. On the second floor of this home, a SpacePak high-velocity hydro-air unit **(5)** will supply heated or cooled air using fluid supplied by the same outdoor-mounted heat pump.

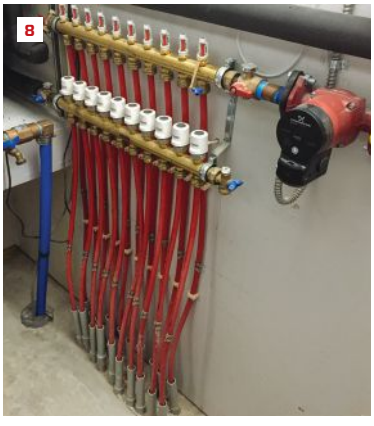
power the heat pump and radiant slab to heat his own dwelling; they also provide all the power Clifton needs to drive his Tesla Model S sedan. After building about a dozen net-positive-energy homes that include heat-pump hydronic radiant slabs, Clifton said, "I feel like every house should have one. Gas boilers, electric furnaces, that stuff has to go the way of the dinosaur. There is no reason to even sell or install any of that stuff anymore."

GROWING PAINS—AND POTENTIAL

It's an attractive dream. But in the real world, air-to-water heat pumps make up a very small fraction of the market. That means that the industry's knowledge base is small, and anyone who dips a toe in the water needs to be ready for a steep learning curve. Even Ted Clifton, an enthusiastic booster of the technology, has to admit that finding a reliable supplier has been tough. Clifton has been through several brands of heat pumps, he says. "The first three—the Unichiller, the Thermo Matrix, and the Daikin Altherma—the supplier that I got them from stopped carrying each one for various reasons. The first two because of issues, but the Daikin, because they stopped shipping them to North America." More recently, Clifton has been installing the Chiltrix.

Clifton is hoping that broader adoption of the technology will boost its reliability. "If more people were installing them, we could put a lot more R&D into these air-and-water heat pumps," he says. "Because so far, it has been tough just getting them to run correctly. And if they were the most popular system, obviously we would be working the bugs out of these things. It's kind of like electric cars, you know; someone has to start buying them before they are really mainstream."

Jim Bashford, the Northeast regional sales manager for SpacePak, downplays the complexity of the technology. "Our unit is essentially a high-efficiency electric boiler that sits outside. It makes really efficient hot water and chilled water. For any contractor that is used to heating with low-temperature water, there is nothing really different. The only thing different is the unit that is making the water."



Moving parts. The heat pump itself is easy to place and connect, but a full heating and cooling system can be complex to understand and install. Above are components of a Chiltrix installation in Bangor, Maine: the outdoor heat pump unit **(6)**, the buffer tank **(7)**, a hydronic manifold for the heated floor **(8)**, and a wall-mounted hydro-air emitter **(9)**.

Chiltrix executive John Williams tempers his optimism with realism. "If an installer has everything done correctly, it takes over an hour to commission," he says. "Because we have hundreds of parameters in there. There's all the installer settings, which are on a hidden menu. Then there's factory settings, which are on a hidden menu. And then you have all the customer-facing settings. So it takes a good minimum of an hour."

"And then what happens is, as we go through some of the diagnostics, we see if there are flow problems, we see if there is any air in the system, and the system starts telling us if it was installed correctly," continues Williams. "It's pretty straightforward, but I'd say our average installer is going to be on the phone for a couple of hours with us, commissioning the system, every time."

"Some people when they have a sale, they go out searching for dumb customers," says Williams. "That's not how it works with this product. We never sell this to a dumb customer. You have to be pretty smart to buy this from us, because otherwise you wouldn't understand how it works and why you should do it."

Fortunat Mueller's company, ReVision Energy, is no stranger to high tech. And some of the company's offerings, such as its integrated photovoltaic and mini-split setups, are fully dialed in (see "Teaming Heat Pumps With Rooftop Solar Power," Jun/14). What about air-to-water? ReVision installed a half-dozen Daikin Altherma units before Daikin pulled the plug on the product, and Mueller says, "They're finicky." And he says ReVision is still working out some kinks with its first few SpacePak air-to-water projects.

But Mueller says ReVision is up front with customers when the company is cutting its teeth with an unfamiliar technology. "With any new product," Mueller says, "we are transparent with our customers about where we are on our learning curve. And we try to match a customer for the place in the product life cycle where we are. Because some customers are excited about being early adopters, and others want nothing to do with that. So we try to be plain about that with people."

Ted Cushman is a senior editor at JLC.

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Site-Built Custom Cabinets

A tried-and-true method for fitting out high-quality kitchens

BY CREGG SWEENEY

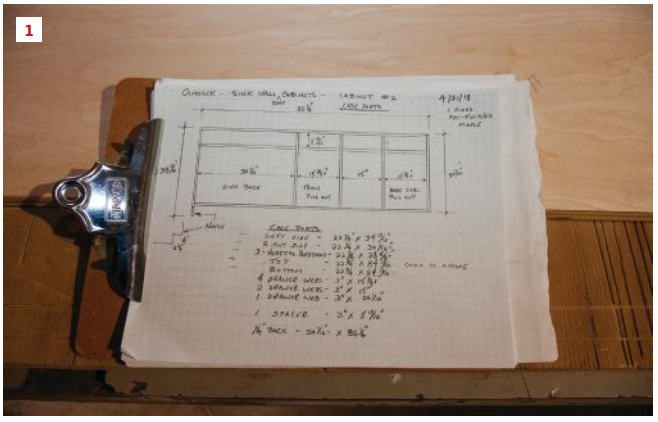
Photos by Dave Holbrook

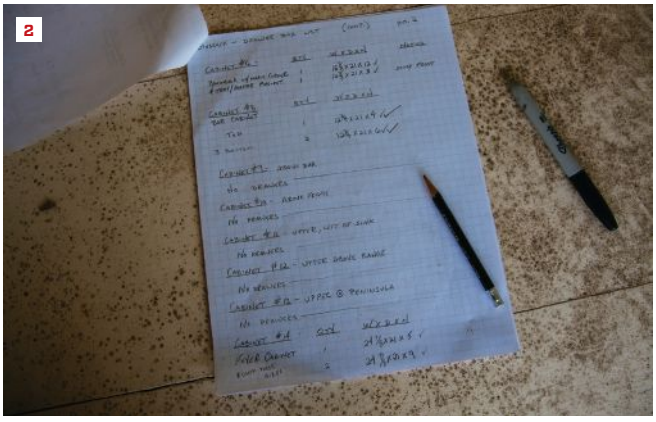
Nearly every project my company undertakes is architect-designed and rich in custom details. Custom built-in cabinets are typically featured throughout the home, with dimensions and details not usually available in stock cabinets. While I do maintain a fully equipped woodshop, I've found that we can effectively produce uncompromising work on site using custom-ordered parts. Our process—a tried-and-true method that uses materials and techniques that have been around for decades—is a hybrid of on-site and off-site production. If there's a door or other panel that can't be precisely defined or determined in advance, we'll make it on site. But generally, I can buy custom doors and drawer boxes for nearly the same money I'd pay for raw materials, so it only makes sense to outsource these items.

Making top-notch cabinets on the jobsite requires both basic and more-specialized tools, including a good, accurate table saw accessorized with a cut-off sled, a pocket-hole machine, a thickness planer, a biscuit joiner, and numerous proprietary or custom-made jigs to aid hardware installation.

DON'T UNDERESTIMATE PLANNING

Before we start cutting plywood, I spend a considerable amount of time developing shop drawings and an accurate list of components





Outsourced doors and drawers. Planning is crucial for this process to work, so the author creates detailed shop drawings for each cabinet run **(1)**, as well as detailed checklists for drawer and door counts **(2)**. Though there are many manufacturers who supply both drawers and doors, the author prefers to use drawer boxes from Scherr's Cabinet & Doors **(3)** and doors from Maple Craft USA **(4)**.

and dimensions for each cabinet. This helps us optimize materials and get a jump on the building process (especially when I need to communicate to other crew members involved in building the cabinets). This planning also provides me with all the information I need to order plywood, as well as cabinet doors, drawer boxes, and hardware from outside suppliers.

PAINT-GRADE QUALITY

For the cabinets in this story, we used cabinet-grade maple-veneer plywood that is prefinished with a clear coat. Typically, we use material prefinished on one side, facing the prefinished side to the cabinet interior and painting the exterior or facing the end with a finished overlay panel. Cabinet sides, bottom, and top are built with 3/4-inch stock, and the backs are typically 1/4 inch.

Because the clear coat prevents a glue-bond between parts, we use GRK wood screws to secure the sides to the bottom and top. Predrilling is crucial to avoid spreading the veneer apart. We attach the backs with pneumatic staples, 3 to 4 inches on-center. All common interior cabinet partitions, as well as shelves, are made from plywood prefinished on both sides, and we edge-band the visible edge with heat-activated wood veneer, applied with a household iron and finished with an edge trimmer.

Cutting the stock. Our primary cabinet builder, Dean Moran, typically slices full plywood sheets to the planned cabinet depth on a table saw, then crosscuts individual panels to height on a workbench using a square and a track saw.

He also crosscuts with a sled on the table saw that has an adjustable stop for repeat accuracy and accommodates panels up to 27 inches wide. The sled ensures true, square corners. However, the wider the panel, the more awkward the sled becomes, since

Cutting and assembly. For cutting wide panels, a track saw (along with a Woodpecker framing square) is used to make accurate crosscuts **(5)**. To precisely cut narrower panels, shelving, and face-frame components, a crosscut sled on a table saw with an adjustable stop is used **(6)**. Web frames for cabinet tops are made out of unfinished 3/4-inch plywood with 3-inch-wide stretchers and 1 1/2-inch runners. The island cabinet's web frame is shown here **(7)**. Pocket-screw holes for web and face frames are made with an older-model Kreg Foreman **(8)**. During assembly, the end panel's dry-fit biscuits are lined up with the slots in the web frame; the biscuits hold the joint together while the screws are driven in **(9)**.

you have to start with it in front of the blade. The sled works best for cutting narrower panels for wall cabinets, shelving, and face-frame components.

Web frames. Instead of using a solid panel for the cabinet top, we typically make web frames, which have the identical outside profile as the bottom panel. Frames use less material, reduce weight, and don't require a cutout for sinks or other countertop drop-ins. Frames are accurately cut on the sled and assembled with pocket screws and glue. If you're using a lot of pocket screws, a Kreg Foreman quickly justifies itself. Our worktable incorporates a T-track, allowing us to use hold-down clamps to hold the glue joint flush while we're installing screws.

Fastening the carcass. Putting cabinet panels together requires some kind of control to hold the parts in alignment while we fasten them. Precise alignment is key to a uniform match with the face frame, as well as to drawer and shelf fit. Moran installs dry-fit biscuits, followed by screws for the final, mechanical connections. Bar clamps hold the joints tight while allowing small adjustments to alignment during fastening.

Intermediate partitions separating cabinet sections typically install between the top web and bottom panel, secured with screws. Temporary spacers cut from scrap wood establish accurate spacing during fastening. Moran turns the cabinet on end for a gravity assist, resting the partition on the spacers and installing screws through top and bottom (see photo, page 41).

Drawer webs. Drawer webs provide a built-in stop in drawer-over-door configurations, as well as direct support for undermount drawer hardware. Other drawer hardware is mounted to the cabinet sides; we use temporary spacers to aid installation, working top to bottom.

Fine-tuning doors and drawers. The author orders the doors (and drawer fronts) sized to the face-frame opening. They are trimmed on site to fit with a 3/32-inch gap on all sides **(10)**. Concealed cup hinges are essential for these inset-style cabinets **(11)**. Here, an Ecodrill hinge jig **(12)** is used to make the needed three holes **(13)** for the cup hinges. The drawer boxes arrived from the manufacturer ready to receive the self-closing undermount slides; a pair of half-inch notches are made in the drawer's rear panel on either side to accommodate the slides **(14)**. A pair of locking devices (orange) are shown beyond, at the front of the drawer. Both the undermount slides and the locking devices allow for fine-tuning the drawer's alignment.

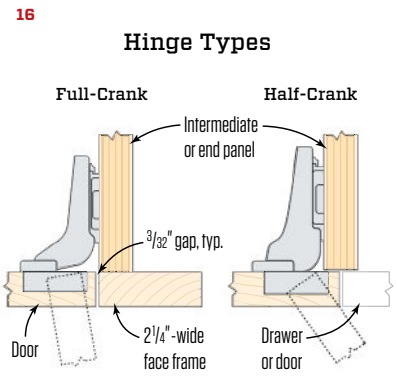
Face frames. For paint-grade cabinets, I use hard maple, which serves as an excellent paint base for face-frame assemblies. We nearly always build the face frame first, letting it guide the dimensions of the carcass, doors, and drawer boxes. The ability to pre-scribe a face frame to an abutting wall before it's applied to the cabinet is a real convenience, especially on large, heavy cabinets.

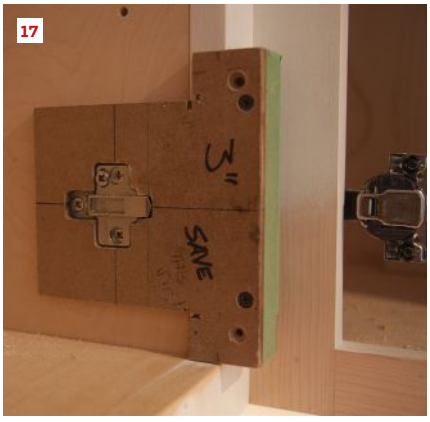
Before attaching them to the cabinets, we sand the face frames to 150 grit, leaving all glued joints flush and invisible under paint. Small imperfections are filled with Bondo (a two-part epoxy filler), allowed to cure overnight to accommodate shrinkage, then finish-sanded. Moran typically spray-paints the frames with a quick-drying primer such as Bin to highlight any lingering defects that need repair.

Inset drawers and doors. On this particular job, the drawer and door faces are inset in the frames. While overlay doors are arguably more forgiving of minor inaccuracies in the fit, inset doors will highlight them. Either way, it's crucial that face frame and carcass mate precisely. To avoid damage to the prefinished interior, we sand the inside edges prior to installing the face frame on the cabinet.

Wherever possible, we glue and screw the face frames from the back. As long as the pocket screws will be concealed by an adjacent cabinet, wall, countertop, or finish end panel, it's a go. In paint-grade work, faces on intermediate partitions are typically glued and face-nailed, and the holes repaired with Bondo. In other situations, we'll use specialty clamps, weights, or other improvised on-the-job ingenuity to glue the frames.

Adjustable legs. Instead of building a standard recessed base, we use PMI metal adjustable cabinet levelers. This not only eliminates scribing the box to an out-of-level floor, but also lets you more or less effortlessly fine-tune all base cabinets to a common laser line.





Hinge options. To provide a built-in door-stop and support for undermount drawer hardware, drawer webs are installed **(15)**. Five hinge types were needed on this job. A "full-crank" hinge lines up the edge of the door with the inner edge of the cabinet, while a "half-crank" lines up the edge of the door half-way, overlapping the partition it's mounted on **(16)**. Blind corner hinges (shown far right) were needed at inside corner locations **(17)**. A site-made jig (at left in photo 17) holds a hinge mounting plate in place for fastening. Where the face frame is offset from the cabinet interior, a frame-hung mounting plate substitutes for the more-common T-shaped plate **(18)**. Half-crank hinges **(19)** were used where this door edge shared a partition with a drawer base **(20)**.

The standalone finish toekick facing is easy to scribe, and snap-on fittings attach it to the leg tubes in a firm but reversible grip.

FINE-TUNING THE DOORS AND HARDWARE

I order doors and drawer fronts the same size as the face-frame opening, then trim them to fit with a 3/32-inch margin on all sides. Doors have to be drilled for the concealed cup hinges we use. Blum offers a pricey but indispensable Ecodrill hinge jig for the job. The jig adjusts to establish the critical margin between door edge and hinge cup bore, which varies from 2mm to 8mm, depending on hinge type. Those holes are hard to alter, let alone hide, if you mess up, so I make a list matching each door to hinge type for reference.

Drawer slides. Installing door and drawer hardware can take place while the cabinet is still on the bench or after it's installed. Having worked with all available top hardware brands, I've settled on Blum as the manufacturer that's nailed the requirements for versatility, adaptability, and ease of installation, as well as smooth, durable performance.

Because I outsourced the drawer boxes specifying Blum self-closing undermount slides, those boxes came ready to receive the hardware, with a 1/2-inch recessed bottom and a pair of notches at the rear edge. The notches fit over the slide bodies, while a pair of adjustable catches applied (by us) beneath the front edge of the drawer capture the slides. Installation is as simple as dropping the drawer into the opening and pushing it home to an audible click. When you pull it open again, it is fixed on the slides and glides effortlessly back to a soft, self-close.

Door hinges. Using concealed cup hinges, you have to do your homework when it comes to hinge selection. The inset doors on

Finishing up. Several cabinets on this job were also designed around prefabricated Rev-A-Shelf storage inserts, including a trash pullout, a blind corner pullout, and a food-storage-container organizer in the base-cabinet lineup **(21)**. The drawer faces were made from 3/4-inch-thick MDF (medium-density fiberboard) **(22)**. The cabinets are sprayed in place with two coats of Cabinet Coat enamel paint **(23)**.

this job called for inset hinges. Blum provides a comprehensive catalog and technical manual and it's worth taking time with this document to see what's available. This job called for at least five different hinge types with varying door-swing degrees for different locations and relationships (flush or inset) to the face frame.

One important distinction we found helpful to understand: Some hinge arms are designated "half-crank" and "full-crank," referring to the bend in the arm that determines whether the door edge will half-overlay or be flush with one side of a mounting partition. It's a subtle but important difference to keep track of.

The hinges are all adjustable for side-to-side, in-out, and up-down fine-tuning following installation, but the range is relatively limited. In a case where the face frame is offset from the cabinet interior, a specialized, frame-hung mounting plate substitutes for the common base plate used in "frameless" cabinet construction. Once you understand the differences, hinge selection becomes more intuitive.

PAINT FINISH

We make drawer faces from solid, 3/4-inch MDF—a smooth, flat, and stable material that takes paints well. The edges are sanded, not banded. We work with a highly skilled paint crew who apply all the finishes in the house, including built-ins and kitchen cabinets. Following two coats of quick-drying primer, filled and sanded in between, the cabinets are sprayed with two coats of Cabinet Coat enamel (www.insl-x.com). The result is a seamless integration with the surrounding architecture.

Cregg Sweeney owns Cregg Sweeney Artisan Builders, a building and remodeling company in Orleans, Mass. (csartisanbuilders.com)

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Installing Effective Rainscreens

Simple, low-tech systems that can work for any type of siding

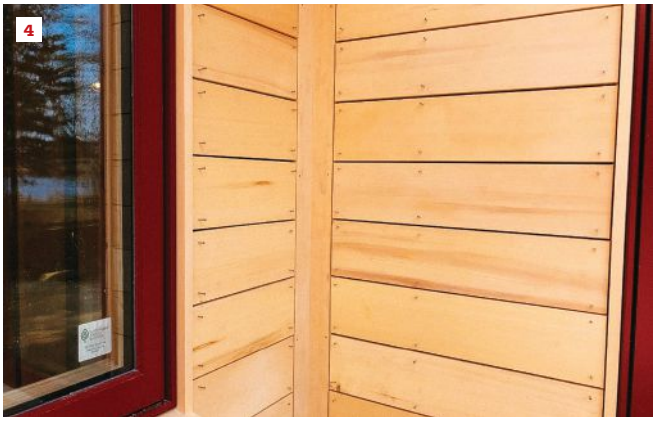
BY STEVE BACZEK

Most of us are all too familiar with old houses that lose heat needlessly and easily. But it was this heat loss that continually baked those houses dry and helped contribute to their continued longevity. Adding insulation and creating airtight building envelopes drastically reduces the "baking" effect in today's houses, which makes using an effective rainscreen almost a requirement now when building a house.

A rainscreen is a system composed of a water-protection layer along with an air space behind the siding that allows excess moisture to drain away, while allowing the siding and sheathing to dry properly. Rainscreens are applied over the sheathing, and there are many materials and systems on the market that can create successful rainscreen assemblies. These include beaded or dimpled housewraps, plastic mesh material **(1)**, and linear corrugated strips in metal and plastic. They are all designed to let water that gets behind the siding drain away safely. But another option that I often recommend for the homes I design is creating a rainscreen on site with the old carpenter's standby—wood furring strips, or strapping **(2)**. Strapping is inexpensive, readily available at virtually any lumber store, and easy to install.

In our area, strapping typically comes as 1x3 stock (2 1/2-by-3/4-inches actual). The crews usually install the strapping vertically for horizontal siding applications, letting the wood strips align with the wood-stud framing on the other side of the sheathing for

Photos by Steve Baczek



Siding nails directly over commercially available rainscreen materials like this mesh **(1)**. With site-built systems, the siding nails to furring strips **(2)**. With a closed rainscreen, the siding installs with a lap joint or it overlaps, as with clapboard **(3)**. In an open rainscreen, the siding nails to the furring strips with air gaps between the boards **(4)**.

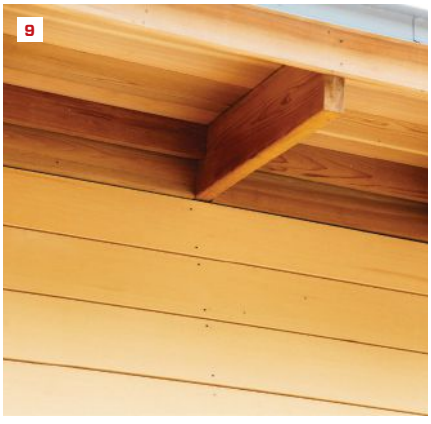
a strong, long-lasting installation. The strapping we use for our rainscreen systems is not treated to avoid rot, although I've seen many builders who use treated 1x4 or rips of treated plywood for this application. Sometimes we paint the strapping, but that is for reasons other than avoiding rot. The reasoning behind my choice of strapping in its natural state will become clearer when we look at how this rainscreen system actually works.

OPEN VS. CLOSED RAINSCREEN

The rainscreens that we build with strapping can be broken down into two basic types: closed-plank systems and open-plank systems. As the name suggests, with a closed system, the siding is installed with some type of closed lap joint or simply installed as a lap siding **(3)**. An open rainscreen has joints between the installed planks **(4)**. Both types of systems rely on the assumption that the underlying sheathing as well as the window and door penetrations are airtight, weathertight, and properly water-managed **(5)**. The siding and rainscreen are just "makeup" on the exterior of the building. But that makeup should drastically reduce the challenges and risks to the sealed building within.

In a closed system, the sheathing is treated normally. For sheathing with an integrated barrier, such as Zip System, the strapping installs directly over the sheathing. If the building has regular OSB or plywood sheathing with housewrap or felt paper as a WRB, the strapping installs over the WRB.

In an open rainscreen system, the gaps between the boards would allow sunlight and damaging UV rays to reach the sheathing, so that system starts with a layer of 15-lb. felt paper over the



Site-built rainscreens install over the WRB, so it should be complete with all seams and openings sealed and flashed properly **(5)**. With an open rainscreen, building paper covers the WRB to protect it from UV rays **(6)**. Protection from critter intrusion can be either mesh **(7)** or corrugated vent material **(8)**. Air space at the top of the wall allows ventilation for drying **(9)**.

sheathing **(6)**. The felt paper blocks sunlight from hitting the sheathing and degrading the WRB, while creating an effective, low-tech, and inexpensive water-shedding surface for the sheathing. The strapping then installs over the building paper.

At the bottom of both types of the strapping rainscreens, the 3/4-inch space between the strapping strips lets water drain out readily, but a space like that can be an invitation to little furry friends and the like. To close it off, but still allow for drainage, I use ridge-vent mesh cut to fit and nailed in between the strapping **(7)**. Another option is using manufactured corrugated plastic vents **(8)**.

MULTITASKING RAINSCREEN

We've already discussed the fact that the air space between the strapping and behind the siding is great for draining away the bulk water. But while a rainscreen's ability to drain water gets the biggest hype, the ventilation that these site-built systems provide is just as important. That 3/4-inch space behind the siding allows air to travel up and through the space, letting the cladding (along with the exterior sheathing based on its permeability) dry quickly from the inside.

With an open system, the gaps between the siding boards provide ventilation space, so that system is virtually air open **(9)**. At the top of the wall in a closed system, I either vent the air spaces into the soffit (provided the soffit is part of a vented roof assembly) or devise a detail to properly vent the air space at the frieze at the top of the wall.

In a typical wall assembly, the exterior sheathing, WRB, wood lap siding, and paint finish all get wet when it rains, and the water

A second horizontal layer of furring provides nailing for vertically applied siding, such as this corrugated metal **(10)**. If there isn't enough depth for the second layer of furring, the strips can be installed diagonally with breaks to allow water to drain down and out of the bottom **(11)**. Site-built rainscreens can be used for shingle siding, but this application is labor intensive **(12)**.

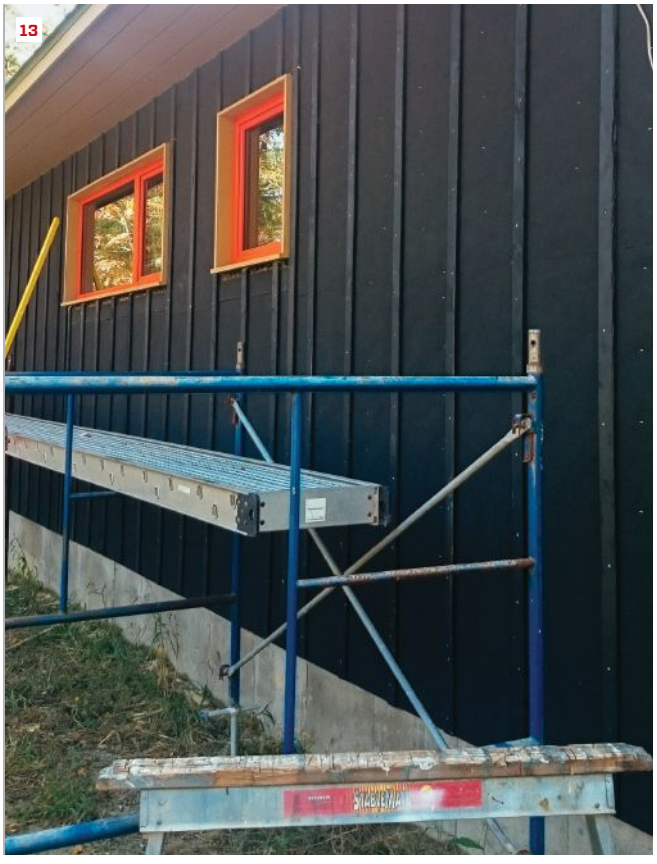
that makes it into the assembly is temporarily stored. When the sun warms the outside surface of the siding, the drive to dry the assembly is from the inside outward. The moisture moves through the assembly relatively freely until it hits the exterior paint surface, which usually challenges the drying process. Over time, this challenge to the paint surface continues, pushing on it from within and eventually causing the paint to blister. Ultimately, the blisters break, and the paint peels. In some cases, paint failure can happen in as little as four to five years.

With the 3/4-inch strapping as the rainscreen, water also moves inward when it rains. But the water cannot bridge a 3/4-inch gap, so the majority of the water drains out of the system more quickly than with a rainscreen that is directly attached, where the surface tension of the water slows the draining process. With less moisture in the strapping system, less drying is required.

Now look at the fact that the 3/4-inch airspace also promotes ventilation, dramatically increasing the drying potential. In a rainscreen, the amount of drying is inversely proportional to the amount of wetting. So the strapping rainscreen system severely reduces the wetting problem, and at the same time, exponentially increases the speed of the drying.

RAINSCREEN FOR OTHER TYPES OF SIDING

Some building projects call for vertical siding, such as board and batten. In these cases, we simply lap the strapping—adding a horizontal layer over the vertical layer—to allow for the vertical orientation of the siding. In one case where part of the elevation called for corrugated metal siding, double-lapping the strapping



Open rainscreen systems leave the furring strips exposed in the gaps between the boards. Many different strategies can be employed to hide the natural color of the strips. One option is painting the strips before they go on **(13)**. The entire furring strip can be covered with building paper **(14)**, or tabs of building paper can be inserted as the siding goes on **(15)**.

was a perfect solution **(10)**. In another project, we installed vertical siding sections above corrugated metal siding. We did not have the luxury of making those sections 3/4 inch deeper, so we simply installed the strapping on the diagonal, leaving intermittent breaks to let the water drain out below **(11)**.

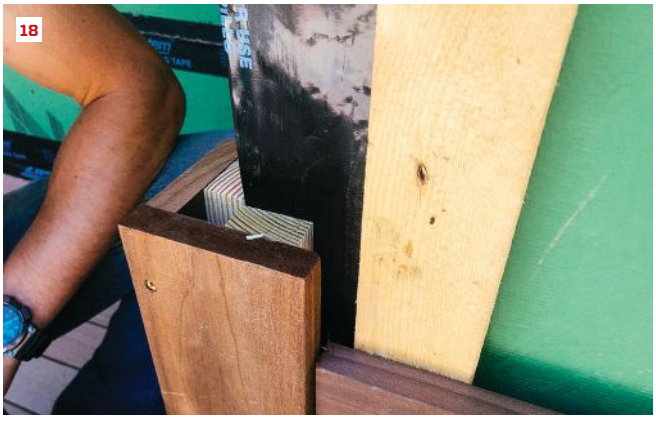
Site-built rainscreens can also work for cedar shingle siding **(12)**. For the project (which was not one of mine) in the photo, the builder essentially created an aggressive skip-sheathing layer over the vertical strapping. While this particular assembly seems a bit excessive in terms of both material and labor, it does work well.

For the record, when a project calls for shingle siding, I usually specify the commercially available product that the builder is most comfortable with installing.

OPEN RAINSCREEN DETAILING

As an architect, I prefer the open-plank rainscreen system for the projects that I design. While this system is tried and true from a performance standpoint, there are a couple of concerns that need to be solved for installation. We already mentioned covering the sheathing with felt paper to prevent UV exposure, which can also void the warranty of some manufacturers. To keep the strapping from being visible through the gaps between the boards, we either paint it black **(13)** or cover it with a strip of black building paper **(14)**. On a recent open-plank installation, the carpenters slipped in short felt-paper tabs before nailing off the tops of the boards **(15)**.

Most building walls have windows and doors to deal with. Integrating these openings into our rainscreen system is extremely



Seal all window openings and integrate them with the WRB. A flap of building paper below the window **(16)** layers into the building paper of the open rainscreen so that it sheds water properly **(17)**. This mock-up of a corner shows how to leave the boards open for maximum air circulation in an open rainscreen system **(18)**.

important. Remember that the siding is just "makeup" for the building's exterior—the real work is literally behind the scenes. Window and door integration starts with a well-designed and well-executed sill detail that allows any intruding moisture to drain away quickly. Meticulous detail should be paid to flashing and sealing the window into its opening (see "Installing High-Performance Windows," Oct/15) **(16)**. The flap of paper under the window integrates with the layer of felt paper of the open rainscreen **(17)**. Before the siding is installed, each window is completely water-managed and fully integrated with the rainscreen.

We also have to properly drain and ventilate the corners **(18)**. In the mock-up shown in the photo, the corners and butt ends of the siding are free to drain and ventilate. As the open plank siding goes on, most of the installers I work with use narrow strips of wood as spacers between planks. They use the same strips to maintain the gaps around windows **(19)** and at corners **(20)**. And with an open-plank rainscreen, maintaining the gap above the top board is crucial for clear ventilation.

In my years of designing and installing rainscreens, I have developed a list of practices to avoid. First, always make sure corners have plenty of ventilation. Never build up columns of strapping installed next to each other. I recommend leaving a horizontal gap of at least 3/4 inch between any vertical strapping.

At window openings, resist the urge to install horizontal strapping at the bottom of the opening or under the sill of the installed window. Flashed sills should run freely into the rainscreen. Be sure to integrate any weep systems in the windows you are using into the sill and the rainscreen system. And treat the head of the window

A carpenter scribes a board around a window in an open rainscreen system, with spacing between the boards and a space left under the window sill **(19)**. A temporary strip creates the open space at a corner board **(20)**. Furring strips end well above the head flashing over a window **(21)**. Services such as this electrical meter are furred off the wall as part of the siding **(22)**.

like the sill, with the ability to drain completely **(21)**. Always terminate the strapping for the rainscreen a good distance above the head flashing.

Any services attached to wall should be considered part of the cladding, not the wall sheathing, so items such as an electrical meter get furred off the wall just like the siding **(22)**.

RAINSCREEN INVESTMENT

When the subject of rainscreens comes up with contractors or clients, the inevitable first question is, "How much does the strapping cost?" I could always look up the current prices at the local lumber store and apply a dollar amount, but I usually answer that question with another question: "How much does that paint job cost every five years?"

As a conservative estimate, let's assume that we paint the siding every seven years on a house with a typical direct-nailed rainscreen assembly. I know of homes that have gone beyond 20 years without their lap siding needing to be repainted when that siding was installed on a site-built strapping rainscreen system. That amounts to three paint jobs in that span of 20 years. So instead of thinking of this rainscreen as a "cost," I like to think of it as an "investment." The money that would be spent on those additional paint jobs would more than outpace the cost of installing the rainscreen, and that investment extends the durability not only of the paint job but of the whole wall assembly and the house itself.

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

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BY SYMONE GARVETT

1. Performance Siding

Ply Gem has launched its new Performance Collection of vinyl siding, soffits, and accessories. This durable, low-maintenance siding coordinates well with other low-maintenance exterior materials such as stone, says the manufacturer. Its seven product lines range from traditional clapboard profiles to the look of rough-sawn cedar siding. Several styles can withstand winds of up to 200 mph, Ply Gem says, and are offered in many colors. All are covered under a limited lifetime warranty. Contact a local distributor for pricing. plygem.com

2. Supreme Sealer

Sherwin-Williams' newest coating, Extreme Block Primer/Sealer, is designed to quickly seal off tough surface stains, including fire, smoke, and nicotine, on both interior and exterior surfaces. The oil-based primer adheres to multiple substrates, including wood, drywall, masonry, and prepared metal, and is easy to sand to a uniform surface, according to the manufacturer. Primed surfaces may be top-coated with either acrylic or alkyd coatings after as little as two hours of drying. Prices run around $42 a gallon. sherwin-williams.com

3. Liquid-Applied Masking

Peel-Tek's flagship product, Peel-Tek 150, is a temporary coating designed to protect both porous and nonporous surfaces from damage during construction. The coating is brushed or rolled on, so it may be used to protect rough surfaces that would otherwise be difficult to mask. When it's no longer needed, it peels away, and reportedly leaves no residue. It's available in one quart, one gallon, and 3 1/2 gallons. Pricing is $20 per quart and $69.50 per gallon. peel-tek.com

4. Resilient Cabinetry

Perfect for outdoor kitchens, WeatherStrong outdoor cabinetry is made from a 3/4-inch marine-grade waterproof polymer. The manufacturer reports these cabinets are assembled with precisely positioned dowels and a fast-cure, solvent-free adhesive. Door pulls, hinges, and drawer runners are 316 stainless steel. The factory finish is an embossed wood-grain texture that's offered in four styles and three colors. Pricing starts around $175 to $250 per linear foot, depending upon model and door style. weatherstrong.com

5. Narrow Ceiling Cassettes
Mitsubishi Electric's MLZ Series One-Way Ceiling Cassette air-conditioning unit features a narrow body and is designed to fit within standard 16-inch joist spacing. According to the manufacturer, the cassettes are effective regardless of ceiling height because of their adjustable airflow. An auto vane control is capable of adjusting air direction based on a homeowner's needs. The unit can be serviced from underneath, without requiring an access panel. Prices vary based on installation labor, components, and the type of unit. mehvac.com

6. Durable, Waterproof Flooring
Rigid Core Vantage from Armstrong Flooring is a hardwood-look-a-like flooring in an extra-long plank format. The manufacturer says that it is structured for durability, even under high traffic, high moisture, and high impact, and that it is waterproof and will not swell or buckle when exposed to water. The flooring boasts a dense polymer composite core for dent resistance and a commercial-grade wear layer, and it carries a 30-year limited residential warranty. Pricing varies by distributor. armstrongflooring.com

7. Industry-First Brick Tie
Narrow air spaces behind brick veneer risk being filled up with mortar droppings, which can block airflow and drainage. Simpson Strong-Tie's new BTH brick tie can connect brick and stone veneers across spans up to 3 inches, allowing for a wider space. Fabricated from 22-gauge galvanized steel, it is field-adjustable in two places and can be installed with either side facing up, providing strength and versatility. Tie ends embed in mortar, a minimum of 1 1/2 inches and connect to framing with a single 0.131-by-2 1/2-inch nail. Retail pricing ranges from 18 to 22 cents each, depending on the distributor. Carton quantity is 500. strongtie.com

8. Voice-Enabled Smart Lock
Yale Locks & Hardware recently announced a partnership with Comcast's Xfinity Home service. Smart locks in Yale's Assure Lock line can now be connected to the system—when purchased with a Yale Zigbee Network Module—to allow homeowners to lock and unlock their doors with a mobile app or X1 voice remote. Besides locking and unlocking the doors, users can also check the lock status and receive notifications if the door is unlocked. Pricing ranges from $130 to $170 and up. yalehome.com

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9. Slim-Line LED

With its slim profile, the surface-mounted Surf LED fixture by Nora Lighting is designed to mimic the look of a recessed light but allow for easier air-sealing. The fixture may be installed over both standard and fire-rated J-boxes. The luminaire is edge-lit and uses an embedded honeycomb lens light guide for even distribution. The light offers 90+ CRI, and features a regressed lens with a deep, grooved white baffle. It is available as a round or square aperture in 4-inch, 6-inch, and 7-inch sizes. Its DC dimmable driver allows an adjustable lumen output from 650 to 1,000 lumens. Pricing ranges from $44 to $54. noralighting.com

10. Farmhouse Sink

Franke has introduced a new Farmhouse Sink Collection, which is characterized by a reversible apron front that allows homeowners to choose between a smooth or fluted surface during installation. Its polished finish is designed to be easy to clean and to stand up to heavy use, according to the manufacturer. The sink comes in a range of sizes and colors, with MSRPs ranging from $1,500 to $1,750. Optional bottom grids, cutting boards, and strainer baskets are available. franke.com

11. Stop Leaks From Self-Leveling Underlayment

A new patent-pending system called EdgeBan helps with leak-proof installation of self-leveling underlayment. EdgeBan creates a barrier around potential run-out areas, including wall gaps, toilet flanges, and floor vents. The maker says that its "Leveler Lock" design not only will seal run-out spots but will integrate with the underlayment, forming a strong bond and solid substrate to install flooring material over. Offered in strips, circles, and rectangles, each variation is easy to cut and simple to install, according to the manufacturer. Pricing for the parts ranges from $4 to $72. edgeban.com

12. Indoor/Outdoor Fridge Drawer

Thor Kitchen has expanded its line of affordable, professional-style kitchen appliances with a new 24-inch Indoor/Outdoor Refrigerator Drawer. The drawers are built from 304 stainless steel and provide 5.3 cubic feet of packing capacity at a consistent internal temperature between 50°F and 32°F. Its ventilated cooling system is designed to automatically defrost its evaporator, which the maker says helps to prevent humidity buildup or freezing. Other features include self-close hinges, LED interior lights, and digital setting controls. Pricing starts at $1,300. thorkitchen.com

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A Compact Cordless Recip Saw

BY JEREMY KASSEL

The rounded footplate of the Bosch made cutting much smoother with the blade buried into the work.

The Bosch GSA18Vkit comes with a 4.0-Ah FatPack battery. But for a lot of his work, the author ran it with a 6.3-Ah Core battery, which performed exceptionally. On most jobsites, a reciprocating saw is used in short bursts, allowing the tool and battery to take a break and cool off. One battery is usually enough.

Photos: Jeremy Kassel

When I first started my remodeling career, in 2004, I felt that cordless tools were implements of convenience, and not for performance or longevity. Corded tools and pneumatics were the core of any construction site for being reliable and steadfast. A lot has changed. Cordless tools not only have become as powerful and reliable as corded tools, but in some ways have eclipsed them. This could not be more true than with the Bosch Compact Reciprocating Saw.

Truly one-handed. When I first got this saw, I noticed immediately that it could be held in the operating position with one hand. When using a traditional rear-handled reciprocating saw, I keep my left hand underneath the front of the saw. While this cutting position is still possible with the Bosch, it's certainly not necessary and maybe even a little uncomfortable. The one-handed usage of this tool is where it really shines.

Versatile and durable. My business partner and I used the recip saw for a variety of remodeling tasks. When we were cutting out the over-sheathed sections of window rough-openings, the short and well-balanced design allowed me to place a free hand on the cutoffs. We also cut out an old entry door, which required cutting the nails driven through the jambs into the rough framing. The rounded footplate of the saw allowed me to "roll" the front of the saw on the jamb and through the cut. Previous to handling the Bosch, I was much more familiar with a traditional reciprocating saw, on which the footplate is flat and only minimally pivots on the rivet that fastens it to the saw. The rounded footplate of the Bosch made cutting much smoother with the blade buried into the work. Last, we tried it on cutting stair stringers (we typically use a circular saw and finish out the kerf with either a jigsaw or hand saw). The Bosch was able to handle this task, but it took a bit more finesse. Sawdust was more prone to collect adjacent to the cut, thereby covering the pencil lines and kerf.

Because the tool was shipped to me as separate components, I don't have a hard case or soft bag for it. I was concerned early on that tossing it in and out of cases with other tools might be an issue, but the tool has been durable. It has been not-so-carefully put in an open pickup-truck bed and inside other tool cases, inadvertently brushed with mud, and more. It even survived unscathed after being dropped off the top of a 6-foot stepladder onto a blacktop driveway.

The Bosch recip saw did everything I wanted it to, and more. The portability and convenience of a cordless recip saw matched with the power of the Core 6.3-Ah battery make this tool a serious contender in the reciprocating-saw market. I'm a contractor with a heavy focus on remodeling, and the Bosch has already taken the No. 1 position in our fleet of recip saws. For the work that we do, having one battery hasn't hindered us.

The saw is available as a tool-only ($110) and as a kit ($219; comes with one 18V 4.0-Ah FatPack battery, one BC1880 18V Fast Charger, two 6-inch bi-metal blades, and a carrying case).

Jeremy Kassel is the owner/operator of Kassel Construction in Glenmont, N.Y., and co-host of the House Calls Podcast. Find him on Instagram at @kasselconstruction.

The Layout Square Gets Some Major Upgrades

BY CHRIS ERMIDES

This square may look conventional, but it is far from ordinary. Well-known for building the world's first titanium-handled hammer, and then re-imagining it into the Martinez M-1, former framer Mark Martinez says he's been asked for years to develop a titanium layout square. What started out as a concept drawing in mid-June of this year journeyed to prototype in just six weeks. Martinez's Instagram followers helped shape the square by providing feedback on his posts as he shared the tool's development—making this the first crowd-sourced construction tool in the industry.

The square has pencil notches every 1/8 inch, from 3/8 inch up to 5 1/2 inches. It features purposefully aligned punch-outs that offer more layout options for framers than other squares on the market (for example, 22.5 degrees). In addition to knock-outs at 3/4 inch, 1 inch, and 1 3/4 inches, there are marks for 3 1/2, 5, and 5 1/2 inches. Also, there is a knockout that fits metric and imperial circular saw arbor nuts so it doubles as a blade wrench as well.

Martinez says that it's the most accurate layout square on the market, comparing its precision to that of high-end woodworking squares used by furniture makers. The square itself is made of military-grade titanium while the housing that holds one bubble vial is made of aluminum. Because it's made of titanium, it is lightweight and also virtually impossible to break.

As you probably expect, these features, precision, and durability come at a hefty price: $250. Martinez understands that this square is not for everyone and admits that he's not looking to mass-produce these or compete with less-expensive models that are widely available. He also recognizes that they may be stolen on jobsites and is planning to offer customizable laser etchings on them in the near future. Production runs will be limited and preorders are now being accepted via martineztools.com.

Chris Ermides is editor of Tools of the Trade. *Follow him on Instagram @toolmagazine.*

Cordless 18V Table Saw

In another move to advance lithium-ion battery technology, Milwaukee Tools introduced a 12-Ah High Output battery as a new addition to its M18 Redlithium battery lineup. While still an 18V pack, the battery reportedly provides more power and runs cooler than others in this series due to its larger cells and internal electronics. According to the manufacturer, the technology allows the battery to deliver 15-amp corded power in a cordless form, allowing the company to cut the cord on more traditionally corded models.

One of the biggest of these announcements was the new M18 Fuel 8 1/4-inch Table Saw with One-Key. Powered by a single M18 High Output 12-Ah battery, the table saw is said to be capable of ripping up to 600 lineal feet of 3/4-inch OSB on a single charge. The saw features a 24 1/2-inch rip capacity (right side of the blade) and a rack-pinion fence system. It has a maximum cutting depth of 2 1/2 inches at 90° and weighs about 41 pounds. The unit is also One-Key enabled, making it trackable with Milwaukee's One-Key app—adding tool security and giving you the ability to lock it out, hide it, or shut it down once someone turns it on.

The 2736-21HD kit includes one M18 Redlithium High Output HD 12-Ah battery, M18/M12 Rapid Charger, blade, blade wrench, guard, anti-kickback pawls, miter gauge, and riving knife. Cost: $550. A folding stand is sold separately for $80. —*C.E.*

Brushless and cordless. Equipped with a brushless motor that's powered by an M18 battery, the saw spins an 8 1/4-inch blade with enough power, says the manufacturer, to rip any wood species you put through it. Runtime will be determined by a number of factors including the Ah battery you're running, density of the material, and blade type.

Dust Particle Separator From Festool

Following the release of Bluetooth-enabled accessories for its CT extractors, Festool now has a cyclonic dust separator available as well. The CT Cyclone unit is an anti-static, pre-separator that collects large debris as well as coarse and fine dust. A pan, which holds a collection container and disposable bag, locks on top of the CT extractor, holding the Cyclone Systainer on top. A hose attaches the unit to the CT extractor. Because large debris is collected into the separator before it reaches the extractor's bag, it means you'll use fewer fleece bags and the filters will have prolonged life. This setup is also said to maintain high suction power by reducing the load on the extractor's filter. According to Festool, when the cyclonic system is used with a HEPA-certified CT dust extractor, it is OSHA Table 1 compliant. This accessory can be used with all Festool CT 26/36/48 dust extractors. The CT-VA-20 includes a Cyclone Systainer, collection container, Systainer pan, hose connector, lid, and disposable bags, and it sells for $375. *—C.E.*

Cyclonic dust separator for portable extractors. Available now, the three-piece unit latches to the top of any CT extractor. The separator has a hose to connect to the extractor. A bottom pan holds the clear collection canister.

Fast-Ripping Sidewinder

Hitachi's C7BUR 7 1/4-inch sidewinder is designed to be powerful and fast. Dubbed the "RipMax," the saw's 15-amp brushed motor runs at 6,800 rpm, which is said to be 40% faster than competitive models. It features an aluminum base, an electric brake, and a dust-blower function for clearing the cutline. When outfitted with a fiber-cement blade and equipped with an optional dust collector shroud connected to a vacuum, the unit complies with OSHA's silica rule. It has a 2 7/16-inch cut capacity at 90 degrees and 1 7/8-inch cut capacity at 45 degrees. The saw's bevel capacity is 0–45 degrees. Cost: $170. The saw is also available without an electric brake (model C7UR); that model has a bevel capacity of 0–55 degrees and costs $150.

Editor's note: Hitachi recently announced that it will change its name to Metabo HPT beginning this fall. Only the name will change; all warranties, model numbers, battery compatibilities, and so on will remain the same. —C.E.

Two versions available. The RipMax is available with or without an electric brake. Both versions have the same features otherwise, though the non-brake model (C7UR) can bevel up to 55 degrees, whereas the electric-brake model (C7BUR) is limited to 45 degrees due to a larger motor housing. Both saws weigh just slightly over 11 pounds.

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Remodelers ADVANTAGE

BY MATT PANELLA

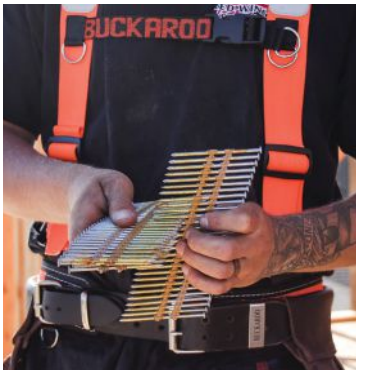
The Ol' Nail Toss

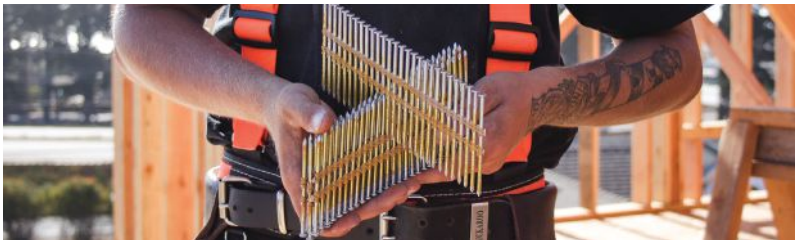
This is a simple trick that's one of the first things we teach our new guys. When framing a building, you need to reload your nail guns (we run Hitachi stick nailers), and you can carry only so many nails in your bags without getting weighed down. But you can't toss a bunch of sticks to a co-worker without them flying everywhere. Tossing one rack at a time doesn't work either: First of all, it's too slow, and more times than not, that one rack is going to break apart, and you'll end up with a lot of pieces.

Here's what we do instead. Take however many racks of nails you want to toss and line them up the same way. Then take one more rack and stick it into the bundle (see photos). That holds them together. They're not going to come apart, and they make for an easy toss to the top plates, to the roof, across the floor deck, or to wherever your guy is.

I've had probably $4,000 in nails tossed at me that have gone flying everywhere and broken. This prevents that.

Matt Panella, 22, is lead carpenter for Panella Construction, based in Arroyo Grande, Calif. He is a third-generation builder and credits his father, also Matt Panella, for everything he knows about carpentry. In case any of you were wondering where all the young carpenters are, they're on Instagram, of course. Follow him there @mattbangswood. Support the youth in our trades!





Send us your tips: *JLC* is partnering with our sister publication *Tools of the Trade* and Milwaukee Tools to give away a power tool each issue to the reader who sends us the best trade tip. (Next month, we'll give away an M18 Fuel Combo Kit, shown at right.) Send tips to JLC-Editorial@hanleywood.com with "Trade Tip" in the subject line. Any building trade qualifies. Don't sweat the grammar or writing; that's what *JLC* editors get paid for. But do send us high-quality photos, and, if needed, a rough sketch to explain your tip.

Top four photos by Matt Panella

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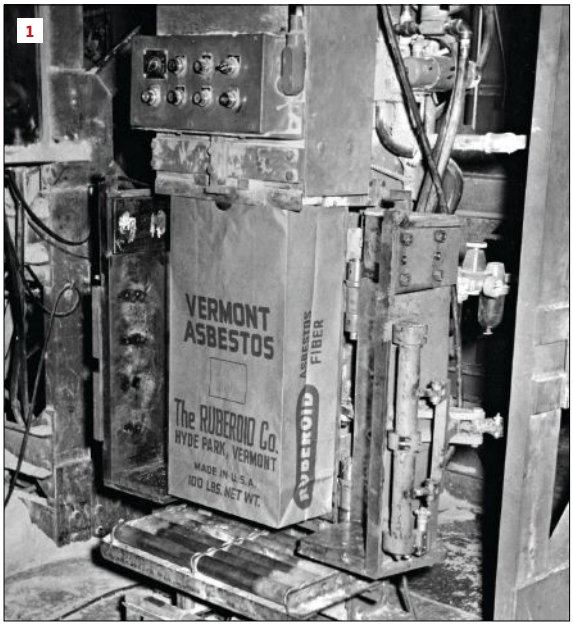
BY TIM HEALEY



Asbestos fiber is loaded into 100-lb. bags at Ruberoid Co.'s Vermont mine, circa 1950 **(1)**. The Eden-Lowell mine was the first (and largest) commercial asbestos mine in the U.S. Thirty million tons of tailings, upwards of 350 feet high, were left at this 1,550-acre site **(2)**. Trucking the tailings off site as well as turning the mine into a solar farm have been proposed.

Photos: 1, courtesy Abestorama; 2, Tim Healey

Home-Grown Asbestos

According to the U.S. Geological Survey (USGS), there are 142 former asbestos mines in the continental United States. Of these, only a handful of mines in a few states (California, Vermont, Arizona, and North Carolina) have produced large, commercial quantities of asbestos. Starting in the early 1960s, multiple large, open-pit mines in California were brought on line, greatly increasing the country's domestic production. Before that, from roughly 1900 to the late 1950s, "home-grown" asbestos was largely confined to the Eden and Lowell mines at the base of 3,376-foot-high Belvidere Mountain in Northern Vermont.

Chrysotile asbestos or "white asbestos," the most common type of asbestos mined in the U.S., was first discovered in the Belvidere Mountain area in the 1820s. By 1899, two mines on either side of the mountain had opened: the Eden mine on Belvidere's south slope and the Lowell mine (the larger of the two) a mile or so to the east. Geologically, these mines are the southern tip of the Quebec asbestos belt—vast deposits of chrysotile asbestos in Quebec Province, Canada—starting some 60 miles north of the Vermont border with the Jeffrey Mine in the French-Canadian town of "Asbestos" and heading northeast 50 miles to Thetford Mines, Quebec. These Canadian mines were among the largest in the world and they dwarfed U.S. production of asbestos (historically, the U.S. produced enough asbestos for roughly 10% of its manufacturing needs and imported the rest from Canada, Russia, and South Africa).

In 1936, the Ruberoid Co. (maker of building products such as asbestos-cement shingles, house sidings, and protective paints) bought the Belvidere Mountain quarries from local owners and began what would be the country's first modern, large-scale open-pit asbestos mining operation. Ruberoid merged with General Aniline & Film in 1967 (changing its name to the GAF Corp.) and continued its mining operation. But as health issues associated with asbestos came more into public focus in the early 1970s, and costs to comply with new environmental regulations (the Clean Air Act of 1970 classified asbestos as a hazardous air pollutant) mounted, GAF scheduled to close the mine in 1975.

In an effort to save hundreds of jobs (the mine was the largest employer in the region), its workers bought the mine from GAF. They raised $2 million for the purchase (most of which was used to retrofit the plant for the required environmental dust-control equipment) and named the new company the Vermont Asbestos Group (VAG). In 1977, the Copperopolis mine in California eclipsed the Eden-Lowell mine as the biggest producer of asbestos in the U.S.

From the late 1970s to early 1990s, VAG survived ownership battles, labor strikes, and dwindling demand for its product. No longer profitable, the Eden-Lowell asbestos mine officially shut down all operations in 1993, 25 years ago.

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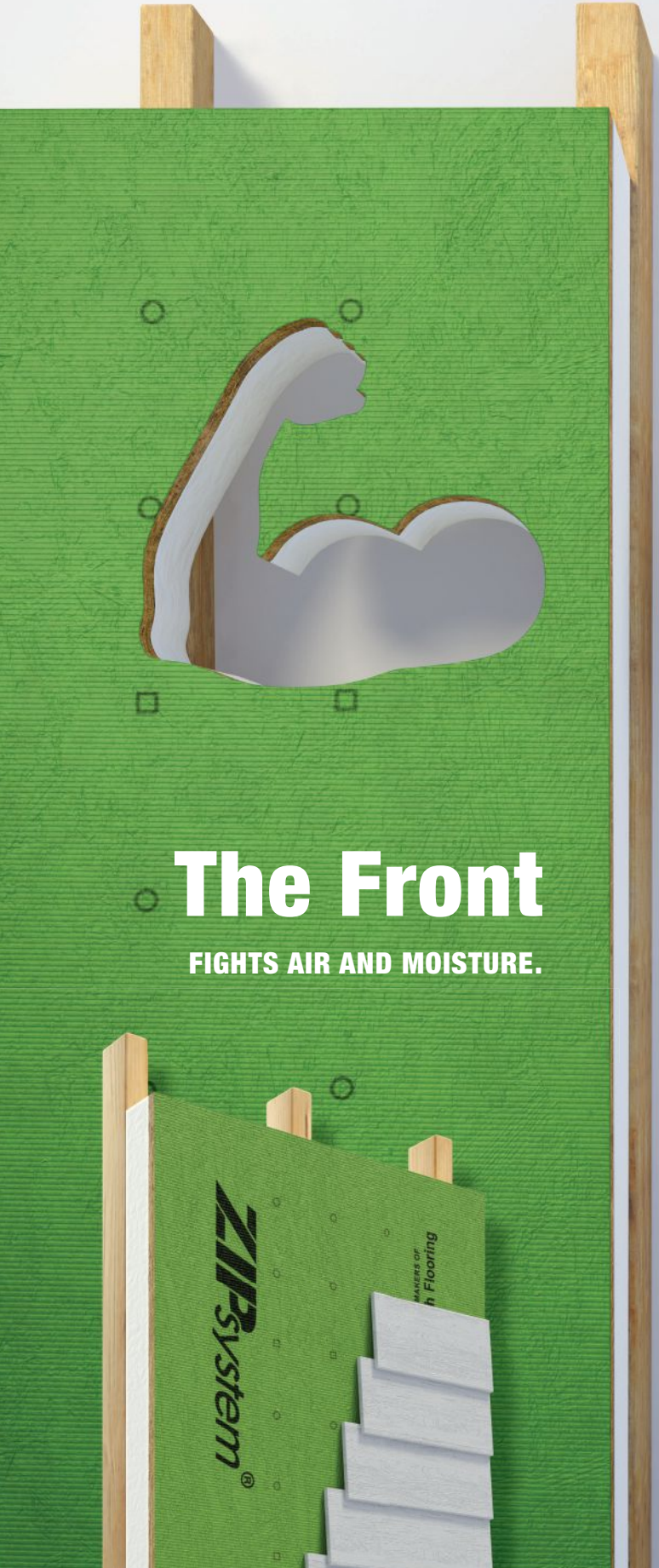

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