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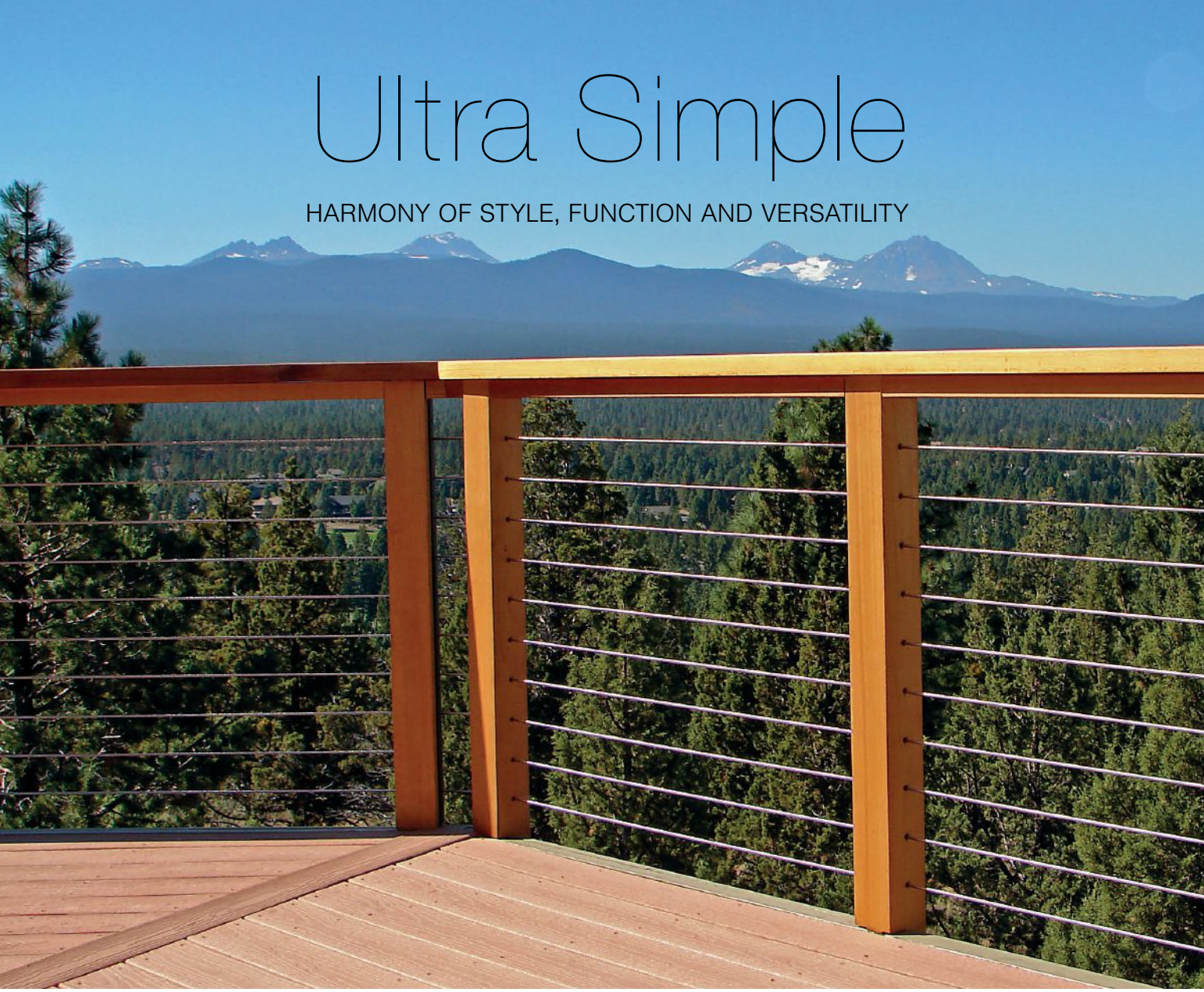

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Contents

On the cover: Aaron Guinness, Adam Haselton, and Josh Girard (working the excavator) of North Country Construction install a foundation drainage system in Jericho, Vt. Photo by Tim Healey. See the story on page 12.

FEATURES

DEPARTMENTS

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Q When you're installing cedar shingles on a wall over a gable roof, how do you detail the courses to keep the shingles at a consistent angle off the wall?

A Chris Yerkes, a cedar-shingle installer certified by the Cedar Shake and Shingle Bureau (CSSB), and owner of Cedarworks, in Brewster, Mass., responds: This is a great question to ask, because I've seen many installers get this detail wrong. If not done properly, the angle of the shingles off the wall will be inconsistent and the shingled siding won't shed water properly.

The key is letting each course of shingles continue up the angle of the roof until it dies out completely. Each course then runs in the opposite direction all the way over to the side of the building. Where the shingles are cut to the angle of the gable roof, they should get progressively shorter as the course continues up the roof, while the tops of the shingles run level across the wall.

I usually start each course at the point where the course meets the roof angle, and work up the roof and back toward the side of the building from there. We precut the angled shingles on the ground, using a bevel gauge on a table saw to ensure uniformity of the cut angles.

The cutting process is much easier if you save wide shingles to use for this detail. In a previous article ("Nailing Wide Shingles," *Q&A*, Oct/17), I mentioned that while I'm shingling a wall, I set aside any shingles more than 8 inches wide specifically for this purpose. Cutting the angled shingles from wides saves me from having to cut a bunch of smaller shingles for the angled sections. I will typically cut the angled shingles for a number of courses at one time to minimize my trips up and down the ladder.

Proper nail placement is a key for the angled shingles. I'm always careful not to nail too low or too close to the roof-to-wall intersection. To secure each angled shingle, I drive one staple (or shingle nail) at least 2 inches above the lower edge of the next shingle course and into the top corner of the step flashing.

Another key to having the roof drain effectively while making this detail look professional is to create a consistent gap between the roofing and the cedar shingle siding. We typically rip a furring strip to about 3/8 inch and use it as a shingle ledger above the roofing material. This strip lays flat on top of the roofing surface, and the shingles rest on the strip as they are nailed in.

We remove the strip after we've finished installing the shingles, and the gap that's left creates a neat and even drainage channel between the roof and the siding. This gap keeps the butt ends of the shingles from wicking water, which would greatly reduce the longevity of the siding.

A quick and easy way to make a ledger strip for along the roof is with a length of standard beveled clapboard. The bottom edge of the clapboard is typically around 3/8 inch thick, so we just lay the scrap on the roof with the thick edge against the wall. Then we install the angled shingles on top of the clapboard, removing it when we're done to leave an even drainage gap.

Cedar Shingling Wall-to-Gable-Roof Intersection

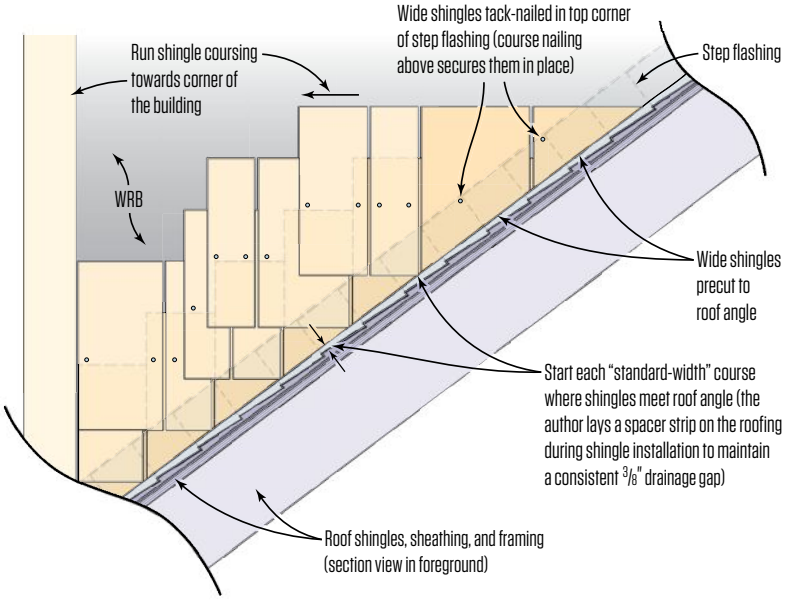

Illustration: Tim Healey

Begin courses at the roof with angled shingles (cut on the ground). Maintain an ample drainage gap between the wall shingles and the roofing material.

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PROSALES

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Q What are the concerns about VOC emissions from exterior plywood and OSB?

A Clayton DeKorne, chief editor of *JLC*, responds: VOC emissions are pretty much a nonissue for exterior-grade plywood and OSB. Exterior-rated structural panels use moisture-resistant phenolic-formaldehyde resins in the adhesives (this is also true for wood I-joists, LVL, glulams, cross-laminated timber, and many other types of engineered lumber). These adhesives do not off-gas substantially, nor do they add much of anything to the levels of indoor air contaminants.

The emissions from exterior-rated composite wood products are quite different from the off-gassing typically experienced from more volatile urea-formaldehyde resins that bind together interior-rated panels, such as the particle board and MDF used in some cabinetry, as well as laminated flooring. But even that is changing quickly.

Effective June 1, 2018, all composite wood products must meet formaldehyde emissions standards set by the California Air Resource Board (CARB) Air Toxic Control Measure (ATCM) for Composite Wood Products. And effective March 22, 2019, these products must meet a national formaldehyde standard, dubbed TSCA Title VI, put forward by the Environmental Protection Agency, which mirrors the CARB standards.

These standards apply only to hardwood plywood (veneer and composite-core panels), particleboard, medium-density fiberboard (MDF), and thin MDF. Structural engineered wood products manufactured for construction applications, including structural plywood, oriented strand board (OSB), wood I-joists, laminated veneer lumber, and glued-laminated timber, have always been exempt from regulation by both CARB and TSCA because they are made with low-emitting, moisture-resistant adhesives.

It's worth noting that the new EPA ruling that set formaldehyde limits effective in 2018 and 2019 applies only to the manufacturers of those panels. The regulation is intended to limit products in the supply chain. Installers of the panels cannot be penalized.

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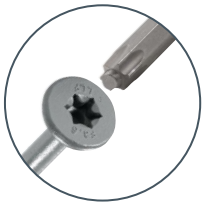

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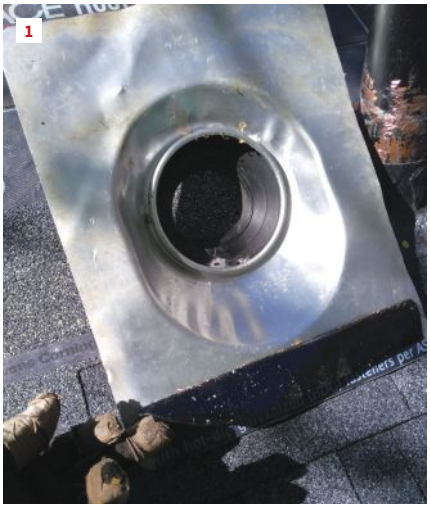
BY MIKE GUERTIN

Updated Boot-Flashing Installation

Nearly every house has a plumbing vent pipe through the roof, and most of these pipes are sealed with a boot flashing. On boot flashings, there are just a couple of inches around the metal pan bell to blend with the roof shingles to resist water intrusion. Like most builders, I used to apply plastic roof cement or another sealant to block water from being blown under the bottom edge or in along the side laps of the flashing.

But many types of asphalt roof shingles today have warranties of 40 to 50 years—and some even have lifetime warranties—so I'm no longer confident that any sealant I use will remain serviceable and keep the flashing boot leakproof for the full duration of the shingle warranty. Instead, I now use self-adhering, self-sealing flashing tape or strips of waterproof shingle underlayment around the boot flashing. These materials integrate the boot with the surrounding shingles and with the underlayment material on the roof to shed water and to resist wind-driven rain.

Mike Guertin is a builder and remodeler in East Greenwich, R.I., and leads the Roofing Workshop (and other clinics) at the JLC Live show. Follow him on Instagram @mike_guertin.



Photos by Mike Guertin

Apply flashing tape to the underside of the lower edge of the flashing, adhering half the strip to the metal **(1)**. Slip the boot over the vent pipe and press the remaining flap of tape onto the shingles **(2)**. Tape the metal boot to the shingles on the sides and up onto the roof underlayment **(3)**. Notch a section of underlayment material around the boot, letting it extend under the next course of roof underlayment above the boot **(4)**. Scribe and fit the shingle courses around the boot in typical fashion **(5)**.

Pumping to Daylight

BY JOSH GIRARD

I own and operate a small, custom home and remodeling business in northern Vermont. Currently, we're in the process of developing a seven-lot subdivision on a 36-acre parcel of low-lying, valley farmland that abuts a river. The land's topography is flat, though it quickly drops in elevation as it approaches the river, far from our new five-acre subdivision (the remaining acreage has been designated as common land). Also, the water table is fairly high and variable. Test pits dug in 2015 during the project's design phase confirmed the groundwater could vary from 5 to 7 feet deep below grade (on average), depending on the season or on how wet or dry the weather has been.

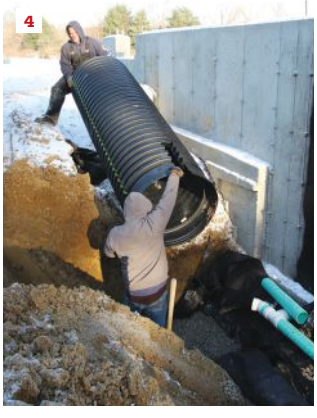
For this development, these two factors necessitated our having to pump the groundwater from the footing drains, since the flat site didn't allow for draining to daylight. To stay out of the water table, we had to install our new foundations much higher than the existing grade, backfilling our foundations with 4 to 5 feet of trucked-in sand and scraped topsoil.

EXTERIOR SUMP PUMP

To discharge potential groundwater, we employed a site-drainage detail I picked up from an excavation subcontractor a decade or so ago. On the exterior side of the foundation, we installed a big culvert vertically that acts as a sump pit well and collection point for the home's perimeter and under-slab drains **(1)**. The culvert installation was straightforward enough, though the trickiest tasks were first determining the sump-pit depth (relative to the high water-table elevation) and connecting up the pump in a confined space.

Typically, we install exterior sump pumps on all our new homes where draining to daylight is not an option, regardless of the height of the site's water table or soil drainage class. The pumps are positioned lower than the perimeter and under-slab drains, so in most cases the drains are never going to see water. But with this site's high, fluctuating water table and location in a low-lying valley adjacent to a river watershed, the perimeter and under-slab drains have a greater potential of filling with groundwater.

Setting the depths. Last December, when we excavated the hole for the foundation of the third home in the development, we hit high water 5 feet below grade,



The author and crew install a 30-inch-diameter culvert vertically to act as a sump pit well next to the home's foundation **(1)**. The under-slab drainage **(2)** is connected to the perimeter drains through sleeves cast into the footing **(3)**. The culvert is muscled into place **(4)**. In this completed home's sump, the pump-to-house wiring connections are made at a wall-mounted junction box **(5)**.

Photos by Tim Healey

largely due to an unusually wet late summer and fall. So we adjusted the basement hole depth to 3 feet (2 feet above the high-water line), then put in a 6-inch layer of clean stone. I like to pour footings on a stone base rather than on undisturbed soils to help level the formwork and provide drainage. As to pump placement, we generally set the bottom of the sump pit 18 inches below the top of the footing (see Exterior Sump Pit, right).

Under-slab drainage (radon). We install under-slab piping on all our new homes primarily for drainage, though it serves as cheap insurance in case radon rears its ugly head (we build in a Zone 3 "low potential" radon zone, though the vast majority of Vermont is in a Zone 2 moderate zone). Our standard layout is a 6-foot-on-center spacing of perforated piping **(2)**, which is connected to the perimeter drains through sleeves cast in the footings **(3)**. Future-proofing for radon, we also rough-in a 3-inch dedicated vent stack from the under-slab piping and through the roof, which a radon mitigation fan can easily be cut into.

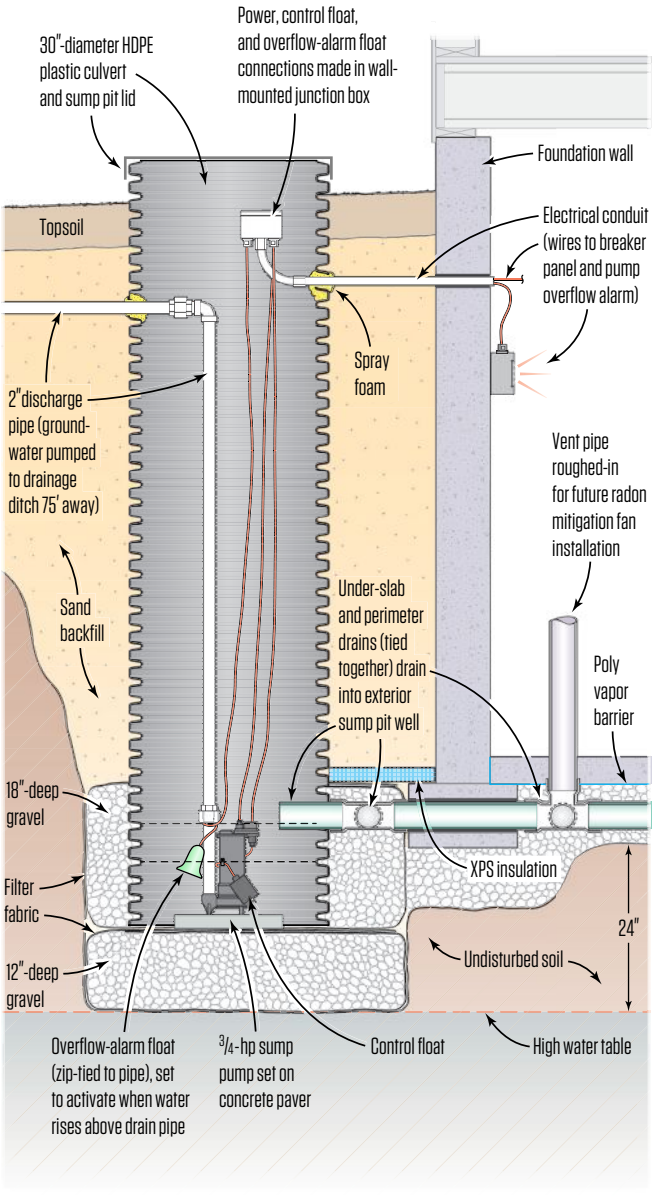
Sump-pit install. With the perimeter and under-slab drains joined, we excavated the sump-pit area. We dug beyond our planned sump-pit depth to first install a 12-inch lift of gravel wrapped in filter fabric. Next, we ran a short length of pipe from the drains to our sump location and then moved the 30-inch-diameter high-density-plastic culvert into place, first cutting a slot in its bottom edge in order to slip it over the drain pipe **(4)**. We wrapped the cut slot in filter fabric, then installed a second lift of gravel 18 inches deep to help stabilize the vertically installed culvert until it was backfilled with sand.

Connecting the pump. After backfilling and running a 2-inch PVC discharge pipe and electrical conduit to the sump, my crew hoisted me into the culvert. I'm a big guy and a 30-inch-diameter space is a tight fit, but I managed to set our 3/4-hp sump pump on a concrete paver to elevate it above the gravel, and then connect the pump's discharge pipe, which leads to a roadside ditch roughly 75 feet away. Working from above, a crew member screwed a junction box near the top of the culvert **(5)**, while I set the pump's control- and overflow-alarm float lengths. We made our power and control connections from the pump and house at the box, then fastened a 30-inch-diameter hard plastic lid to the culvert.

The sump has an overflow alarm, which is located near where the conduit passes through the foundation. This is right next to the home's septic alarm, since the site's high water table also required engineered mound septic systems.

Josh Girard owns and operates North Country Construction, in Jericho, Vt.

Exterior Sump Pit



The foundation holes were dug 24 inches above the historic high water-table line while the bottom of the sump pits were set 18 inches below the top of the footing. Potential groundwater will be discharged into drainage swales 50 to 100 feet away from the development's seven sump pit wells. Pump activation can be fine-tuned by adjusting the length of the float lines.

A Multivista technician uses a Matterport scanner and an iPad to create an accurate, photo-realistic virtual model of a Risinger Homes building under construction in 2018. At the same time, the tech is taking high-resolution still photos of some locations, which can be keyed to the virtual model of the building.

As-Built Documentation on Steroids

BY TED CUSHMAN

There comes a time in every construction project when everything that's built into the walls and ceilings—wires, pipes, ductwork, all of it—disappears forever. You stuff the cavities with insulation, you hang drywall over the studs, and all the framing, wires, and pipes are buried. After that, if there's a problem inside those walls, you kind of have to guess about what's where—guided only by drawings that may or may not reflect what was actually built.

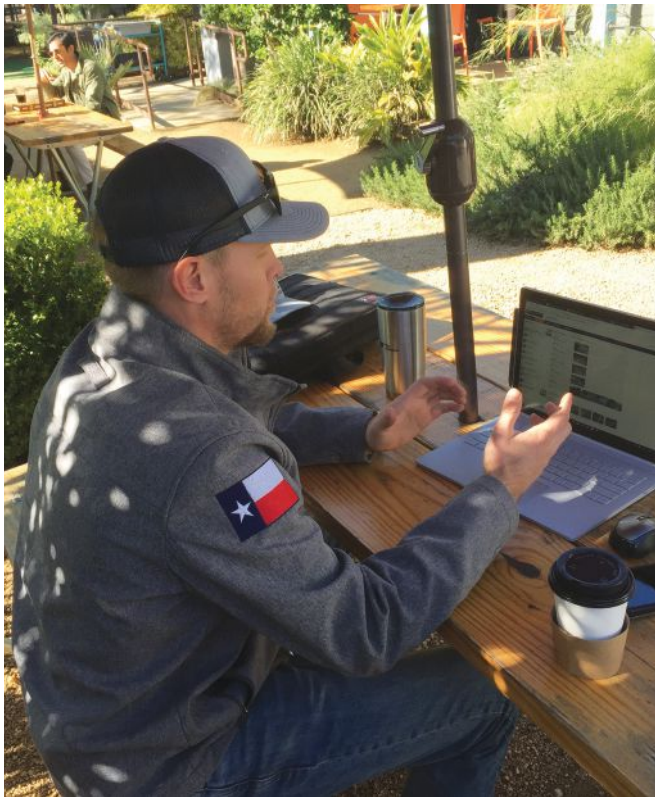
At least, that's how it used to be. But not anymore. Nowadays, it's possible to make detailed, accurate three-dimensional photo records of a house the day before everything is covered up. Technology is revolutionizing the face of construction documentation.

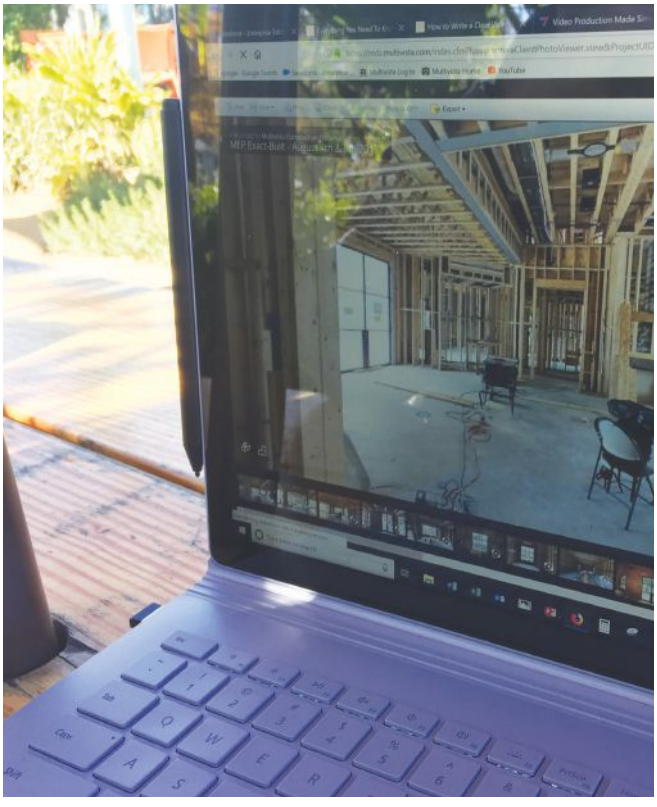
The photos at left show a technician for Multivista, a construction documentation firm, creating a three-dimensional photo record of a house under construction by Risinger Homes in Austin, Texas. *JLC* had gone to the job for another reason, but when we saw the Multivista crew at work, we were curious. So we sat down with John Whitton (j.whitton@multivista.com), a Multivista contractor in the Austin market, for some explanations.

"The way the business was built was from an electrician in Victoria, British Columbia, who always—just for his own purposes—took photos before the walls were covered as proof of his work installations and stuff, and he would save them in folders on his computers," said Whitton. "And then homeowners who noticed him taking the photos, years later would reach out to him and say, 'I remember you taking photos inside the walls, can I see those photos? I am trying to solve some issues.' Well, after that happened a couple of times, he thought, 'Man, I really think I could build a business on this idea, taking photos, and if I could link them to the floor plans that would be great, so you could tell exactly where you're at within a home, or within a construction project.'"

That inspiration grew into Multivista, a franchise operation with dozens of franchisees around the United States and in Europe. With two co-managers and seven photographers on staff, Whitton's franchise now handles the market in Austin and San Antonio. "We offer

Photos by Ted Cushman/JLC





Multivista contractor John Whitton logs on to a project model over Wi-Fi at a coffee shop in Austin, Texas. The interface gives password-protected access to project documentation wherever there's an Internet connection.

a product and a service," said Whitton. "Our product is our online platform, where you can access the photos, you can add your own photos, you can share the photos, you can email them, and you can send links to people with any number of photos attached to that link, so they can only see those photos."

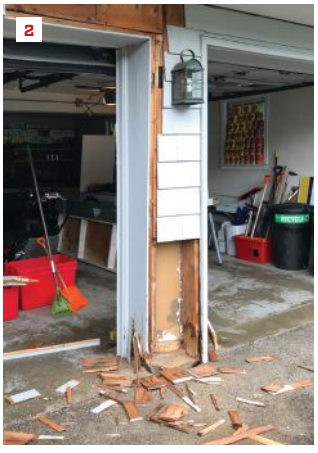
The fly-through 3-D photo model of each project shows the real condition of the walls and ceilings the moment before everything is closed up.

The service is a construction documentation process. "We coordinate with the construction team to be out there on site at the exact moment after everything has been inspected inside your walls, but just before you stuff insulation or you drywall," said Whitton. "We wait until everyone is done working in the wall, come out and take our photos, then they insulate and drywall, and we do it without affecting their schedule. We can shoot photos pretty quickly. So we create the best visual as-built that is possible. We cover every square inch of the building. And then we link those photos to the floor plans of the project, and then we store them, or we host them online in an easy-to-use mobile application and desktop application."

From the original solution of a collection of still images keyed to a floor plan, the technology has evolved. Now, Multivista technicians bring a sophisticated 3-D image capture device to the job. "Matterport (matterport.com) is the technology," said Whitton, "and we have a strategic partnership with them. It's the same technology used in real estate to create virtual-reality walk-throughs; the only difference is that, in our case, we're walking you through the building under construction, instead of when it's finished."

"There are a few different ways that we document," said Whitton. "We capture exact moments in time—for instance, just before you pour concrete, we will come out and take photos of what's inside that concrete so you can look back into those systems. You can basically have X-ray vision of what's inside the concrete. But then we also offer progress photos, where we come out once every two weeks, or once a month, and we take the same photo from the same location, so that when you click on an arrow in the model, up pops a photo, and when you choose 'progress,' up pops a string of photos, so you can see the building from the same perspective over the course of the project duration."

Ted Cushman is a senior editor at JLC.



After being struck by a car, the garage support showed signs of internal rot as well as structural damage **(1)**. The author peeled back the siding and sheathing to find that the support framing had been placed directly on top of an untreated 4x6 timber that had rotted **(2)**. Before doing any more work on the support, the author propped up the continuous 6x12 header spanning the openings with a pair of house jacks **(3)**.

Close Encounter With a Garage Support

BY EMANUEL SILVA

Stuff happens, or at least that's what I told myself when a client called to tell me that his car bumper had accidentally clipped the trim on the support between his two garage bays. I went by that afternoon to check it out, figuring that I'd probably only have to replace some damaged trim. When I got there and took a closer look, I realized how close he might have come to bringing the entire house down on top of him.

Investigation. The first thing I noticed was that the siding and sheathing had separated from the bottom of the support **(1)**. The boards on the side jambs of the garage door opening appeared to be rotted at the bottom. I tore back the sheathing and siding and saw that the support had been framed on top of an untreated 4x6 timber in direct contact with the ground **(2)**. The aprons for each of the garage bays had then been poured around the support. The timber had totally rotted and the studs were well on their way.

The continuous 6x12 header that spanned across both garage bays was marginally large enough to support the garage opening and carry the weight of the house structure above. But to be safe, I got out my house jacks and set them up on either side of the center support to help carry the load while I repaired the support **(3)**.

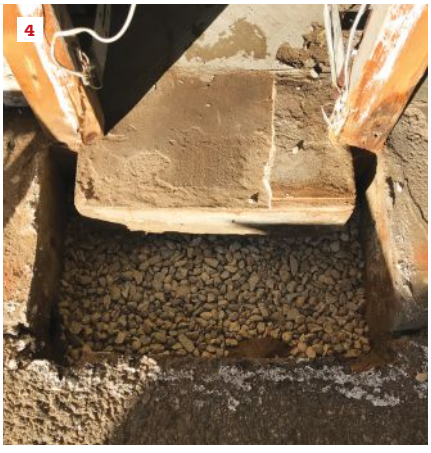
Pouring a footing. With the opening reinforced, I took out the rest of the rotted lumber and cleaned away the debris from the hole. To give the support a solid base and to raise it above the ground, I wanted to pour a concrete footing. I began by excavating down between the aprons, then added a layer of crushed stone on the bottom of the hole **(4)**.

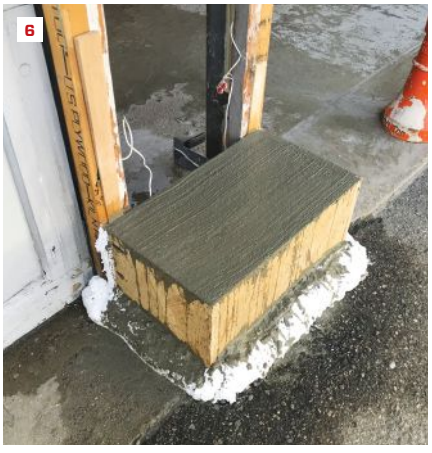
Next, I drilled holes into the edge of the garage slab as well as into the sides of the aprons and epoxied lengths of 1/2-inch rebar into the holes. I then tied the lengths together where they overlapped in the center of the hole.

I wanted the footing to extend well up above the aprons and the asphalt driveway, so I built a rectangular form out of 3/4-inch OSB that was 8 inches tall. I shimmed the form level in both directions across the top and then tacked the form to the 2x4s holding the door track **(5)**. I filled the irregular gaps between the base of the form and surrounding concrete and asphalt with spray foam.

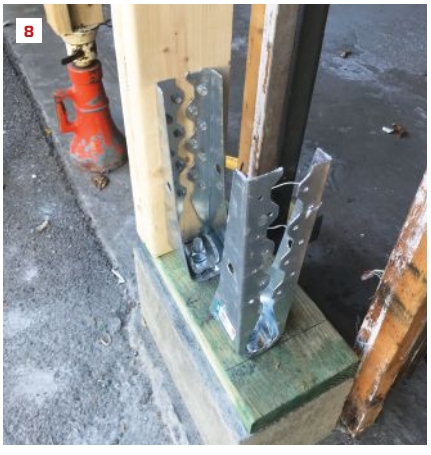
After mixing the concrete and filling the forms, I gave the top surface of the footing a broom finish **(6)**.

Photos by Emanuel Silva





The author cleaned away the rotted wood, dug out the hole, and added a layer of crushed stone **(4)**. He epoxied rebar into the garage slab as well as the aprons **(5)** before forming and pouring the concrete footing **(6)**.



After letting the concrete cure, the author capped the footing with a treated 2x8 sill **(7)**. He drilled and epoxied galvanized hold-downs into the concrete footing **(8)** and drove special lag screws to secure them to the bottoms of the new support studs **(9)**.

I let the concrete cure for about a week before coming back to strip the forms. I wanted the concrete green enough that I could nail and drill into it easily, but I didn't want it to chip out.

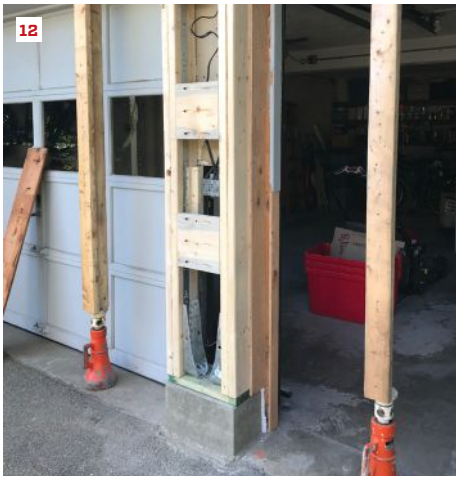
Framing and hold-downs. Reframing the garage support started with a section of treated 2x8 that I tacked to the footing as a mudsill **(7)**. The original support had a single 2x6 on either side, with additional 2x8s that acted as the finish surface for the openings. To create adequate support, I planned to use double 2x6s from the footing to the header on both sides of the support. I started by measuring and drawing a line 3 inches from each end of the sill.

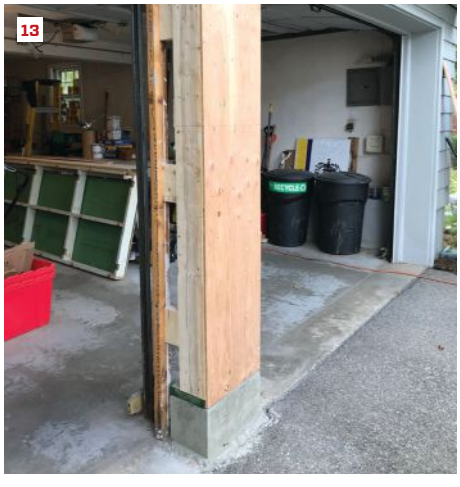
With the ever-present possibility of cars rolling into the support, I did not want to depend solely on nails for the connection between the support studs and the sill. So I reinforced the attachment to the sill with a pair of Simpson Strong-Tie HDU hot-dip galvanized hold-downs. The hold-downs are fastened to the sill (and to the footing) with 5/8-inch-diameter bolts, so I positioned the hold-downs on the lines inside the studs and drilled holes for the bolts. I epoxied the bolts into the holes and installed the hold-downs **(8)**.

Next, I plumbed up to the header to locate the positions for the double 2x6 support studs. After cutting the studs to length, I nailed them in place **(9)**. I drove the SDS lag screws that came with the hold-downs to anchor them to the studs.

Tying the support to the header. I was confident that the hold-downs would do a good job resisting the impact of a car

Flat straps attached with structural screws to the hold-downs and to the inside faces of the support studs reinforce the framing assembly **(10)**. At the top, shorter straps reinforce the connection between the studs and the header **(11)**.





Solid 2-by blocks span between the studs on either side of the garage support to add rigidity **(12)**. The treated sill had been kept back 1/2 inch from the face of the footing so the sheathing could be installed flush **(13)**. The exterior of the support was finished with cedar shingles and PVC trim to match the house.

bumper at the bottom of the support, but I worried that without reinforcement, the studs could crack in the middle or separate from the header at the top. So I installed 16-gauge SST HTP straps to strengthen the sides of the studs, attaching the straps to the hold-downs at the bottom and overlapping a couple of lengths to within an inch or so of the tops **(10)**. These straps are screwed to the studs with the same SDS lag screws that I used to attach the studs to the hold-downs. SST HRS straps designed to be attached to the edges of 2-by stock reinforce the connection of the studs to the header **(11)**.

To finish the framing, I cut and installed solid blocking that I pocket-screwed to the double studs. To anchor the garage door tracks, I screwed blocking between the support studs and the 2x4s holding the track **(12)**. Then I nailed 1/2-inch plywood sheathing to the support framing **(13)**.

Finishing up. I replaced the old wooden trim with rot-resistant PVC, finishing the outside face of the support with a short water table with a drip cap. Finally, I installed cedar shingles that blend nicely into the original cedar shingles above the garage doors. The new support perfectly matches the rest of the house, and I'm confident that it won't move in its next close encounter with a car bumper.

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

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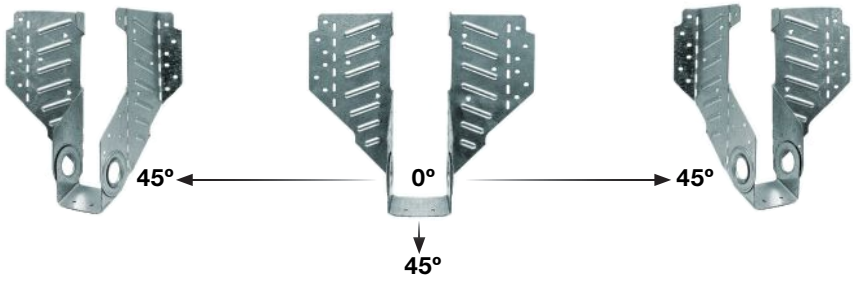

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BY DAVID GERSTEL

Your Best Opportunity for Business Education Might Be in Your Hometown

Over the last few decades, educational opportunities for aspiring builders have proliferated. We now have numerous magazines, books, podcasts, websites, YouTube channels, and conferences. But the most powerful of the opportunities may well be "peer-to-peer" learning groups. Builders are getting together to help one another up their game. As Remodelers Advantage, a respected champion of peer-to-peer learning puts it, builders are discovering "The Power of We."

My own experience with peer-to-peer learning has been with a group that embraced near anarchy as its organizational principle. More typically, however, peer-to-peer learning groups are set up within structured programs offered for a fee by for-profit companies. The services they provide can include conferences, coaching, and webinars. But their key offering to their clients is an opportunity to participate in a group of fellow builders who push one another to higher levels of performance, even acting as members of a board of directors for each other.

The group members typically meet—together with a trained facilitator—twice annually, often arriving from far-flung parts of the country, for a long weekend at the office of the host. They may begin with a relaxed dinner, later gathering to discuss a variety of business issues. One has a problem client. Another wants guidance for working with a skilled but obnoxious employee. A third needs tips on opening a showroom. Their prime focus, however, is on the financial performance of their respective companies, with group members sharing and evaluating one another's detailed financial reports. Bottom Lines, a program offered by the New England Sustainable Energy Association (NESEA), focuses on a triple bottom line: People, Planet, and Profit. Its members are currently struggling with the challenge of reducing embodied energy in their projects while maintaining durability and operating efficiency.

Meetings organized by the for-profit companies culminate with the group members taking a deep dive into the business operations of the member acting as host. They interview the host's employees and even their clients. They inspect jobsites. They pour over financial records. With their examinations complete, they put the host on the "hot seat" and give them recommendations for eliminating weaknesses and capitalizing on opportunities in their business.

Membership in these groups does not come easy or cheap. Participation requires courage. As a fiercely loyal member of one group put it, "You must be willing to be vulnerable. You have to be able to put aside ego and say 'I don't know everything about this business. I want to be better, and I need help.'"

The companies that organize the groups can demand discipline. One of the best established companies pushes its members to make specific commitments in writing to improve their businesses and to live up to those commitments. Sometimes people in a group quit because the pressure to change is too great. In one group run by a company that is now out of business, a member became so distraught during their turn on the hot seat, they began weeping.

However, because groups typically meet only twice a year, a new member may not have to take their turn on the hot seat for several years. That gives them time to get comfortable with the prospect. Meanwhile, they are learning from the reviews of the other companies in their group.

The dollar costs for membership in groups organized by for-profit companies are substantial. With travel expenses figured in, costs can run near $10,000 a year, though with some of the companies or for smaller-volume builders, membership can be around $3,000, or less.

COLLABORATING WITH THE COMPETITION?

Bottom Lines, the peer-to-peer program offered by NESEA and founded by Paul Eldrenkamp, John Abrams, and Jamie Wolf, does not emphasize a noncompetitors' angle when recruiting new members. Competition, Paul says, is "an issue really not worth worrying about. It's a potential fear for a new member, but in the end it is not a problem ... If you are running a business with integrity, then there is a responsibility to take advantage of all resources to get better and that includes learning from fellow builders in the same micro-economy."

Paul is himself a member of a Bottom Lines group. It includes a builder who was once Paul's employee. And that builder's office is in the same town as Paul's. Paul is fine with that. "View other builders as colleagues, not competitors," he says. "Do referrals back and forth. The point is to grow your business to the point that people are coming to you because they want you."

Notwithstanding the costs and the challenge of taking the hot seat, many builders who have participated in peer-to-peer education groups believe they made a good investment. One told me that when he joined his group, he was working 90-hour weeks and struggling financially. With his group's guidance, he cut his work hours by almost half and began to make a good living. Another explained, "You make less mistakes when you hang around with people who have made those mistakes." He has been a member of his group for four years and treasures not only the meetings, but the chance to contact fellow members at any time and ask them for guidance. He values them as friends, and he feels himself to be part of a community.

What bound us together was a willingness to share. We gathered to break down the walls that had existed between builders, and seized on the advantage of working together.

The owners and staff of the for-profit companies work steadily to recruit new members for their groups. Their marketing usually (not always) emphasizes that if you join one of their groups you will be meeting with builders who operate in locales distant from your own. They believe that builders will balk at letting direct competitors see inside their companies and will be more comfortable sharing with those from distant places. Distance, says one veteran group facilitator, helps dissolve a psychological barrier to sharing. Most builders, she insists, "will not share numbers with people in their own community."

While I have come to appreciate the benefits of participation in the groups organized by the for-profit companies, I do wonder about their insistence on "non-competing." My own experience with peer-to-peer learning suggests that sharing with competitors can likewise offer great benefit. The members of the group I participate in operated in the same territory, the San Francisco Bay Area. Often, we were interviewed for projects by the same clients and designers. But we brushed aside the fact that we were nominally competitors. We embraced the realization, as one member put it, that you benefit by "breaking bread" with other builders from your hometown.

We called our initial group the Splinter Group. It was formed some 35 years ago. Several then-young builders splintered off from an association sponsored by a national construction organization because they found its ethics "appalling" and were not getting the mentoring they had hoped for. And so was born, recalls Deva Rajan—one of the initiators of the group—"a movement of young men who were determined to focus on high-quality craftsmanship, giving people really good value, and building reputations for operating with integrity."

Splinter grew to include construction companies of all sizes, from classic belt-and-suspender operations (gifted carpenter with dog riding shotgun) to those strong enough to lose 200 grand or more on a project, survive to tell the story, prosper, and grow. What bound us together was a willingness to share. "That is what motivated us," says Rajan. "We gathered to break down the walls that had existed between builders. We began to catch a glimpse of the advantage—and then we seized on it—of working together. That is why we flourished ... I never once regretted giving away information about how our company worked."

At first, Splinter was just a few guys meeting to talk over dinner. But even that was powerful. The gatherings were "almost a refuge, a rare chance to engage with your fellow builders," recalls a man who loved those early meetings.

Word spread. More builders joined the gatherings. As Splinter grew, it became apparent that more structure was needed. However, as one journalist wrote, the group had "an extreme distaste for bureaucracies." Therefore, an adamantly counter-bureaucratic protocol was established.

The idea of dues was firmly rejected. We instituted only one regular procedure, an annual "Board of Non-Directors Meeting." Anyone who wished to could attend. At a non-directors gathering, one Splinterite or another would be dragooned into facilitating it. Somehow, they would find themselves at the front of the room, a piece of chalk in hand, writing down suggested topics yelled out by other attendees for the year's coming meetings, then calling for a vote to select eight topics and posting the names of volunteers to lead the meetings.

The gatherings began conventionally enough: First food and socializing. Next a presentation, usually by the host. Next Q & A. Then the special moments began as we drifted into what one member describes as "call and response." Questions were now directed not to the speaker

HOW TO CREATE A HOMETOWN SPLINTER GROUP

- Ask a few trustworthy fellow builders if they would like to get together for dinner and share ideas about construction and business management.
- Let the group grow as members spontaneously invite other builders to the gatherings.
- When necessary, put a bit more structure in place.
- Establish one office, a Keeper of the List, who will maintain a list of the contact information of all members.
- Hold an annual Board of Non-Directors meeting to select topics for the year's gatherings.
- At the meetings, select a year's worth of topics and a person to lead each of the gatherings.
- Otherwise, resist bureaucratization.
- Host your meetings in attractive spaces.
- Don't allow architects or other designers (and probably not even subs) into your group.
- Encourage the code: No member ever takes advantage of what is learned in the group to ace another member out of a job.
- Don't charge dues.

but to the group at large and ranged far beyond the evening's topic. Members would describe issues and challenges they were facing. Others would offer their solutions to similar problems—often, and especially valuable, divergent solutions. "I always loved that segment of the meetings. The honest disclosure was so valuable—and possible only in a room where you could trust everyone to have your back and your best interests at heart," recalls one Splinterite, voicing the views of many.

The trust was vital. We had to be able to count on one another not to take information from a meeting and use it perniciously should we find ourselves being interviewed for the same project. Though never written down nor even much articulated, that was our code. You violated it at your peril, risking being despised by or even expelled from the group. So far as any Splinter member I have talked with has been able to recall, only two people violated the code in a serious way. Fittingly, they seem also to be the only two Splinter members to have gone bankrupt.

With the trust in place, a great range of subjects could be openly discussed—both in Splinter and in the smaller groups it eventually gave rise to. We shared financials including labor rates, markups for overhead and profit, gross revenue and gross margins, the salaries we paid ourselves to run our companies, and the percentages of profit we shared with employees. We even provided reports of our net worth. We reported the number of hours it took us to estimate our various types of projects. And we pooled our contracts, comparing clauses and discussing how to best protect ourselves on projects requiring AIA documents.

Rather than dogmatically pushing "best practices," we just laid out our differing approaches to handling issues, leaving it to one another to take what was useful while leaving the rest (quite like 12-step groups, a visiting journalist mused). Several members, for example, described their varying tactics for obtaining clients' budgets before investing much time with them. But another explained that he never even brought up budget, preferring to plunge right into guiding a prospective client with the confidence that money would somehow emerge and that he would build the project.

We happily reported our successes to one another. Most importantly, we shared our challenges and setbacks. One Splinterite described the missteps that cost him $175,000 on a job, giving us all to understand the danger of simultaneously moving into too many unfamiliar territories—in his case from residential to commercial, from general contractor to subcontractor, and from his own contract and change-order procedure to much less accommodating protocols.

The sharing went well beyond the meetings. Did you need an extra carpenter for a few days? One of your Splinter friends would ask one of his guys if he would be willing to move over to your project temporarily to lend a hand. Did you need a good sub? With a few phone calls, you would get several recommendations. Were you interested in a new software product? Someone in the group who was already using it would be glad to tour you through it.

All in all, Splinter's experience indicates that, while you can certainly learn from builders operating in markets distant from your own, there is an also an advantage to sharing with builders in your own micro-market—with men and women who work with the same designers, who understand the expectations of clients in your market, and who must navigate through the same building departments.

For all its strengths, the Splinter Group began to subside after 35 years. One member theorizes that the group grew too large and unwieldy. Its membership had briefly swelled to more than 400, including numerous "carpetbaggers and opportunists" who swept into town looking for contracts in the Oakland fire zone, where several thousand houses had burned to the ground.

The trust was vital. We had to be able to count on one another not to take information from a meeting and use it perniciously should we find ourselves being interviewed for the same project. That was our code. You violated it at your peril.

Additionally, as I see things, we made several mistakes of governance. We moved our meeting from a pleasant restaurant to a dismal room provided by a local lumber company where no craft-loving builder would happily spend time. And, most seriously, in our commitment to open membership, we let architects, engineers, and subcontractors into the group. The subs were there to look good to general contractors and win them as clients. The generals wanted to wow the design professionals, and vice-versa. Now the confessional nature of the group was impaired as Splinter transformed into a networking and marketing venue. Attendance at meetings declined and finally the group ceased to exist.

But like an old oak laying itself down, Splinter threw out acorns that sprouted into vigorous saplings. It gave birth to smaller groups—the Slivers, as we named them. A number of those successor groups are thriving today and continuing to foster the success of collaborating competitors. Steve Nicholls, a Sliver participant to this day, was one of the initiators of the original Splinter. At the time, he was not far removed from his years as a finish carpenter. Now he heads a residential construction firm that did $22 million worth of work in 2017. He is grateful for his success and credits it in large part to his participation in the Splinter group, to "having those mentors available," he says.

I credit Splinter with much of the good fortune I have been blessed with as a builder and an author. I am grateful for the support of an alliance of craft- and freedom-loving builders who helped me along my way. There is no reason why you can't enjoy a similar experience. That's the case even if you are already richly benefiting from participation in a fee-based peer-to-peer program. All it will cost you is the price of a dinner every six weeks and the small amount of effort needed to kick-start your hometown Splinter group.

David Gerstel is the author of Running a Successful Construction Company *and of* Nail Your Numbers: A Path to Skilled Construction Estimating and Bidding. *You can learn about the books or contact David at DavidGerstel.com.*

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BY TED CUSHMAN

Makeup Air for a Kitchen Range Exhaust Hood

The restaurant-grade vent hood for this custom home pulls 600 cfm from the kitchen **(1)**. A makeup-air duct dumps into the living space **(2)**. Controls are wired to match intake fan speeds with the kitchen exhaust **(3)**.

Photos and illustration by Tim Healey

It's a problem custom builders face more and more often. You're building a high-performance home with advanced airtightness and insulation details. But your clients also want a trophy kitchen with a commercial gas range and a commercial-grade exhaust hood. The hood they've chosen can pull 800 or 1,000 cfm from the space. But in an airtight house, where does that air come from?

The building code has evolved to take this problem into account. The 2015 International Residential Code (IRC), Chapter 15 (Exhaust Systems), reads, "Exhaust hood systems capable of exhausting in excess of 400 cubic feet of air per minute ... shall be mechanically or naturally provided with makeup air at a rate approximately equal to the exhaust air rate. Such makeup air systems shall be equipped with not less than one damper. Each damper shall be a gravity damper or an electrically operated damper that automatically opens when the exhaust system operates. Dampers shall be accessible for inspection, service, repair and replacement without removing permanent construction or any other ducts not connected to the damper being inspected, serviced, repaired, or replaced."

Makeup-air requirements for range hoods are new in the code, and not every municipality has caught up. But whether makeup-air rules are enforced or not where you work, it's well worth your while to consider the implications of a high-powered range hood. In conventional homes, range hoods can backdraft fireplaces and combustion equipment. In an advanced house, a range hood's power can easily cause reverse air flows on a bath fan or overwhelm an energy recovery ventilator (ERV). Reversing a bath fan can lead to comfort and moisture problems in the bath, and interfering with an ERV can cause moisture problems throughout the house.

The issue came up this year on a large custom home under construction by Vermont builder Hayward Design Build on the shores of Lake Champlain. The home's blower-door test came in at about 0.7 ach50, says Jim Bradley, Hayward's manager for building-science issues. "So we're down near Passive House levels of airtightness."

Here's the wrinkle, says Bradley: "This house is getting a gourmet-quality kitchen. This cooktop is going to have 168,000 Btu worth of burners, restaurant quality, with a restaurant-quality vent hood. We're looking at a 600-cubic-foot-per-minute (cfm) outflow, on a house that's going to be super-tight." That 600 cfm of exhaust is "guaranteed," says Bradley: The unit can sense airflow and ramp up to as much as 900 cfm at the intake point in order to achieve an effective outflow of 600 cfm.

Knowing how tight the house was going to be, Bradley was concerned. Fresh air for the house was to be supplied by four pairs of Lunos e2 ERV fans, plus one Lunos Ego unit in the bath. Lunos units alternate between drawing in air and expelling air, with an energy storage core serving to recover heat. But the kitchen fan could easily have overcome the small, low-voltage fans on the Lunos systems, causing them all to admit outdoor air at the same time and disrupting their heat-recovery functioning. "This could have been a building-science nightmare," Bradley says.

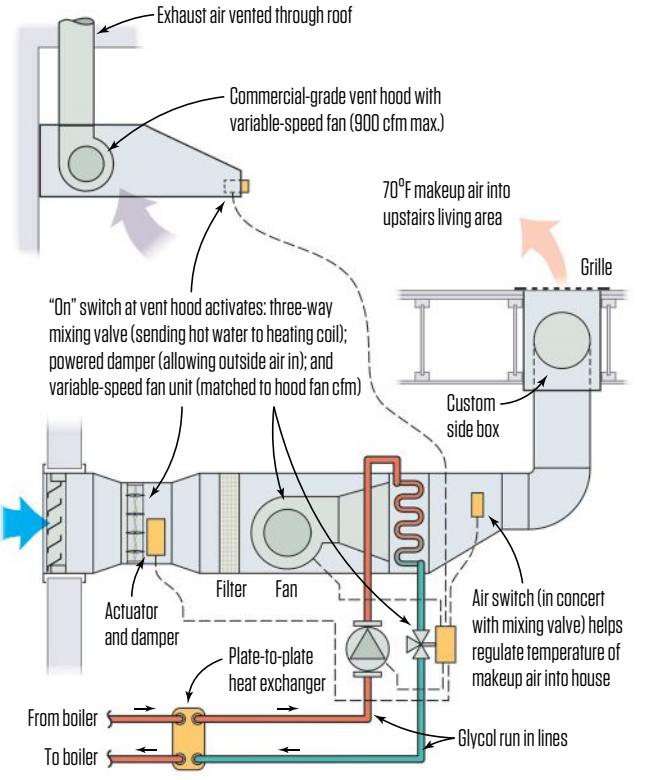
Bradley turned to Paul Blanchard at wholesaler F.W. Webb's branch office in Williston, Vt., for guidance (fwwebb.com). The photos (on page 25 and at right) show the system that Blanchard cooked up, as installed by Benoure Plumbing, Heating & Air Conditioning of South Burlington, Vt. (benoure.com). Complicating the problem was the fact that this house, built on a superinsulated slab, has no real basement aside from a small 12-foot-by-12-foot under-floor area for mechanicals. It was into this mechanical space that Bradley and Blanchard had to squeeze their makeup-air duct system.

A dampered louver at the exterior wall is controlled by a relay that's wired into the switch for the kitchen range hood. Also wired to the kitchen switching is a control for the intake fan. Bradley says, "We were able to tie into the low-voltage control at the hood, and we ran wires all the way back to the basement so that when the cook selects low, medium, or high, it will cause the combustion air makeup fan to ramp up accordingly. It's designed to marry what is going on at the vent hood."

Vermont has cold winters, and dumping 600 cfm of fresh air into a heated room in the dead of winter could cause some discomfort. For that reason, Blanchard provided for heating the makeup air by placing a hydronic heating coil in the duct run between the outdoor intake and the floor grille where makeup air emerges into the upstairs living area. The heating coil is equipped with a thermostat and control circuitry that senses the indoor temperature and the temperature of the indrawn outdoor air, and it warms up to temper the incoming air as needed.

Ted Cushman is a senior editor at JLC.

Makeup Air Schematic



Under the floor, a fan draws outdoor air into a duct and passes it over a heating coil **(4)** before directing it up into the home's living space. Controls open the intake damper, adjust the fan speed, and activate the heating coil as needed (see illustration, top).

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Craftsman-Style Wainscot

Clean and simple details for this classy wall treatment

BY GARY STRIEGLER

One of the things I enjoy most about my job as a custom builder is getting to know my clients and coming up with trim details that match their individual tastes. Recently, a client shared a picture of what I call Craftsman wainscot, which, according to the Gary Katz article "Correct Height for Chair Rail and Wainscot" (Aug/17), isn't wainscot at all but rather wall paneling. I have done a lot of raised-panel and flat-panel wainscot at the much lower and more traditional heights. Typically, the panels in classic wainscot are horizontally oriented. The wall treatment in my client's photos, however, featured an upper short panel over a much taller lower panel, with a cap rail that lined up roughly with the tops of the door and window casing. Classic wainscot usually dies into any built-in cabinetry, but the extra height of these panels meant that they would step up and over any built-ins. To complicate matters, these wall panels would be stained.

CAREFUL LAYOUT

As with any other finish carpentry project, I needed to start with a careful layout for a successful finished product. I knew for certain that the paneled sections would be vertically oriented, and I also knew that they needed to be fairly wide.

I began the layout on the longest wall, aiming for panels that would be at least 30 inches wide. Because the 1/4-inch-thick plywood panels would be rabbeted into the backs of the frames, I

Photos by Gary Striegler

The author first draws a full-scale layout of the wall panels, getting proportions right and making sure electrical boxes fall in the field of the flat panels **(1)**. Starting with the longest wall, he cuts and assembles the frames face down on the floor in front of where they'll be installed **(2)**. Assembly moves along quickly with pocket-screwed joints, which don't require long clamps.

Two routers are fitted with different bits **(3)** to cut the rabbets for the plywood panels **(4)**. The first pass, done with the bit with the large bearing, makes a shallow cut and leaves a clean edge **(5)**. On the second pass, the router bit with the smaller bearing finishes the rabbet, hogging out the material to the full width of the rabbet **(6)**.

allowed for 3/4 inch of overlap at each inside corner.

I decided on 2 1/2-inch-wide stiles with a 3-inch top rail, 2 1/2-inch intermediate rail, and 4 1/2-inch bottom rail. The height of the panels would be set to leave 2 inches of the bottom rail exposed with the baseboard installed. Another factor in the layout was to make sure any electric outlets and switches fell in the field of the plywood panels. On larger walls like this one, I always do a full-scale drawing on the wall to make sure the proportions look right **(1)**.

BUILDING THE PANELS

After finishing the layout, my partner and I tackled the panels for the longest wall. Building a frame this large was easiest to do on the floor directly in front of the wall we would install it on. We cut all the stiles and rails from poplar stock that we purchased at 13/16-inch-thick (the extra thickness gives the pocket-screwed joints a lot more strength). Pocket screws let me assemble the frame one joint at a time without having to use long clamps **(2)**. My biggest


7


8


9

Instead of using a chisel to square up the rounded rabbet corners left by the router, the author just clips the panel corners with a miter saw **(7)**. Before dropping the panels into the frame, a crew member carefully applies a bead of glue to the rabbet and spreads it thin to avoid squeeze out **(8)**. Medium crown staples hold the plywood panel tight against the frame while the glue dries **(9)**.


10


11

To reference electrical-box locations, the author plumbs down from each box with a level, marking the locations on the floor **(10)**. Then he measures to the top and bottom of each box and marks the measurements next to the plumb marks **(11)**. When the panel section is lifted into place, he merely reverses the process to locate and cut out the boxes.

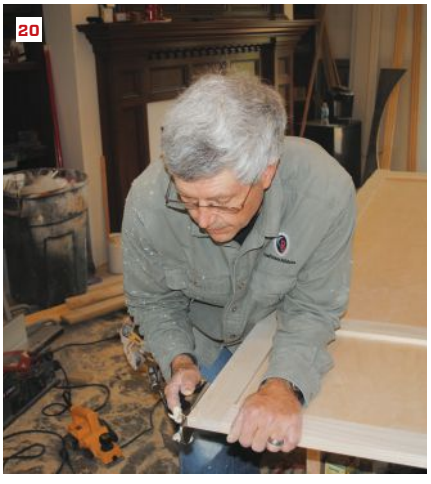
Lifting the long panel section is a two-person job **(12)**. Once the panel is in position, the author nails it to the wall framing **(13)**, and then, because the panel is assembled face down, he gives the joints a light sanding **(14)**. Guided by his reference marks on the floor, he uses a level and a square scrap of plywood to help locate and mark the electrical boxes on the panels **(15)**. After verifying box location by cutting a small center hole, he finishes cutting out the boxes with a multi-tool **(16)**.

concern was keeping the screws far enough back from the edge to stay clear of the rabbet, which we cut after assembling the frame.

This type of wainscot has very clean lines with no panel molding, so the rabbet cuts had to be crisp with no tear out. I decided to cut the rabbets in two passes with two routers **(3, 4)**. The first pass cut a 1/4-inch-wide rabbet 3/8 inch deep, establishing the clean, crisp line on the inside edge of the frame **(5)**. The second router hogged out the rest of the material, taking the rabbet to its full, 1/2-inch width **(6)**. As I routed the panels, I did my best to stay focused: One slip of the router could ruin the frame.

Next, we cut the birch plywood panels to size using both a track saw and a table saw. The routers left the rabbets with rounded corners, so we clipped the corners of each plywood panel on a miter saw to let them drop in **(7)**. Because the paneling would be stained, we tried to match the grain pattern from the lower panel to the upper one. We lightly sanded each panel, applied a light bead of glue to the rabbeted frame **(8)**, and dropped the panel into place, using plenty of medium crown staples to hold it in position while the glue dried **(9)**. To avoid squeeze out, we were careful not to use too much glue.

Because the plywood panels wouldn't fully contact the drywall, we tacked thin shims to the wall around electrical boxes. Before lifting the panels into place, we plumbed down from the boxes and marked their locations on the floor **(10)**, along with the vertical measurements to the top and bottom of the boxes **(11)**.



Layout for the side panels is similar to that for the long one **(17)**, though the smaller panels can be assembled on a worktable rather than on the floor **(18)**. For a tight fit, the author scribes the corners with a pencil flat against the adjacent frame **(19)**, then cuts the panel to the scribe line with a block plane held at a slight bevel **(20)**. After nailing the panel to the wall framing **(21)**, he finishes up the installation by locating and cutting out the electrical boxes, as he did on the long wall **(22)**.

Instead of using a wide bottom rail and then covering it with baseboard, we nailed spacer blocks to the wall framing to hold the frame at the proper height. Lifting the frame was a two-person job **(12)**. Once it was up and in place, we attached it to the wall framing with 2½-inch finish nails **(13)**, shooting a few extra nails in at the corners to pull the frame as tight to the wall as possible. Because we assembled the frame face down, we sanded it after it was installed **(14)**.

Once the frame was set, I laid out the electrical-box locations, plumbing up from the floor with a level and marking each box with a square scrap of plywood **(15)**. Using a multi-tool, I cut a small hole in the middle to verify my measurements before carefully cutting out the whole box **(16)**. The electrician would install box extenders to cover the exposed wood when he did his finish work.

THE REST OF THE PANELS

The other panels in the room were smaller, so after doing the wall layout **(17)**, we built them on a worktable **(18)**. I made these panels just a little wide so that I could scribe-fit the corners. After setting a panel in place, I marked the scribe by running a pencil flat against the adjacent frame **(19)**. I then trimmed to the scribe line with a block plane **(20)**, back beveling the cut slightly to ensure a tight corner. After nailing the panel in place **(21)**, I located and cut out the electrical boxes using the same method as before **(22)**.

To let the horns of the window stool wrap onto the panel frames, the author installs the stool after completing the side panel installation **(23)**. He then pads out below the window to allow the window panel to step out from the side panels **(24)**. With the window panel nailed in place **(25)**, the step-out detail adds a decorative accent when finished with baseboard.

The double window in the room got its own treatment, and I waited to set the stool until both side panels were in place **(23)**. The horns of the stool notched over the panels by 1 1/4 inches, and the panel under the window overlapped the side panels by 3/4 inch at each end. To support the panel under the window, I installed plenty of blocking, which let the panel step out from the side panels **(24)**. This panel fit tight under the window stool, and the step out created some nice outside corner details for the baseboard molding **(25)**.

When all the panels were installed, I finished off the top edge with a three-step cap molding, using a rabbeting bit in my router to create the steps. This style of paneling is simpler and less ornate than the traditional frame-and-panel work that my clients typically ask for. Getting the proportions and little details right makes all the difference when creating a clean look—less really can be more.

Gary Striegler owns Craftsman Builders, in Fayetteville, Ark., and teaches workshops at the Marc Adams School of Woodworking. His website is craftsmanbuildersnwa.com.

Blower Doors for Builders

Whether you're building only to code or going way beyond code, a blower door has become an essential tool

BY JAKE BRUTON

As a builder, I have lots of favorite tools. Often, my crew and I speculate during coffee break about what is the one most important tool that we own. We never decide on an absolute basis; it changes. For a long time, it was an impact driver, then a track saw. It often changes with the task or the job. But for the last few years, for me it has unequivocally been our blower door.

We strive for an extremely airtight home and the blower door not only tells us when we've reached our goal, it has also taught us how to get there with each build. I don't believe my firm would be as good today as we are without owning our own blower door.

Photos by Jake Bruton

CAN A HOUSE BE TOO TIGHT?

I still hear from builders who think we're nuts to strive for extremely airtight homes. And I understand why they might think that—there's a sort of natural aversion to living in an airtight box. Nevertheless, my answer to the question "Can a house be too tight?" is always an emphatic "No." It is only possible to not properly ventilate a home.

The old misconception that a house should breathe has been debunked repeatedly over the last four decades, and that's finally beginning to be reflected in our building codes. We now know that "natural ventilation"—the air that leaks though the cavities and cracks in an old house—is unreliable and never provided sufficient

There are currently two popular blower-door makers selling in the U.S. market—The Energy Conservatory (TEC) and Retrotec. The author runs an older TEC model (left); the HERS rater he often works with runs a Retrotec (right). Both work well, though there are numerous small features offered by each company that differentiate these products. In the author's estimation, which one someone trains on first is usually considered the "best."

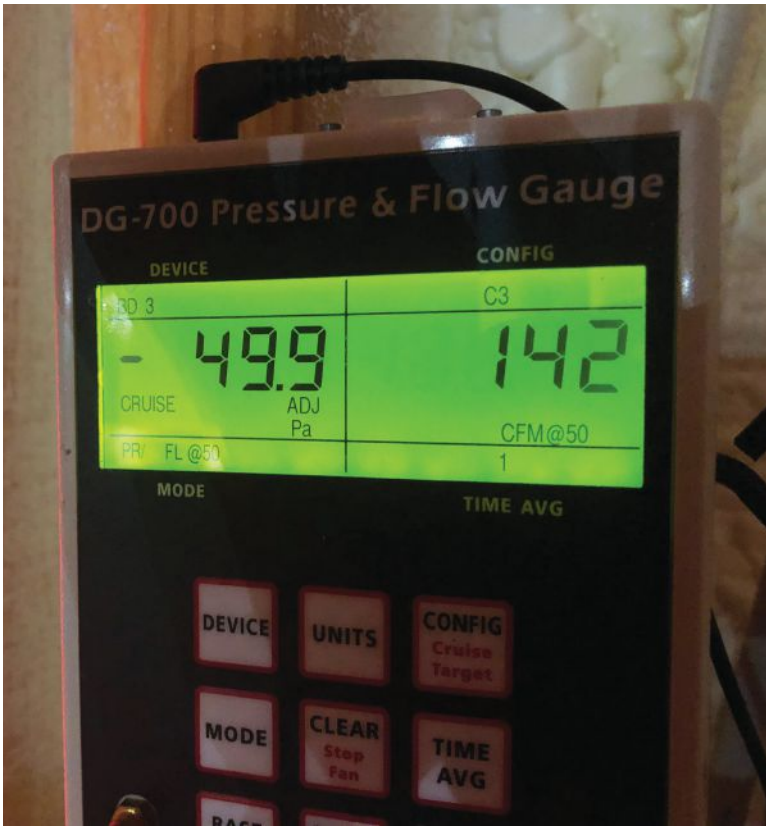
fresh air for healthy living. It certainly didn't provide any comfort, to say nothing of the energy it wasted. We should be building tight homes and controlling the air with mechanical ventilation. We not only want to control the rate at which we bring in fresh air, but we also want to filter and condition any air entering our homes. And, where feasible, we want to recoup as much energy as we can from the stale air we exhaust out of the home. It's all about control. The alternative, that we adamantly want to avoid, is having uncontrolled air—carrying water, pollutants, or all the thermal energy your clients have to pay for—moving through the envelope. Limiting all of those is a good thing.

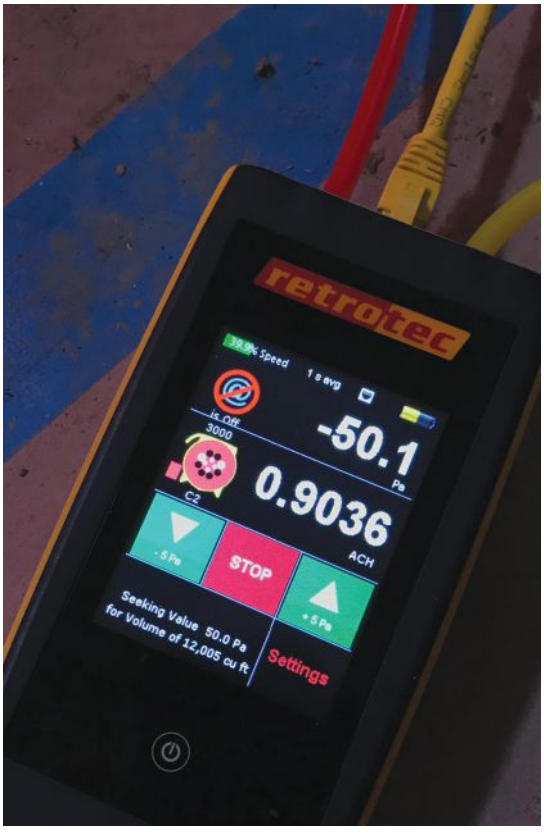
HOW TIGHT IS TIGHT?

The energy code has pushed most builders towards building tighter and ushered in a new era in which blower doors are an essential tool. The 2009 residential energy code (Chapter 4 [RE] of the International Energy Conservation Code, or Chapter 11 of the International Residential Code) instituted blower door testing as one option for showing compliance with the energy code's air-sealing requirement. In 2012, however, it turned blower door testing into the only way to demonstrate compliance. While currently only about half the states in the U.S. have adopted the 2012 code or a newer version, the handwriting is on the wall: All builders will have to get serious about controlling air leakage sooner or later.

The code measures the air leakage of a home in ACH50—air changes (replacement of the total volume of air in a given home) per hour at 50 Pascals of pressure. If you are in climate zones 1 and 2, you must tighten the home until you limit the air leakage to 5 ACH50 or less, and in zones 3 to 8, you need to reach 3 ACH50 or less (N1102.4.1.2).

The reason the minimum leakage rates differ by climate region is that in colder climates, the difference in temperature between





The TEC manometer (left) is reading in CFM, while the Retrotec (right) uses an added input for house volume to read out in ACH. The author prefers CFM, which more directly relates to the leakage level. He performs the calculation to normalize for house volume (ACH50) by hand. During a test, it can be difficult to dial in to an exact "50 Pa.," given the sensitivity of the instruments, but 49.9 or 50.1 are both sufficiently accurate.

indoors and outdoors is generally greater. The greater the difference in air temperature, the more energy you use to condition the air that leaks in, and the more energy you lose when the air leaks out. My firm builds in climate zone 4 and we often experience temperature differences upwards of 80°F in winter.

After those minimum leakage numbers, the two big takeaways from Chapter 11 of the IRC code (N1102.4–N1102.5) are the terms "shall be verified" and "shall be sealed." I covered the "shall be sealed" part in "Air-Sealing That Works" (Apr/18). The "shall be verified" part—blower door testing per the newer code—is critical to the sealing part: Unlike so many other aspects of building code where we can visually verify that, for example, joist hangers, or jack studs, or backflow preventers have been installed, you cannot always see the air barrier. And even if you can see the air barrier, visual inspection can rarely ensure its effectiveness.

For reference, my firm now routinely builds much tighter than code requires. We have built a number of homes with blower-door numbers that have met or exceeded the Passive House standard of air leakage (0.6 ACH50). These homes are basically airtight and that means they are healthier, more comfortable, and more efficient than our competitors' homes in our building market.

TESTING WITH A BLOWER DOOR

The process for verification is simple: We close all the windows and exterior doors, turn off any appliances like the furnace and water heater, turn off the clothes dryer, and shut the dampers and doors on fireplaces. Then we set up our blower door. It consists of a temporary (nylon fabric) door and a large, variable-speed fan that we install in one exterior opening, typically the front door. A small rubber tube connects a port on the fan to a manometer—an electronic device that measures air pressure. A second small tube connects to the manometer, and we position the end of this

Using a Halloween fog machine ($30 to $40 on Amazon), the author and his crew pumped fog into the interior of a newly framed building. By pressurizing the house with a blower door, they were able to identify and seal myriad tiny leaks before those holes were buried in insulation. This allowed them to go from a tight 1.1 ACH50 (the initial test) to a very tight 0.35 ACH50.

outside, somewhere protected from the wind. Then we crank up the fan's speed, with the fan blowing out of the house to depressurize the home. (The fan can also be positioned to blow into the house, which pressurizes the interior of the home.) Because we typically run a depressurization test, the readout of house pressure on the manometer shows a negative pressure. It also shows a flow rate in CFM that gives us a measure of envelope leakage. In essence, the leakage rate is deduced from a comparison of the outdoor pressure to the indoor pressure.

Understanding the math is a little less straightforward. Most blower doors these days can be run automatically using software on a laptop that syncs up with the manometer. Once the baseline parameters of the blower door are entered into the system, a test can be run. That test will provide two data points. One shows that the home is depressurized to 50 Pascals of pressure different from the exterior air, which is the required testing pressure; and the second, a CFM number, shows the cubic feet per minute of air being drawn from within the home at 50 Pascals of pressure.

To get to an ACH50 number, you must calculate the cubic footage of the home. You can get as detailed as you like here. I generally measure the interior space without taking away for interior walls or furniture, for simplicity.

Not wanting to carry a laptop around to jobsites, I opt to run the blower door manually and do the math myself. I have even written the formulas on the back of my instruction booklet to easily refresh my memory. All I need is the volume of the home and the CFM number that is displayed on the manometer readout during the test (see photo, facing page) once the fan is cranked up and the reading from the fan shows the house is at (or very near) 50 Pascals:

Cubic Feet Minute at 50 Pascals (CFM50) x 60 = Cubic Feet Hour (CFH)
CFH / Volume of home (in cubic feet) = ACH50

On homes with very tight envelopes, the author sometimes tests for air leakage with a Duct Blaster—the blower door's tiny cousin—which provides greater accuracy when the flow rate is extremely low. A blower door can also be used effectively for low-flow readings using these two tips (both from Gary Nelson of TEC):

1. Put a bungie cord around the fan to really clamp down on the leakage between the door and fan.
2. Keep a small ziplock bag with a couple of scraps of fiberglass insulation to tuck into the corners of the door panel during tests. This will stop the biggest leaks in the corners.

As an example, this was the calculation for a recent build:

142 CFM50 x 60 = 8,520 CFH
8,520 CFH / 24,300 CF = 0.35 ACH50

This amount of air leakage is equal to an opening roughly the area of a dollar bill in 9,000 square feet of envelope area.

The math is pretty simple. Some blower doors will make the calculation in the manometer for you. My door doesn't (it's a few years old), but I don't mind doing the math myself. It even helps me understand what I am testing because it forces me to think of the variables, such as the volume of air in the house and the rate at which the air moves. Otherwise, it is just a number coming out of a black box.

To really understand all the variables involved is not easy. CFM doesn't directly correlate to the size of opening because different shapes allow for different flow rates. And knowing the number and sizes of the penetrations in your envelope still remaining to be sealed doesn't directly correlate either. A good way to understand how much air leakage there is in a home is to test before window install with the sheathing running over the openings. You can then drill holes in the window sheathing. A 3/4-inch hole amounts to very little change in CFM. But 10 holes start to add up, and you begin to understand what kinds of things you might be trying to track down to further tighten the envelope. Another quick method we use to gain a tangible idea of the leakage is to crack a window while testing. It is controllable and easy to measure, and the crew starts to get a feel for how our readout numbers correlate in practical terms to air leaks in the home.

MAKING BLOWER DOORS WORK FOR YOU

As discussed in my previous article on air-sealing, owning the door allows me to test multiple times during a build in order to track down and seal leaks. We want to find the leaks during construction, not just after the home is completed. Recently we were able to take the results of an envelope-only blower door test of 1.1 ACH50, and reduce that number to 0.35 ACH50 on our second test by combining the door with a Halloween fog machine. We ran the door for hours while pumping fog into the home. This would have cost much more to do if we were paying a subcontractor to operate the door while we crawled around the home searching for leaks.

Conducting multiple tests during construction also gives us the ability to double-check things like our window and door installation. Drywall returns to the window (no casing) are common details in our market. Once that return is installed, we can't seal that window any better. But if we wait until the drywall is installed to test, then we don't know if the install was executed properly until it is too late. We even have the ability to pressurize and depressurize the home to test how the windows and doors we buy are performing, and this helps us with our selections on future homes, as we constantly try to improve our product.

Having access to the equipment means we use it often. Rarely do we run a blower door test and not learn something about our processes. The information gathered from extra time with the blower door helps us understand how our envelopes are functioning and allows us time to alter or amend our approaches in order to build a tighter and more efficient home.

As a builder, owning and using a blower door has also given us the ability to check the quality of our subcontractor's work. For example, the spray-foam crews installing wall-cavity insulation or attic air-sealing can now be held accountable immediately, not six weeks later. By being able to test and alter our approach constantly, we have raised our own expectations of what a quality home should be. In the way the track saw provides a finish quality cut or an impact driver provides more control over the torque to drive Tapcons without stripping them out, the blower door provides a level of understanding not achievable by watching an energy rater run a blower door test while clients stand outside with a moving truck.

Jake Bruton is the owner of Aarow Building, in Columbia, Mo. Follow Aarow Building on YouTube and follow Jake @jakebrutonlive on Instagram.

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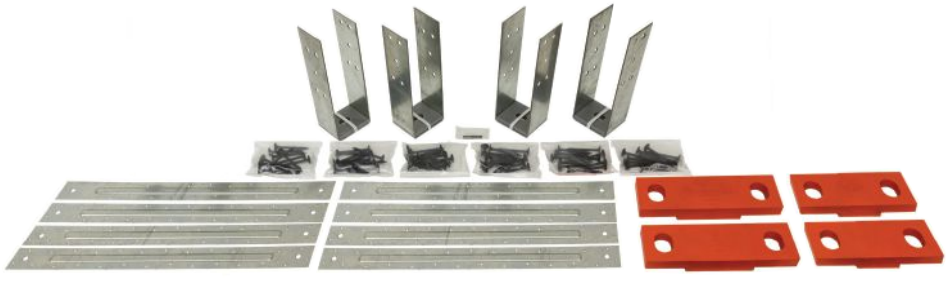

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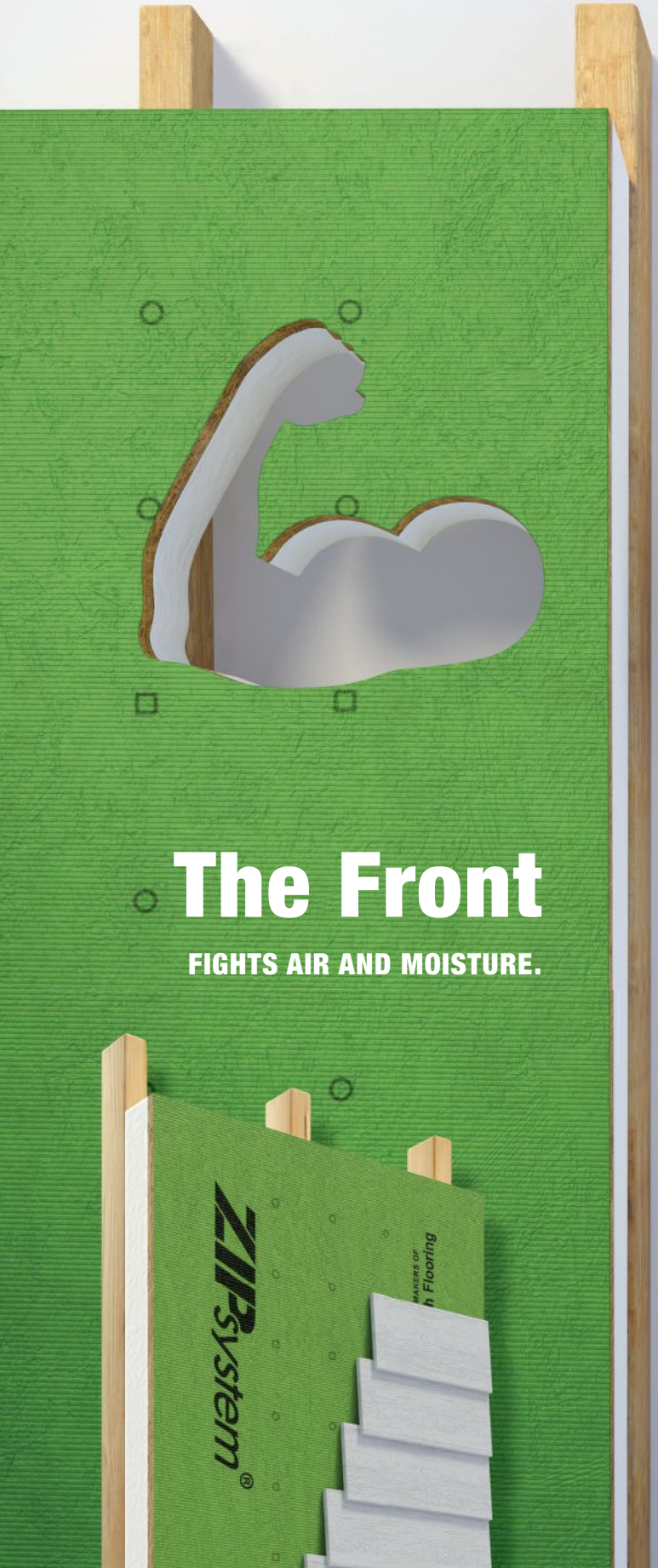

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Roofing Details That Work

For good results, pay careful attention to flashing

BY DOUG HORGAN

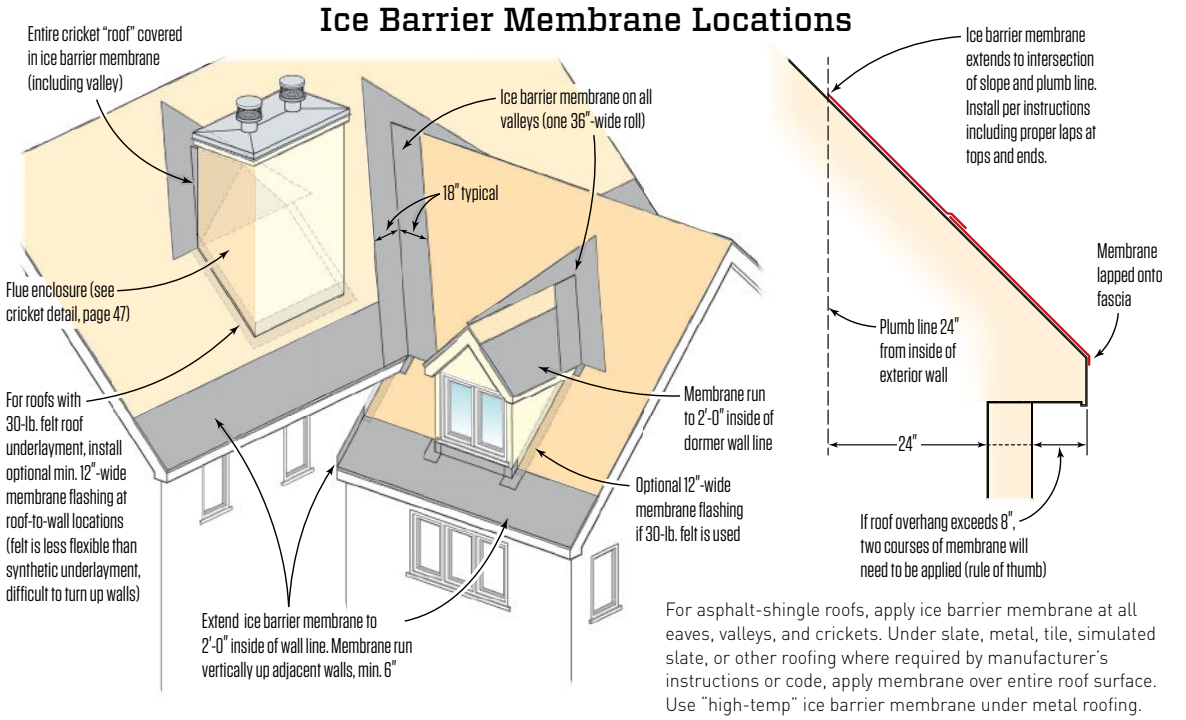
Our company is celebrating its 30th year in business, and we've had plenty of opportunities to see what works and what fails on roofs in our climate.

In the next few pages, I'll show a few examples of our tradecraft standard for steep-slope roofs, as we teach it to our people. The photos on these pages show some mistakes, and some things done right. The drawings show how we would prefer to see things done. In particular, I'm showing our recommended details for ice dam protection, step flashing, underlayment and drip edge, step flashing, and crickets and valleys.

These methods we teach aren't the only way to do any of this work, but they're the techniques we've developed over many years of trial and error on hundreds of jobs.

These details are guided in part by code, but more importantly, we're guided by the goal of making sure we don't have to come back and fix something after it's built and has to face the weather. In our Maryland and Virginia climate, we have high confidence that these roofing details will work.

Roofing is back-breaking labor. That's probably why in our market, and most likely in yours, there's a lot of turnover among the roofing contractor labor pool. And so while many of the details here are fairly simple, we find that we have to teach them over and over again to roofers in our market. If you're in that situation too, I hope the drawings here will be helpful to you.



For asphalt-shingle roofs, apply ice barrier membrane at all eaves, valleys, and crickets. Under slate, metal, tile, simulated slate, or other roofing where required by manufacturer's instructions or code, apply membrane over entire roof surface. Use "high-temp" ice barrier membrane under metal roofing.

ICE DAM PROTECTION

We use an ice barrier membrane at all eaves and in all valleys. At the edge of the roof, we call for the membrane to be folded over and adhered to the fascia board, lapping down onto the fascia about an inch. Depending on the manufacturer's spec, some roofing materials may require an ice barrier membrane on the entire roof.

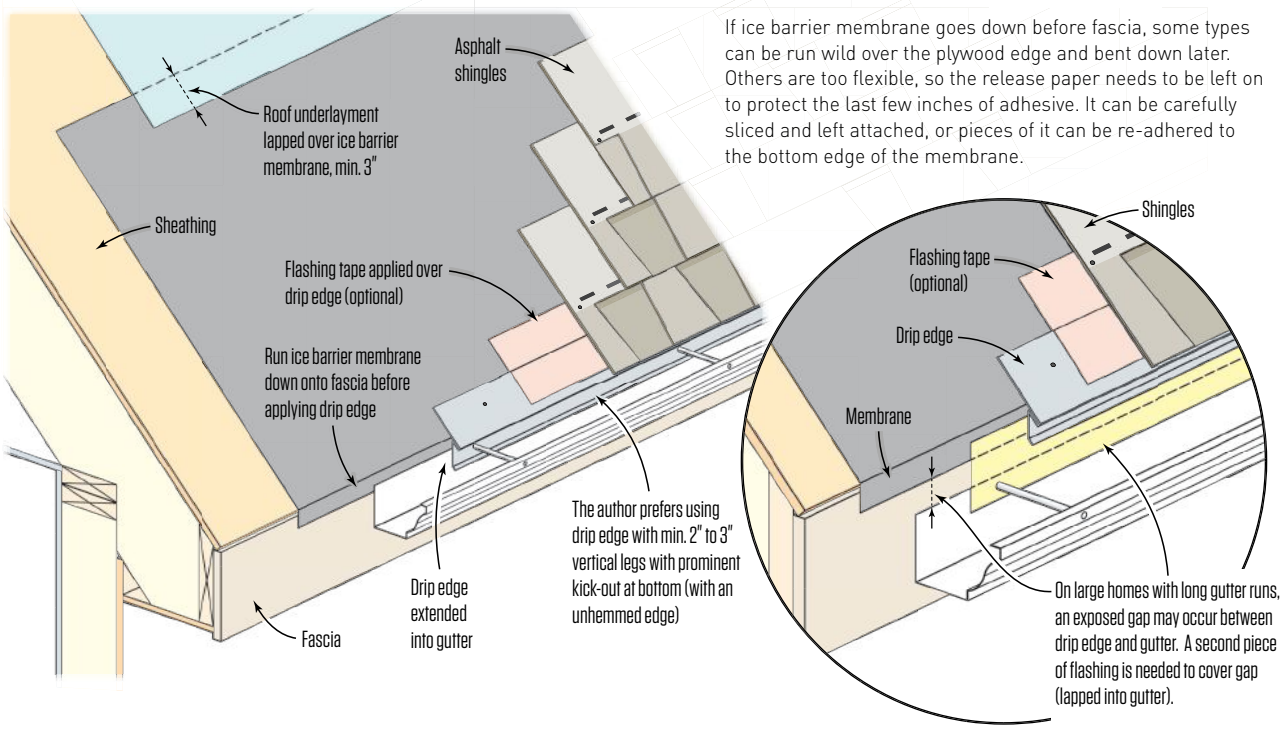
By code, the membrane has to extend inboard of the exterior wall by 2 feet. As a rule of thumb, we expect to use two courses of membrane if the roof overhang exceeds 8 inches.

Some ice barrier membranes have a granular or sand surface to make them more slip-resistant for trade workers who are stepping on the roof. That type of membrane can bleed soft asphalt in the hot sun, and it's subject to damage during construction.

Also, the asphalt in that membrane can cause shingles to stick down in service. So as an option, we suggest

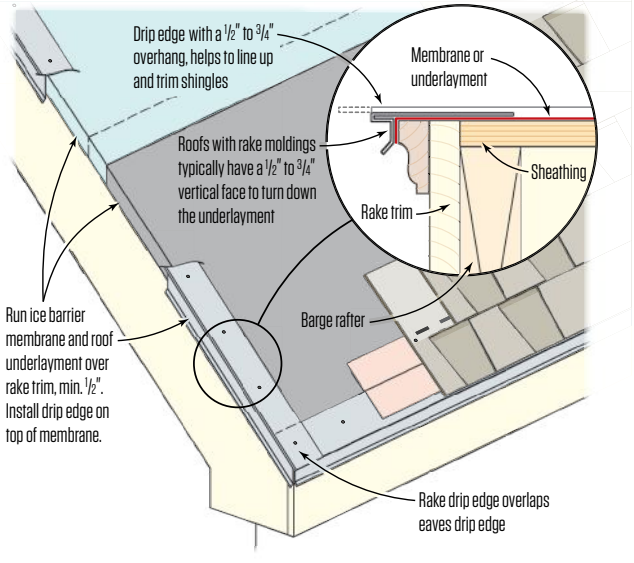
Drip edge that doesn't hang into the gutter can direct water behind the gutter and soak the fascia and soffit, as shown at right.

Eaves Details



If ice barrier membrane goes down before fascia, some types can be run wild over the plywood edge and bent down later. Others are too flexible, so the release paper needs to be left on to protect the last few inches of adhesive. It can be carefully sliced and left attached, or pieces of it can be re-adhered to the bottom edge of the membrane.

Rake Details



Drip edge is installed along the rake to keep out wind-blown rain. In Virginia where the author works, installing it isn't required by code, so roofers have to be specifically instructed to install rake drip edge.

covering the membrane with felt paper or synthetic underlayment as a bond break for the shingles.

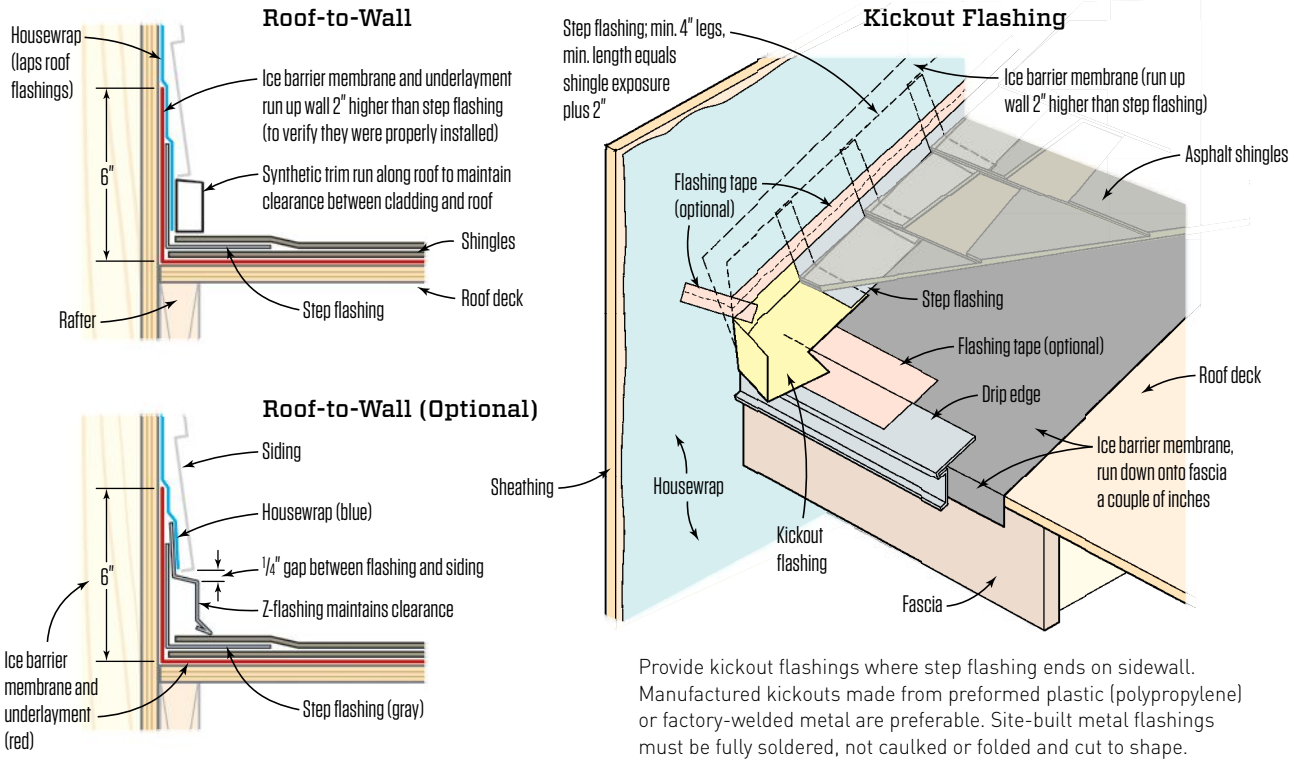
UNDERLAYMENT AND DRIP EDGE

Ideally, fascia board will be installed before the ice barrier membrane to facilitate adhering the membrane to the fascia. Our practice is to install the membrane next, then install the drip edge over the top of that. As an option, we may specify a strip of peel-and-stick flashing tape over the top edge of the drip edge.

Our standard gutter install is to tuck the gutter under the drip edge, and place the fasteners straight through both on the back edge. But on our larger houses, long runs of gutter sloped at 1/8 inch per foot may run out from behind the drip edge. In that case, we call for an additional strip of metal to bridge the gap between the drip edge and the gutter.

The author's spec calls for ice barrier membrane to extend down over the fascia board on eaves and rakes, helping to protect against drips and windblown rain.

Sidewall Flashing Details



Provide kickout flashings where step flashing ends on sidewall. Manufactured kickouts made from preformed plastic (polypropylene) or factory-welded metal are preferable. Site-built metal flashings must be fully soldered, not caulked or folded and cut to shape.

STEP FLASHING

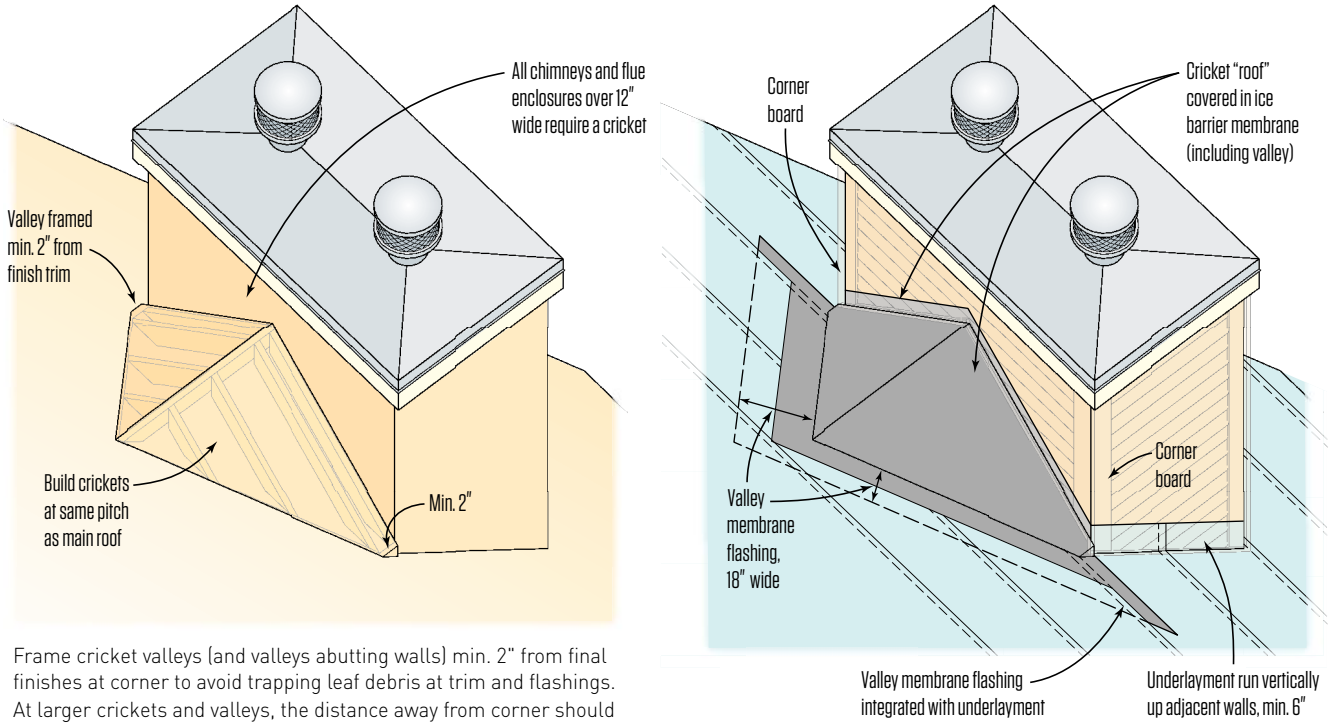
Wind-driven rain and snow can penetrate between step-flashing pieces and wet the sidewalls and the roof. So we instruct our roofers to run the ice barrier membrane and the roof underlayment up the sidewalls. We ask for 6 inches up the wall. Four is adequate, but asking for 6 allows for a bit of imperfect utility-knife work, and it's easy to check if it's been done even with the code-required 4-inch-tall step flashings.

To keep the roof and the wall dry, drainage-plane fabric (housewrap) on the wall needs to lap down over this roof underlayment, not run behind it. If the wall housewrap is already in place when the underlayment is installed, we instruct the roofers to slit the housewrap and pull it back, then reattach it over the roof underlayment.

Synthetic underlayment and ice barrier membrane readily fold at this wall-to-roof joint. But the heavier

At right, a roofer has cut the housewrap at the joint between the roof and the wall, folding it back so that he can lap it down over the underlayment and step flashing, as the author recommends.

Cricket Details



Frame cricket valleys (and valleys abutting walls) min. 2" from final finishes at corner to avoid trapping leaf debris at trim and flashings. At larger crickets and valleys, the distance away from corner should be increased to accommodate increased volumes of water.

asphalt felts have a tendency to crack if you try to fold them like this. So if we're installing felt paper, we back it up with a peel-and-stick membrane at the corner.

CRICKETS AND VALLEYS

Architect plans for crickets behind vertical elements such as chimneys often show the cricket terminating right at the corner of the wall. It looks good on paper, but in practice, this creates a trap for leaves and debris, blocking the flow of rainwater coming down the valley downslope of the cricket. So we coordinate with the framers to construct the cricket so the valley misses the wall intersection by a couple of inches, allowing a freer flow of water. This also makes it easier for the roofers and siding contractors to keep the valley flashing and the sidewall step flashing disentangled.

Doug Horgan is vice president of best practices at BOWA.

At left, a cricket valley is trapping leaves and debris. Framing to allow more space at this location could help keep the valley clear.

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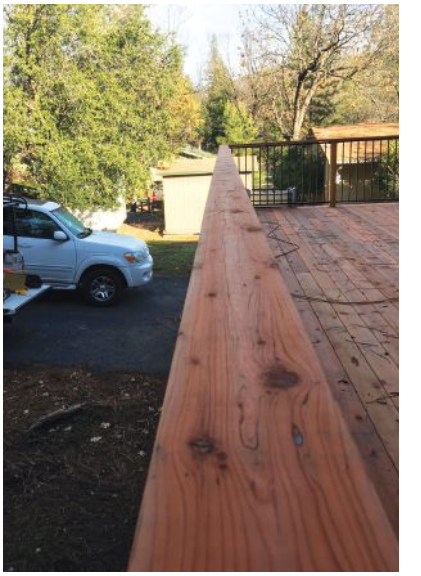

Rail-Post Alignment Trick

by Duane Ragan

As we all know, PT posts will crown and twist during a deck build. To compensate for that movement, when installing posts that will support a deck beam and ultimately become part of the railing system, I initially fasten the posts to their metal post bases with only three screws, instead of the seven or so per side typically called for by post-base manufacturers. Later, after the deck has been framed and the decking installed, I quickly remove the screws and adjust the position of the posts until the tops of the posts are perfectly aligned.

The design of the hardware means that posts can be adjusted in only one direction, so I orient the brackets for play in-and-out rather than side-to-side. This makes it easy to knock the posts a little this way or that to get the top rail perfectly straight. Because I've driven in only a few screws at first, I can reposition the posts and drive in new screws in the unfilled holes without worrying that screws will find their original holes. Once everything is aligned perfectly and the top rail is in place, I finish driving all the remaining fasteners into the post bases. ❖

Duane Ragan owns Ragan Construction, in Columbia, Calif.

PHOTOS OF POSTS AND DECK: DUANE RAGAN

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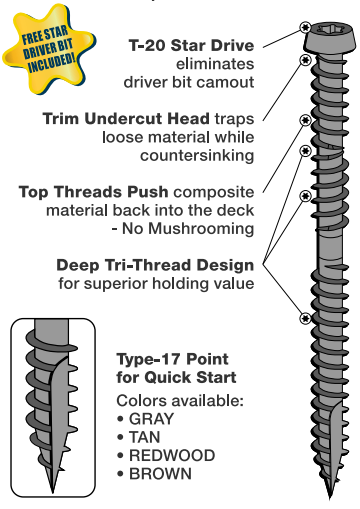

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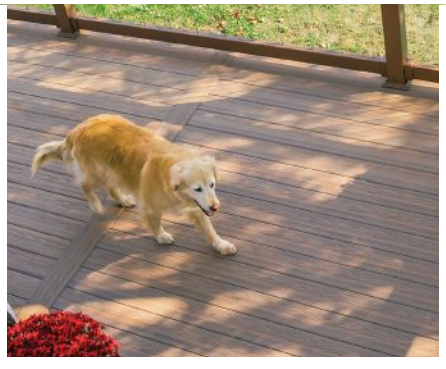

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Single-Ply Beams

Q My clients—who are on a fixed income—would like a small deck off the side entrance to their house. I'd like to build it as efficiently as possible to keep it affordable, and hope to use a simple single-ply 2-by beam supported by a pair of 4x4 posts. The problem is, I can't find any span tables for single-ply beams or appropriate post-to-beam connection details in DCA6 to show my inspector.

A Glenn Mathewson, a building code consultant and former inspector and plan reviewer in Westminster, Colo., responds: Here's a case where I think (at least for now) you'll have better luck if you check with your code book rather than DCA6, and here's why: Starting in 2015, prescriptive deck codes finally began to appear in the IRC—the mainstream model building code. While this may sound like bad news for an industry that sometimes views building codes negatively, it's actually quite the opposite. That's because prescriptive deck codes spell out uniform design methods (like maximum joist and beam spans and connection details) that allow contractors to know what to expect from building departments. Prescriptive codes also allow building departments and inspectors to be more confident in approving decks without requiring review by a design professional or engineer.

The 2018 edition of the IRC built on this momentum by adding some flexibility with single-ply beams in Table R507.5 Deck Beam Span Lengths (**Figure 1**). This key beam-span table (which will appear in the yet-to-be released 2018 edition of DCA6) has five new rows for 2x6 through 2x12 single-ply beams. The spans aren't huge, but they help the IRC be what it is supposed to be—a minimum standard.

Intermediate stair landings are a prime example of a place where a single-ply beam can be an appropriate framing solution, even for above-code

Figure 2. The double-ply beam supporting this stair landing is structurally unnecessary and could be replaced with a single 2x6, according to Table R507.5 in the 2018 IRC.

PHOTO: GLENN MATHEWSON

TABLE R507.5
DECK BEAM SPAN LENGTHS[a, b, g] (feet - inches)

SPECIES[c]	SIZE[d]	DECK JOIST SPAN LESS THAN OR EQUAL TO: (feet)						
		6	8	10	12	14	16	18
Southern pine	1 – 2 × 6	4-11	4-0	3-7	3-3	3-0	2-10	2-8
	1 – 2 × 8	5-11	5-1	4-7	4-2	2-10	3-7	3-5
	1 – 2 × 10	7-0	6-0	5-5	4-11	4-7	4-3	4-0
	1 – 2 × 12	8-3	7-1	6-4	5-10	5-5	5-0	4-9
	2 – 2 × 6	6-11	5-11	5-4	4-10	4-6	4-3	4-0
	2 – 2 × 8	8-9	7-7	6-9	6-2	5-9	5-4	5-0
	2 – 2 × 10	10-4	9-0	8-0	7-4	6-9	6-4	6-0
	2 – 2 × 12	12-2	10-7	9-5	8-7	8-0	7-6	7-0
	3 – 2 × 6	8-2	7-5	6-8	6-1	5-8	5-3	5-0
	3 – 2 × 8	10-10	9-6	8-6	7-9	7-2	6-8	6-4
	3 – 2 × 10	13-0	11-3	10-0	9-2	8-6	7-11	7-6
	3 – 2 × 12	15-3	13-3	11-10	10-9	10-0	9-4	8-10

Figure 1. Spans for 2x6 through 2x12 single-ply beams have been added to Table R507.5 in the 2018 IRC. Expect to see a similar table in the next version of DCA6.

builders. In most cases, a two-ply beam at the front of a stair landing isn't structurally necessary, because (according to Table R507.5) a single-ply 4-foot-11-inch 2x6 beam can support joist spans up to 6 feet (**Figure 2**).

This prescriptive solution is also good news for folks who are living on a budget and might prefer a small deck instead of a cheap concrete paver patio. The single-ply beam spans from the IRC's prescriptive table allow for a simple 7x7 deck or 8x8 deck with cantilevered joists using only single members, a ledger connection, and two footers. That's an economical solution.

If you're going to have single-ply beams for budget decks, you might as well have a notched and bolted post-to-beam connection, especially since hardware manufacturers don't offer much in the way of hardware that is designed for single-ply beams. The problem with that plan is that the 2015 IRC only offers a notched post-to-beam connection detail for a 6x6 post to a two-ply beam, which calls for a 2½-inch flange beside the notch to bolt the beam to. However, only a 2-inch flange is left when a 4x4 is notched for a single-ply beam. Fortunately, the 2018 IRC takes care of this problem by including a new detail for notched 4x4 posts and single-ply beams, which specifically allows for the narrower, 2-inch flange (**Figure 3**). ❖

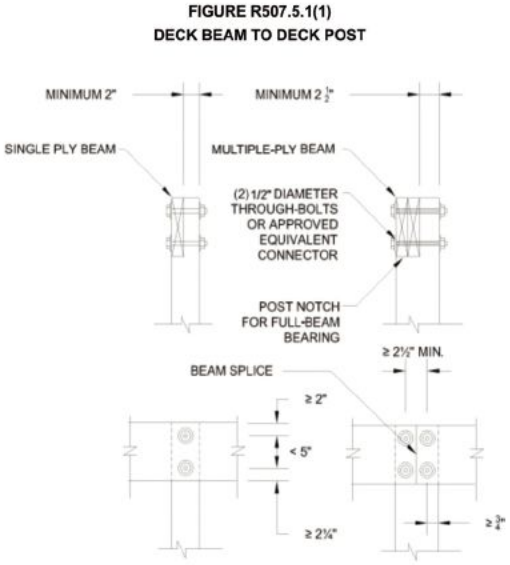

Figure 3. The 2018 IRC also includes a post-to-beam connection detail for 4x4 posts and single-ply beams.

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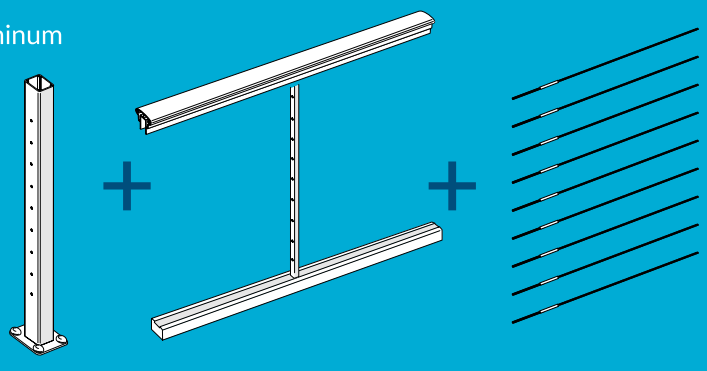

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Boosting Profits With Production Methods

by Pat Noonan

Our company offers a prefabricated deck system that is much more detailed than most would ever care to utilize. But in my opinion, the production principles we use to work more efficiently are applicable to both standard and custom deck builders.

It all started years ago when I bought a notebook to journal every deck I built. I kept track of actual materials used, the actual cut lengths of joists and beams, the leftovers from the order and what was returned to the lumberyard, and the labor hours that it took for each stage of construction. Soon I had a "database" that I could refer to when planning the next deck.

With a little prep time spent with this information the night before, I started showing up on the first day with an actual cut list to give to my guys. By the time I had the ledger installed, they had precut all of the joists and beams and were ready to start framing. While one guy started laying the decking, another was already cutting the rail sections to fit. These methods allowed us to save a little time on each deck, and when scaled over a full season, the increase in productivity was dramatic.

The Assembly-Line Model

I cut my teeth hauling studs and throwing 4x8 sheets on new-construction jobsites. During my time framing homes, I learned firsthand the advantages and efficiencies of production framing and how building the same plans over and over becomes routine. While Henry Ford's assembly line has evolved, the founding principles remain the same: A line worker, or in our case, a carpenter, will perform tasks faster and better the more times he or she repeats the same task. It's a matter of efficiency. The more often we repeat a process, the more skilled and efficient we become.

On the jobsite, this approach can lead to efficiencies with material and labor, and in turn generate more accurate and confident pricing through standardization. The bottom line? Increase your bottom line, and reduce price estimate surprises.

Towards Standardization

What I learned from new-home construction has helped me to become a better deck builder and smarter business owner. Over the course of the past 15 years, my team and I have developed a builder deck program that operates with national builders. Our program provides turn-key, high-quality decks that our builders can market as a custom add-on that can be included in the overall home price. The homeowner gets several advantages this way. Not only do they get a superior product over a typical home-builder deck, but also the price of the deck can be rolled into the mortgage, and the deck is completed before move-in. This year, my team will complete more than 400 builder decks, essentially building the same plans repeatedly. This process has helped pinpoint our costs, consolidate materials, and save labor, and it has greatly increased our margins and capacity for overall growth.

We also build higher-end custom decks, and have taken the knowledge and benefits from our production deck program and translated those efficiencies to our

PHOTO COURTESY DECK AND BASEMENT COMPANY

Produced off site, this deck package is ready for assembly. The same production techniques used to prefabricate the parts can be adapted to custom deck construction.

custom design division. After changing our mind-set from "building one deck at a time" to "building the same deck repeatedly," we tracked the actual length of joists and beams we were cutting and produced detailed plan drawings for the designs we were building. By cutting the framing members to the identical size every time, all of the layout, rail sections, and posts stayed consistent from deck to deck, even after the addition of the "bells and whistles."

We still bid per square foot, but we have different multipliers based on overall size and add-in factors for sizes that generate waste. By incorporating total material costs with average labor per square foot, we were able to establish our base price per square foot for 10 different-sized decks. Not a guess, or an estimate, but a true cost based on a history of actual materials used and average labor hours spent.

Track Your Costs

If you are bidding your projects per square foot, I strongly suggest you take the time to track the actual costs of different-sized decks. This will give you an idea of how costs change over scale. My team and I were surprised at how much more cost-effective some deck dimensions were to build compared with others. The square footage of deck space per footing and the amount of waste on cutoffs from composite decking and railing will swing the cost per square foot of a deck considerably. For example, 12x16 and 14x14 decks offer about the same square footage, but come in at a significantly different cost per square foot after 16-foot-long composite decking and 8-foot-long rail panels are cut down to fit.

This industry has so much diversity market to market: regional preferences, average deck size, preferred materials, and colors. Regardless of the geographical region, product, or size you are pitching, the price is ultimately what your client wants to know. Take the time to accurately track your costs and develop your own true-cost pricing formula that relates to your business and preferred projects. Even if your projects are never exactly the same, by spending 30 minutes recapping your actual materials and labor expenses for each project, you will gain a much better understanding of your company's true price per square foot. You will walk into your next appointment with the ability to confidently price at the table with accuracy, setting you apart from your competition and protecting your bottom line. ❖

Pat Noonan is the owner of Deck and Basement Company and Pro Deck Supply, in Minneapolis. He is a NADRA member with more than 25 years of residential construction experience.

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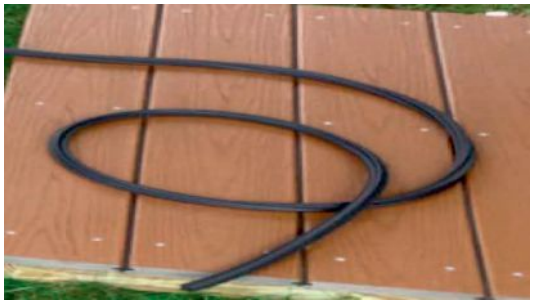

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PHOTO: MATTHEW BREYER

Efficient Deck Building

Pros share their tips for working smarter, not harder

by Andrew Wormer

If you're not familiar with the Fast-Cheap-Good project triangle, you should be. That's because it's a great tool—applicable to virtually any line of business—for recognizing and dealing with unrealistic clients. You know who I'm talking about: the ones who seemingly demand museum-quality work on a tight schedule, all at a discounted rate. While they might not understand when you tell them it will cost more to build a high-quality deck in time for their daughter's wedding or the big company picnic later that summer, they probably will understand when you patiently break it down for them and explain that they have to pick two out of three.

That's where building efficiently comes in. By figuring out ways to reduce material and labor costs without compromising quality, you can remain competitive. For some builders, that means streamlining the framing process, perhaps by standardizing deck sizes or even prefabricating deck packages off site. For other builders, it might mean closely tracking labor costs to optimize results.

Last fall, *PDB* reached out to a number of deck builders to find out their various methods for working more efficiently. Here is what they told us.

Stage the Job

For Mike Guertin, a remodeler and builder in East Greenwich, R.I., working efficiently means starting each job with a planned lumber drop. He says he coordinates with his lumberyard to ensure that his materials aren't randomly loaded and delivered—so that he has easy access to the lumber he needs in the sequence he needs it.

If the deck is small and all the materials are delivered at once, he starts with the joist stock on the bottom of the pile, then the ledger stock, and then stacks the post and beam stock on top. The decking goes in a separate pile, says Guertin.

Another planning tip from Guertin is to develop a good working relationship with inspectors. Once you've gained their trust, many inspectors will allow you to skip some on-site inspections—such as for footing holes, lateral load connectors, and framing details—if you email them good photos that verify the work has been completed. Guertin notes that he can usually get approval in a couple of hours with a set of emailed photos instead of waiting a day or several days for an inspector to come out to the jobsite (**Figure 1**).

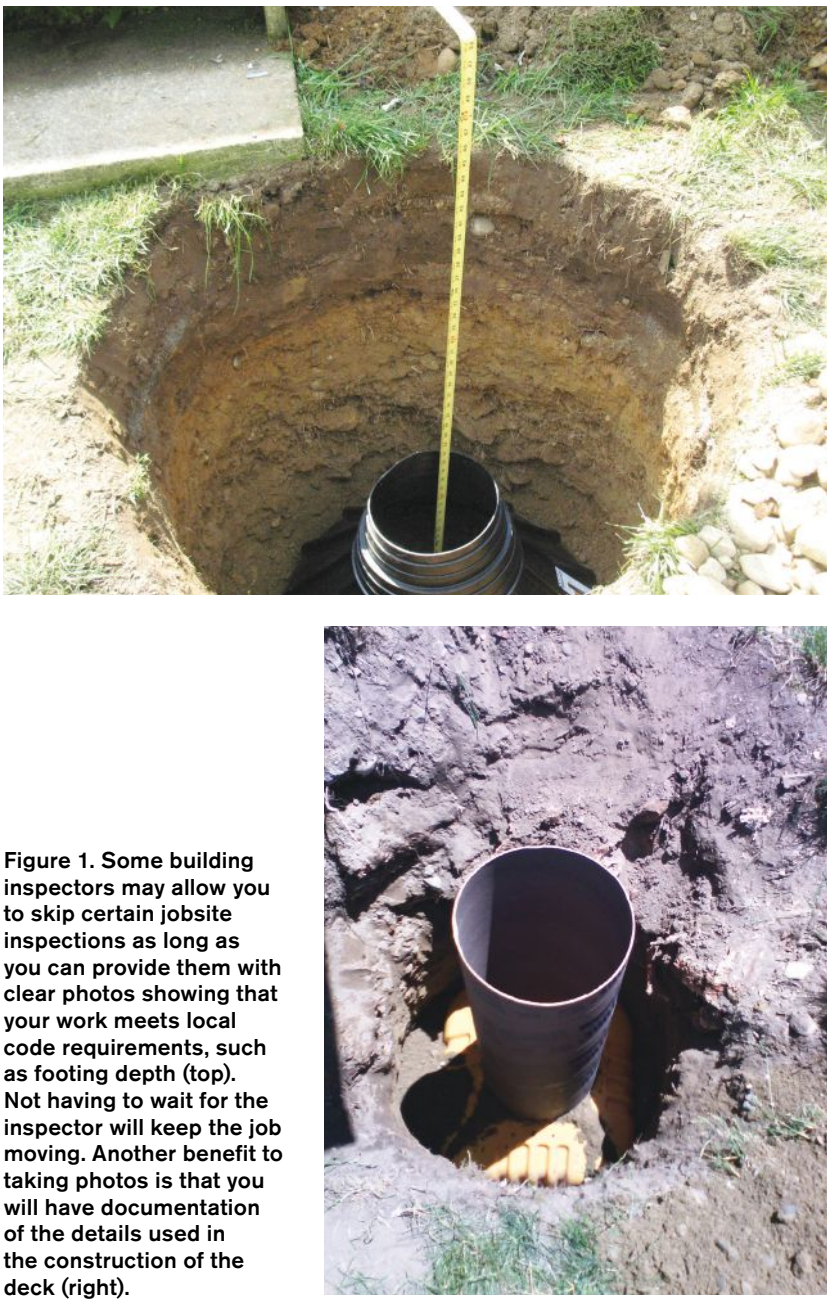

Figure 1. Some building inspectors may allow you to skip certain jobsite inspections as long as you can provide them with clear photos showing that your work meets local code requirements, such as footing depth (top). Not having to wait for the inspector will keep the job moving. Another benefit to taking photos is that you will have documentation of the details used in the construction of the deck (right).

Tools and Jigs

Guertin believes that having the right tools for the job is one of the keys to working efficiently. To a standard assortment of saws, compressors, air tools, and hand tools, he has added an arsenal of specialty tools over the years. For example, he points out that a metal-connector nailer significantly speeds up the framing process over nailing joist hangers by hand. For tight spots, he recommends adding a simple palm nailer to your toolbox.

If some deck demolition is involved, it makes sense to supplement your pry bars and digging irons with one (or more) of the various decking removal tools that are on the market. Pennsylvania builder Matt Breyer says that his company keeps several different types on hand, including a Demo-Dek (greentektools.com) and a Duckbill Deck Wrecker (duckbilldeckwrecker.com), since each tool works slightly differently and better fits different jobsite conditions.

If your company installs a lot of PT or tropical-hardwood decking, you'll need at least one of the various types of deckboard benders and straighteners.

Specialty jigs made on site with leftover material can also be used to increase speed and accuracy. One of Guertin's go-to jigs is his joist-hanger installation tool, which enables him to quickly nail hangers onto a ledger and beam (using a metal-connector nailer) and then drop the joists in place (**Figure 2**).

Another helpful aid is a simple post-holding jig, which is basically a hollow box made with scrap plywood or 1-by material that fits around a 4x4 post. Before installing a rail post, Guertin slides the jig over the post and clamps it in place so that it acts as a stop when he's positioning the post. This allows Guertin to quickly register the post at the right height on the deck frame, rather than trying to eyeball it to a line while fastening it into place. Guertin uses a second clamp to hold the post tight to the framing while he's bolting it into place.

Like many deck builders, Guertin runs his 4x4 railing posts a little high when he

PHOTOS: MIKE GUERTIN

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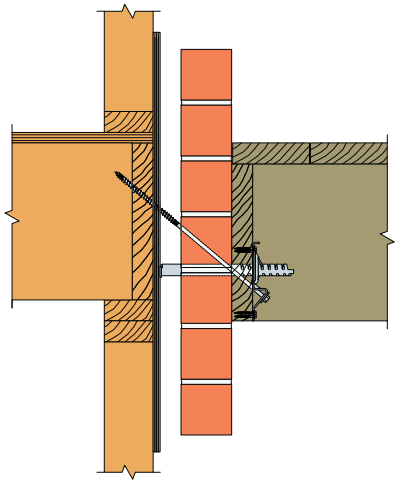

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Figure 2. Joist hangers can be preinstalled on the framing, using a simple joist-hanging jig to accurately position the metal hardware (A). After the rim joist and ledger have been installed, joists can be quickly dropped into place (B). Key specialty tools include metal-connector nailers (C) and board benders (D).

Figure 3. In a top-down framing approach, the deck is framed on temporary supports (above left), which allows for more accurate placement of the footings (above right). In some jurisdictions, the approach allows for a single inspection visit for framing and footings.

installs them, then cuts them to height later, using a laser to establish a level line. But a regular circular saw doesn't have quite enough capacity to cut through a 4x4 post in one pass. In order to get a square cut, Guertin has a jig that is similar to his post-holding jig and can be clamped to the post to guide the cut. The cutting jig takes the place of drawing a cut line around all four sides of the post while ensuring a perfect square cut.

Footings

When a deck is above grade by more than a couple of feet, Guertin doesn't pour the footings right away. First, he digs the holes and inserts the forms. Then he frames the deck, propping the beam up with temporary supports and suspending the finish support posts above the footing holes.

That approach allows Guertin to schedule the framing and footing inspections at the same time, instead of waiting a day or two for the inspector to come out and check the footing holes. When the inspection is complete, the concrete can be placed and the crew can go ahead and start the decking installation on top of the frame (**Figure 3**).

Greg DiBernardo, owner of Peachtree Decks & Porches, in Atlanta, is another deck builder who recommends framing from the top down. DiBernardo says it's easier to accurately locate the footings, especially on irregular terrain, with the framing in place. It also allows his crew to dig the footings when the timing is most efficient for their schedule. For example, if two workers are laying decking, a third worker can start digging the holes.

Another advantage of top-down framing is that it allows a crew to work around the weather. And DiBernardo agrees with Guertin that it's sometimes possible to get footing and framing inspections at the same time (which the inspectors like too, because it saves a trip for them). Occasionally, says DiBernardo, projects receive the final inspection along with

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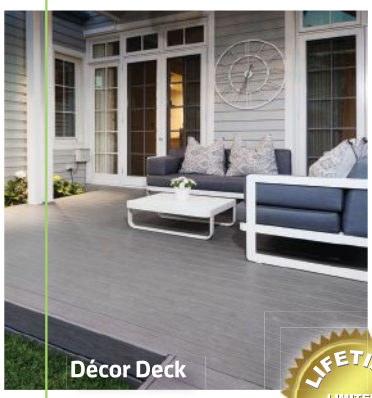

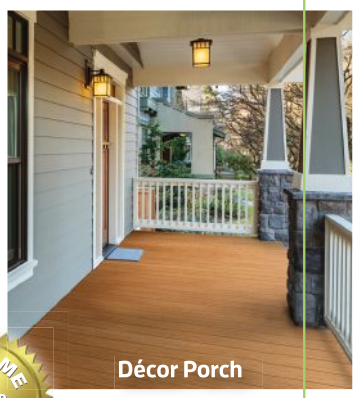

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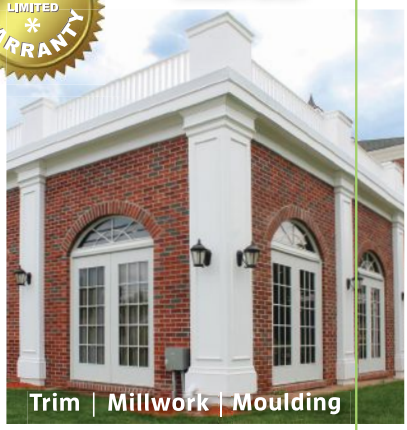

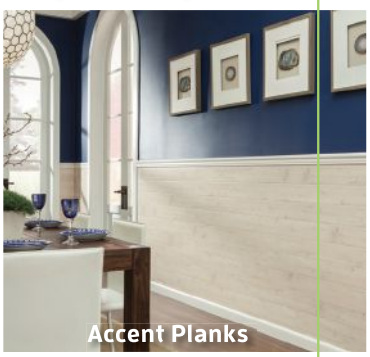

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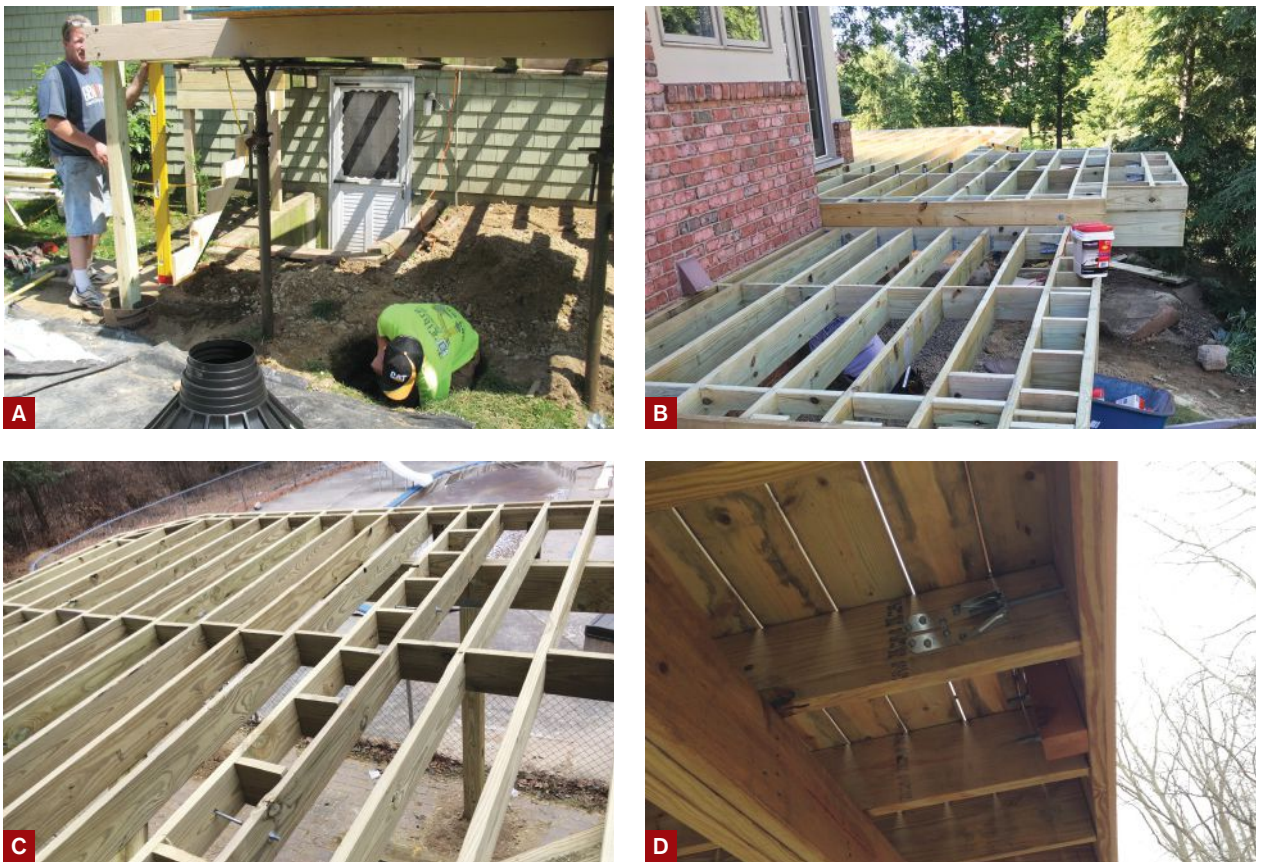

Figure 4. Ripping the PT joists of an eye-level deck to uniform size with a perfectly straight upper edge prior to installation will eliminate noticeable dips in the decking later (A). Vertical blocking reinforced with lateral-load brackets will provide support for picture-framed border decking while strengthening the rim joist (B). Threaded rod should be used to reinforce the ladder-like blocking used to support seam boards (C). Lateral-load brackets are often required to reinforce the connection between cantilevered joists and the rim joist (D).

the footing inspection if there is a good relationship with the inspector.

Framing

On composite decks that are between waist and eye level, it is really easy to see dips and waves in the deck boards caused by crowns or thickness variations in the framing. Instead of trying to correct the problem after the joists have been installed, DiBernardo's crews first rip all of the joists to make sure they are uniformly sized with perfectly straight top edges before beginning the framing.

DiBernardo says that it takes only 10 minutes or so to snap chalk lines along the lengths of the joists and rip them to size. The reduction in strength is minimal, since only 3/16 inch or less is removed from the width of each joist, and the result is a very flat surface for the decking. On taller or lower decks, this step isn't necessary, since the variations won't be visible.

Michigan builder Bayn Wood considers the rim joist and joist blocking to be key components to a strong, long-lasting deck frame. Taking the time to reinforce these areas during the framing process avoids callbacks later on.

For example, Wood explains that the rim joist typically bears the load of all the railings, fascia, and borders (if used) but is often fastened to the main deck joists only with screws or nails driven into the end grain of the joists. To reinforce this connection, Wood installs one or two Simpson Strong-Tie DTT2Z lateral load brackets every 6 to 8 feet along the rim joist (a measure that Wood says is required by most municipalities in his area for proper rail-post attachment) (**Figure 4**).

Seam boards—where a deck board (or boards) is installed that runs at a right angle to the main field decking, usually to avoid butt joints and to get the best usage of decking lengths—typically require additional blocking for support. Most deck builders simply nail (or screw) joist blocking between two main deck joists,

PHOTOS: A, MIKE GUERTIN; B, C, D, BAYN WOOD

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Figure 5. Tacking guard posts in place as the deck is framed (A), then going back later to install blocking and plumb the posts all at once (B) can help speed installation. Both vertical (C) and horizontal (D) blocking can be used to reinforce the connection between stair guard posts and the stair stringers, though remember that blocking installed on the flat should be protected from water intrusion with a peel-and-stick flashing membrane.

with no other connection to hold the ladder-like assembly together. But Wood has found that as the decking expands and contracts over time, the blocking gets pulled away from the joists because of the weak connection into the blocking end grain. So Wood reinforces the blocking with DTT2Z brackets or ½-inch-diameter threaded rod (or both) installed every 6 feet to hold the assembly together.

When you're installing blocking, Wood cautions that it should always be installed vertically, rather than on the flat. While flat blocking offers more surface area for nailing, vertical blocking is stronger. And even when the flat blocking is protected by a peel-and-stick membrane, Wood has found that water still manages to penetrate the assembly and work its way into the attachment points. Before long, the connection loosens, allowing water and debris to accumulate, eventually leading to rot.

Railings and Stairs

If deck plans include a poured concrete landing for a set of stairs, Guertin tries to cast the landing at the same time as the footings. That means one less delivery for the batch truck, or—if the concrete is mixed on site—less time setting up and cleaning up the mixer.

When you're installing the stair stringers, Matt Breyer points out that it can be tough to keep the bottom of the framing from twisting with all the abuse the lower rail posts get. To help strengthen this assembly, Breyer installs both vertical and horizontal blocking, which not only locks the posts in place and ties the stringers together, but also provides solid support for the decking (**Figure 5**).

Finally, when you're installing guard posts, Guertin recommends optimizing guard-post spacing to match the lengths of the rail system being used. By precisely positioning the posts so that the rails fit exactly between them, you'll save cutting time, and the spacing between the last baluster and post will match the spacing between the balusters. ❖

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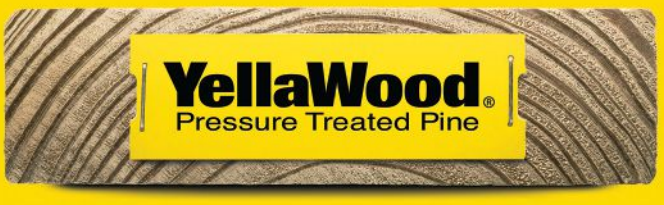

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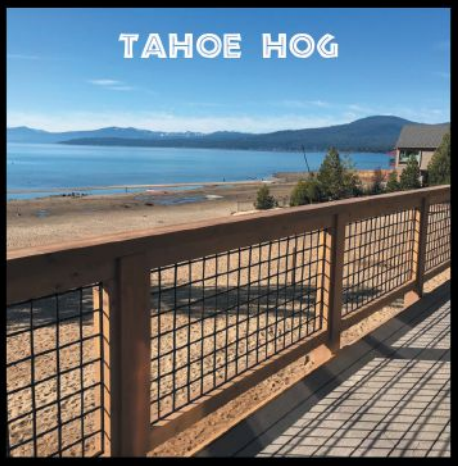

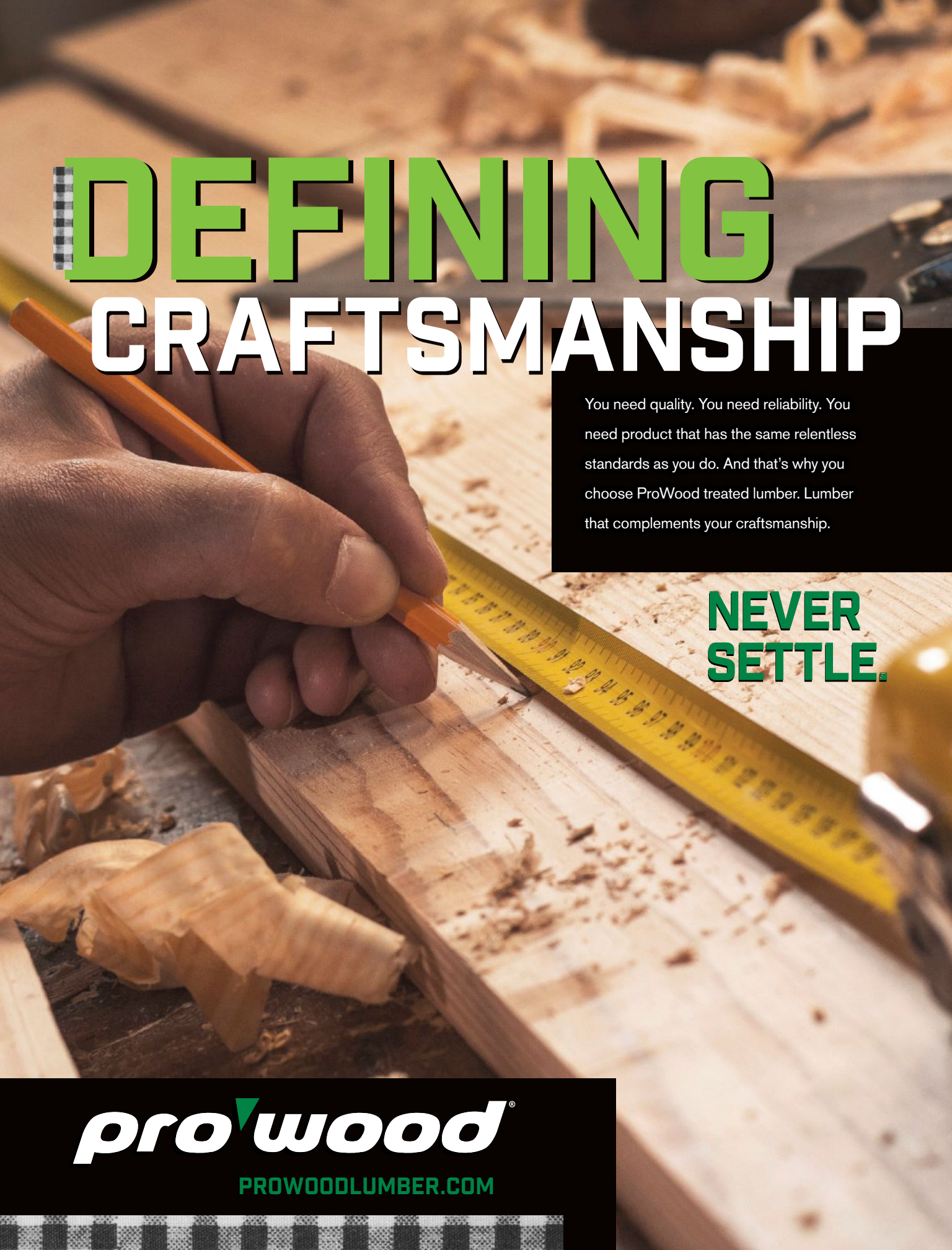
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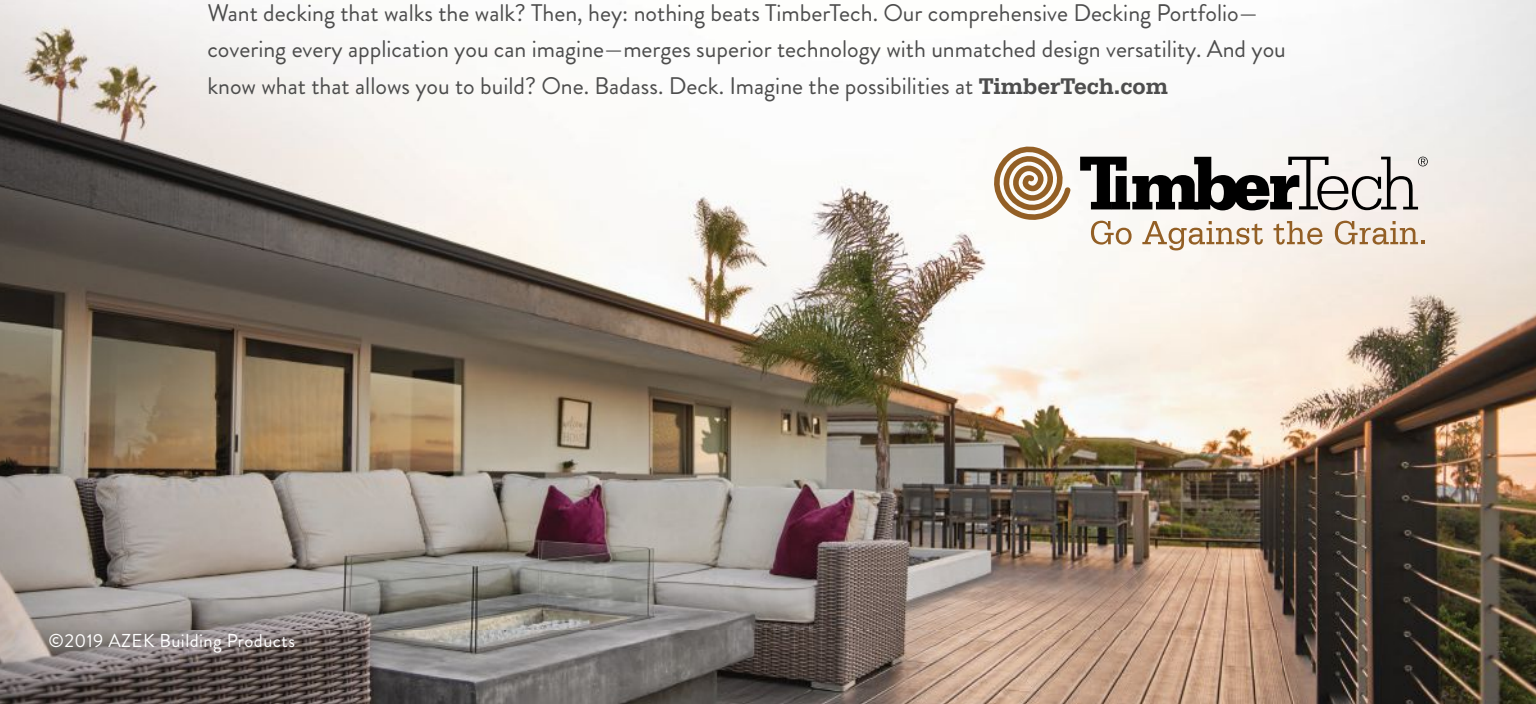

Framing a Deck With Engineered Lumber

Can I-joists and LVLs be used to build a deck? This Minnesota builder says yes.

by Tim Brown

A couple of years ago, a landscaper asked us to work a deck into the landscape design for one of his clients. But after the initial budgets for the landscaping and deck came in a little too high, the customer did the right thing and tabled the whole project for a later date. Instead of compromising on their goals, they decided to save up while they refined their design. The result—a thoughtful, usable outdoor living space that we recently completed—was worth their wait.

The design features a full patio below an elevated deck. To keep the patio from feeling enclosed, the clients wanted us to use as few posts as possible to support the structure. Fewer posts mean longer spans, which require bigger beams and deeper joists. Another request was an under-deck drainage system, to keep the patio dry. Because we felt that the rubber membrane we use in our system would also keep the joists and beams dry, this seemed like a perfect opportunity to take advantage of I-joists and LVLs to frame the deck.

Engineered Framing

Even if we hadn't planned on waterproofing the deck, we could have incorporated either Alaskan cedar glulams or PT glulams (in about a 5 ¼-inch-by-16-inch size) into the framing. But Boise Cascade, our supplier, warrants its engineered wood products for open but protected exterior applications, including decks that have been covered with a rubber membrane from above and fascia from the sides. With full water protection for the deck and plan approval from our building inspector, we had the option of using the company's standard 1.75-inch-by-16-inch Versa-Lam LVLs to build up a 19-foot-6-inch three-ply beam, which was cheaper and easier to install than a single big beam.

Typically, our supplier sizes the beams and provides the fastening schedule. Usually, we nail the plies together as we

PHOTOS BY TIM BROWN

install them per the schedule (in this case, six 16D nails at 12 inches on-center, both sides), then use structural screws as needed to pull the plies tightly together.

One portion of the deck extended 18 feet out from the house, which—with a flush beam—would have required 2x12 PT joists. In general, we prefer to use uniformly sized joists in a deck, even with varying spans, since different-sized joists tend to dry out at different rates and cause a wavy surface in the decking (a problem that we combat by installing midspan blocking). It's also more difficult to install under-deck finishes when the joists aren't uniformly sized.

On this project, we used standard 9½-inch BCI 6000-series I-joists for the joists, and 1.75-by-9½-inch LVLs for the rim joists and ledger (where there was a ledger—more on that below). Since we weren't waterproofing the stair landing, we framed that conventionally with 2x10 PT joists and beams.

Minimum footing depth in our area is 42 inches. As on most of our projects, we used helical piles to support the framing, subcontracting their installation to a local Techno-Metal Post installer (**Figure 1**).

Figure 1. The deck's 6x6 PT support posts bear on Techno-Post P2 helical piles with a 16-inch-diameter helix and a 6,500-lb. bearing capacity (A). The new I-joists couldn't be hung from the cantilevered section of the house, so the crew carefully cut channels through the exterior sheathing and rim joist so that the joists could bear directly on the home's wall framing (B), and removed existing spray foam insulation for access to the basement wall framing (C). Where the 12-inch-on-center deck joists aligned with the 19.2-inch-on-center house joists, the author tied them together with mending plates (D).

Solving the Cantilever-to-Ledger Connection Problem

The existing deck, which we removed, was directly attached to a cantilevered section of the house, but this cantilever was never designed to carry a deck load. Our clients didn't want to interrupt their new below-deck patio with additional posts next to the house to support the cantilever, however, so we needed a different solution. We decided to bypass the cantilever entirely and rest the new deck joists on top of the basement exterior wall, which bears directly on the foundation and which we verified would be capable of supporting the additional loads.

The existing first-floor system was framed with 11⅞-inch I-joists, which would allow us to slide our 9½-inch deck I-joists alongside them until they rested on top of the wall plate. First, though, we had to remove the soffit below the cantilever and then cut away some of the spray foam used to insulate the joist bays. Luckily, the original insulation contractor didn't do a very good job insulating the cantilever, so there were a number of voids that were missing foam, making the process a bit easier.

Once the foam was gone, we cut out channels in the exterior rim where we could slide our new joists in. To make it easier to re-insulate the assembly with foam later on, we were careful to cut these accurately and only slightly oversize them.

The existing house joists were spaced 19.2 inches on-center, while we were installing the new deck joists 12 inches on-center. So every 8 feet along the length of the 22-foot-long cantilever, a deck joist aligned with a house joist. There were also a few oddly-spaced joists where this

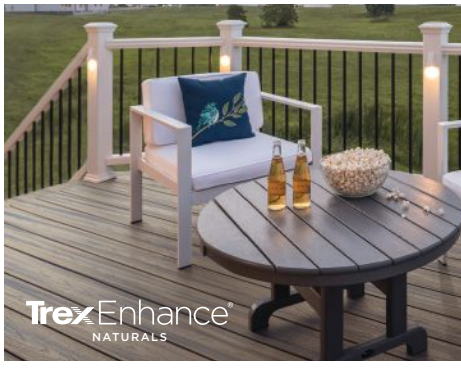

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Figure 2. The waterproofing process begins with cutting 14-inch-by-18-inch bibs from 40-mil EPDM rubber waterproofing membrane, and stapling the bibs to the front of the beam (A). A worker then staples tapered EPDM troughs to the joists, bedding the troughs where they overlap on top of the joists into a thick bead of neoprene sealant (B). After cutting away excess material to allow water to flow freely down into a gutter installed underneath the rim joist (C), a worker covers the tops of the joists with SAF flashing tape (D). Around the perimeter of the deck, another membrane layer is installed over the top of the LVL framing to direct water back into the troughs (E).

occurred. At all of these locations, we fastened the overlapping I-joists together with structural screws and installed Simpson Strong-Tie TP37 tie plates on the underside of the joists where they overlapped. This was done to prevent withdrawal and meet lateral-load connection requirements.

Where the new deck I-joists simply rested on top of the wall, we securely fastened them to the top plate with 16D nails driven through the bottom chords of the I-joists.

The original deck didn't extend past the cantilever, so here we had to remove the siding and relocate a bathroom exhaust vent before we could install a new ledger. After bolting a 2x10 PT ledger to the house framing, we built out the ledger with an additional two-ply LVL beam that extends past the house and is supported at one end by a 6x6 column.

One of the benefits of using I-joists over standard PT lumber is that the joists are consistently sized, so the top-flange I-joist hangers we used could all be set to the same height, making them much quicker and easier to install than standard joist hangers. We were able to lay out and install all of the hangers on both the ledger and the beam and then simply drop each joist into place.

Compare that with sawn framing, where we typically toenail the joists flush with the top of the ledger and beam and then come back afterward to install the hangers. This technique leads to some precarious balancing on top of scaffolding to hold a 100-pound joist flush while toenailing it in place. Weighing only about 20 pounds or so, an 18-foot-long 9¼-inch I-joist can be easily handled by one guy.

Best of all, our deck was perfectly flat right away, compared with one framed with conventional PT lumber, where getting the joists installed is just the first step in framing it. Next, we would have

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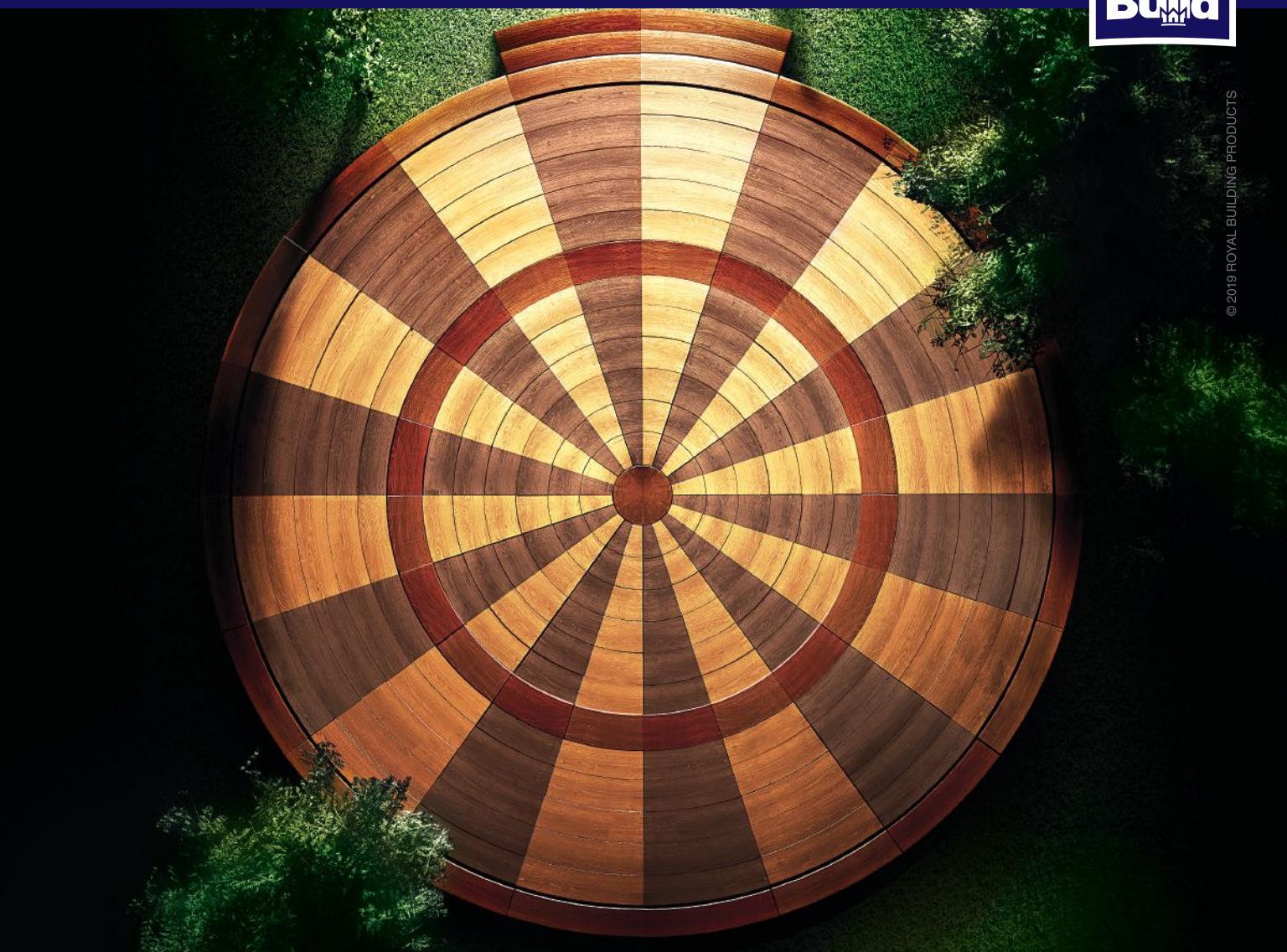

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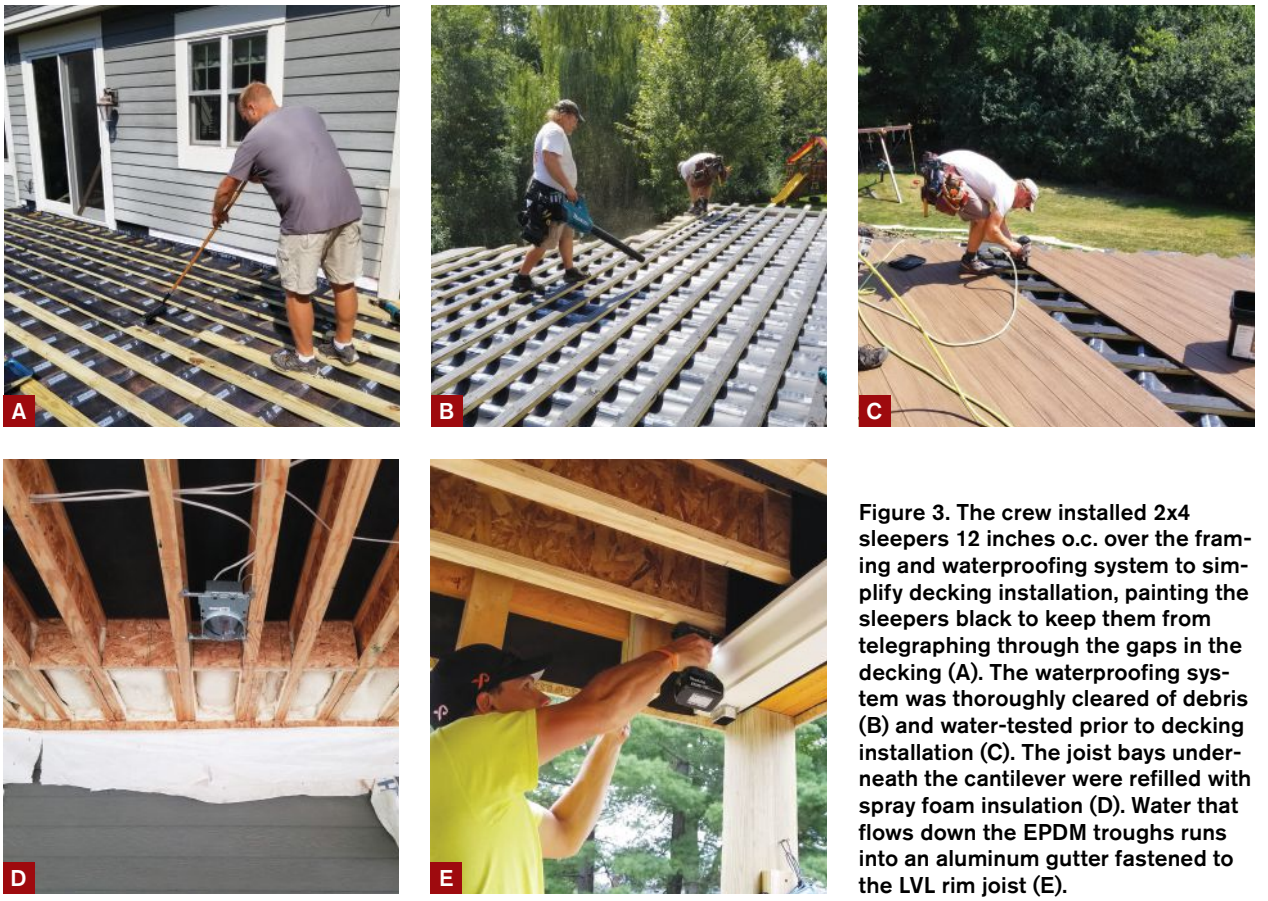

Figure 3. The crew installed 2x4 sleepers 12 inches o.c. over the framing and waterproofing system to simplify decking installation, painting the sleepers black to keep them from telegraphing through the gaps in the decking (A). The waterproofing system was thoroughly cleared of debris (B) and water-tested prior to decking installation (C). The joist bays underneath the cantilever were refilled with spray foam insulation (D). Water that flows down the EPDM troughs runs into an aluminum gutter fastened to the LVL rim joist (E).

to install midspan blocking every 6 feet on-center to help straighten out any cups in the joists. What we couldn't fix with midspan blocking, we would then have to plane down to get everything lined up, a tedious and time-consuming—though absolutely critical—step.

Waterproofing

Our water protection system started out as a 100-foot-by-20-foot roll of 50-mil EPDM rubber. Using the on-center distance between each set of joists as well as the distance from the ledger on the house to the front rim (plus a couple of extra calculations), we laid out our troughs on the full sheets of EPDM. The resulting strips had a tapered shape that was roughly 4 inches wider at the beam end.

After cutting and labeling the troughs, we cut out the bibs, which were 14-inch-by-18-inch rectangles installed at the front of the beam to direct water flowing down the trough into the gutter (**Figure 2**). We also cut perimeter strips from the membrane; these varied in size and were used to cover the front rim and any flat blocks that directed water from the front edge back into the main troughs.

Installation started with the bibs. These were stapled tight to the front rim and flush with the top of the joists, so that they wrapped around each side of the joist bay a few inches. The bibs hung below the joists by about 4 or 5 inches and were trimmed to length once the gutter was installed (the main thing here was to make sure the bib hung into the gutter).

Next, we installed the troughs, starting at the house. We tucked each trough up behind the housewrap 6 inches and sealed it to the sheathing with neoprene flashing cement. We then stapled the troughs down along one entire joist before starting over at the house on the other side. Since the troughs were tapered, installing one edge of the rubber along the edge of the joist automatically creates a pitch away from the house, as the trough starts taut and loosens up at the front rim.

As we installed each trough, we ran a bead of neoprene flashing cement over the previous trough on top of the joist, where the two troughs would overlap. When we were done installing the troughs, we taped the seams on top of the joists with 4-inch-wide Vycor, a self-sealing flashing tape that added another layer of protection to the assembly.

Finally, we taped any other seams in the membrane, as well as where the Tyvek housewrap overlapped the rubber

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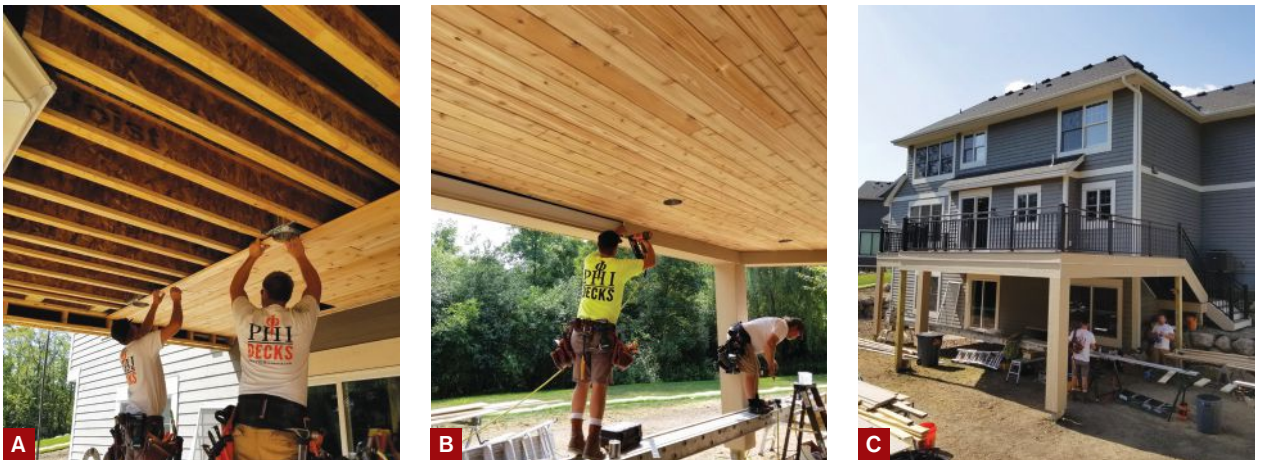

Figure 4. The crew blind-nailed tongue-and-groove cedar to the underside of the I-joists to finish the ceiling (A). The gutter system is concealed by LP SmartSide trim, which can be removed for inspecting the drainage system and cleaning the gutter (B). The nearly completed deck features an expansive dry area underneath, ready for paver patio installation (C).

membrane. This ensured any water running down the Tyvek would be directed into the trough system.

Sleepers

We installed the decking over a sleeper system, which consisted of treated 2x4s installed 12 inches on-center perpendicular to the main joist framing (**Figure 3**). The sleepers allowed us to complete the initial framing more quickly, since we didn't have to account for seam boards or other decking details that would require blocking.

The sleepers also simplified water protection under the perimeter picture-frame border. Where the border ran parallel with the sleepers across the front of the deck, we installed short 2x4 blocks directly on top of the joists and beam.

At all of our railing post locations, we screwed 2x10 flat blocks directly into the joists below and toe-screwed them into any adjacent sleepers. We put a dab of neoprene sealant between any 2-by sleepers or blocking and the rubber, and fastened them to the framing with pairs of #10 2½-inch structural screws. The sleepers and blocking helped lock the entire system together, making for a very rigid structure. Afterward, we hit everything with a quick coat of black paint so that the sleepers and blocking wouldn't be visible through the gaps between deck boards.

Before installing the decking, we thoroughly cleaned and water-tested the drainage system by flooding it, especially in all the corners along the house. This was a critical step on this project; if we had found any leaks (we didn't), we would have diagnosed the cause and repaired that defect, rather than just blindly filling the area with more caulk.

Finishing Up

On this project, we installed Azek PVC decking using TigerClaw clips and guns. Around the perimeter, we fastened the picture-frame border with 2-inch (rather than 2½-inch) Cortex screws and plugs so that we didn't run all the way through our sleepers and into the rubber below. Since 2-inch screws have a little less bite than 2½-inch screws, we spaced them more closely together.

We installed a Westbury aluminum railing system with top-mounted posts. Because we had installed flat blocking between the joists at all post locations, as well as additional blocking as part of the sleeper system, we had a solid 3 inches of framing and one inch of decking for fastening our posts. After predrilling holes for GRK RSS lag screws, we squirted some neoprene sealant into them prior to installing the post fasteners.

After one more water test, we moved on to finishing the underside of the deck. First, we installed an aluminum gutter system across the front edge to direct the water from the bibs out into the landscaping. After the electrician installed the recessed lighting cans and 110-volt wiring, we finished the ceiling with 5½-inch WP4 tongue-and-groove cedar (**Figure 4**). To match the house, we trimmed out the posts and beams with LP SmartTrim.

The trim covering the gutter is removable, and we've planned regular inspections to check and (if necessary) clean the gutter. We're also lobbying the owners to install heat tape to keep the gutter from freezing up in the winter, along with vents along the house side to promote airflow through the joist bays in the warmer months. ❖

Tim Brown is a co-owner of PHI Decks in Plymouth, Minn.

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Approved by:

Trex

FastenMaster PRO Driven

The vaulted ceiling gives the sunroom a spacious feeling (left) without interfering with the views from the second-floor windows (top). Japanese-style "rain chains" guide water collected by the gutters away from the walls (above).

A Circular Screened Porch

by Andrew Wormer

While this 40-year-old northern Virginia home already had a nice stone patio, the homeowners were looking to expand their outdoor entertainment options. The challenge? To work within the footprint of the existing patio, which had been built by their son, while not obstructing views of the nearby woods from the upper level of the home.

The NARI CotY award–winning solution that Bob Gallagher and his team at Sun Design Remodeling came up with features a circular design and a conservatory-style conical roof with a 12-foot-high peak. The circular screened porch connects to the home's lower-level family room, which was already equipped with a bar and kitchen area, creating separate areas for the family to dine, entertain family and friends, or simply sit in an area protected from bugs and rain while enjoying the outdoors.

After partially disassembling the travertine stone patio pavers, the Sun Design team corrected some grading issues that had created a drainage problem underneath the original patio. Then they installed concrete footings and 6x6 PT posts to support the structure's 2x8 PT wall framing.

The circular porch features a knee wall clad with natural stone veneer both inside and out. The knee wall is capped with stone taken from the existing patio, helping to tie together the existing elements and the new work.

The posts and columns are wrapped with PVC trim for low maintenance, and have strategically placed weep holes in the wall assembly to allow water to drain out. The room is finished with a vaulted tongue-and-groove beadboard ceiling, which gives the space a more expansive feel and a traditional look.

On the outside, gutters collect water draining off the conical roof. But instead of clunky downspouts, the design features rain chains to avoid obstructing the view from inside the pavilion. ❖

Andrew Wormer is the editor of PDB.

PHOTOS BY GREG HADLEY PHOTOGRAPHY

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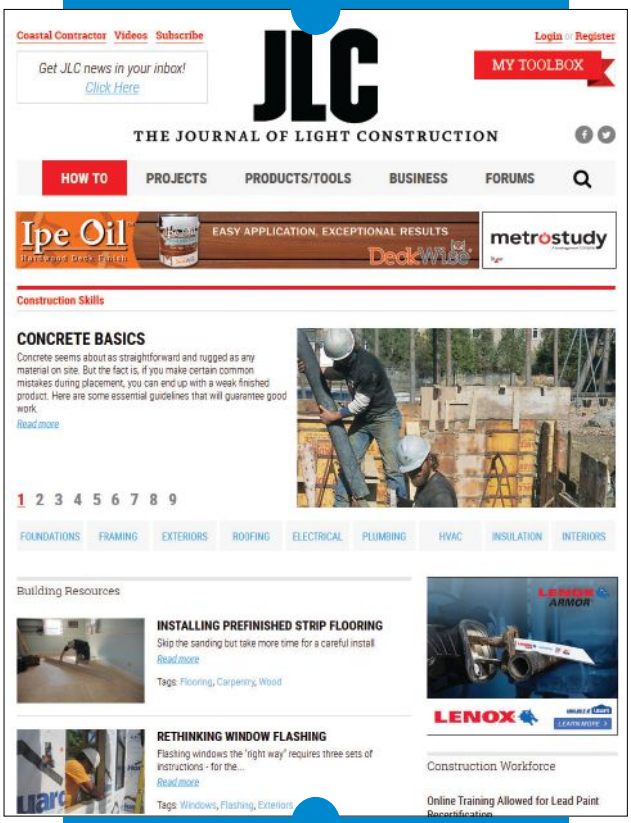

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BY JAKE LEWANDOWSKI

Repairing Rotted Trusses

My family has a structural repair business in the greater Chicago area, and we are often called in to repair damage caused by water leaking into a building. In my position as project manager, I am responsible for assessing the problem, coming up with a repair solution, and then making sure that the repairs are completed properly in the most efficient way, while being fair and honest to the client.

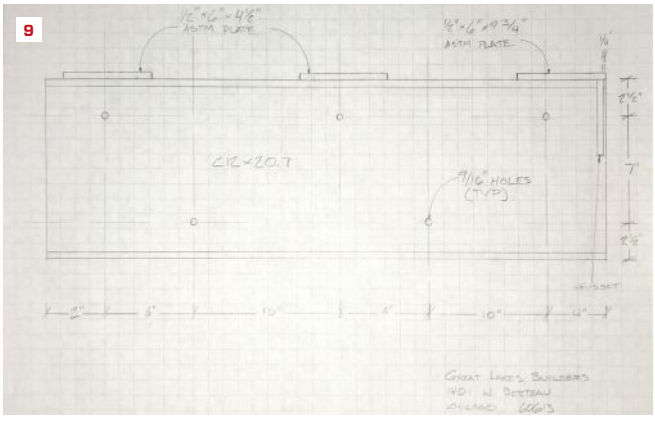
Damage from a roof leak. We recently were called in to repair trusses on a townhouse that was built in the mid-1990s. The trusses supported a third-floor deck with a living space below. After seeing water damage on some interior drywall, the clients opened up the wall below the trusses. When they found extensive mold, they removed the rest of the drywall, exposing an adjacent CMU wall with pockets that supported the trusses. The ends of three of the trusses had rotted **(1)**.

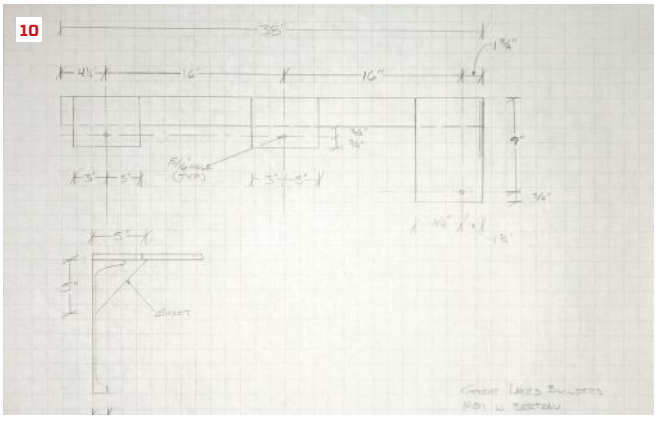
After removing the ceiling drywall and finding more mold, the clients discovered that water had been coming in where the roof met the parapet wall. The contractor who had done all the work up to that point replaced the entire roof under the deck, including the sheathing. A mold-mitigation company cleaned away the mold and painted all the framing with white mold-resistant primer. An engineer was called in to assess the damage to the trusses, and we were called in to do the structural repair to the trusses.

Engineer's specs. The engineer's recommendations were specific. The trusses needed to be lifted to their original height and cut flush with the inside face of the CMU wall, with the rotted sections removed. To reinforce the ends of the trusses, 3/4-inch plywood gussets were to be attached to both sides of each truss with 10d nails 3 inches on-center on all chords. To keep the plywood from cupping under the load, 2x4 squash blocks were to be inserted between the top and bottom

Removing water-damaged ceilings and walls revealed three trusses with rotted ends **(1)**. To reinforce them, the author made plywood gussets. He traced the chord pattern onto a blank **(2)** and made a template to transfer the fastener layout **(3, 4)**. Squash blocks stiffened the ends of the trusses **(5)**.

Photos by Jake Lewandowski





A palm nailer was used to drive the specified fasteners at each location to attach the gussets to the ends of the trusses **(6)**. The crew used screw jacks and beams to lift the trusses to their original height **(7)**, then cut away the rotted wood with a reciprocating saw **(8)**. With an engineer's guidance, the author drew the support-beam elevation **(9)**, plan, and section **(10)**.

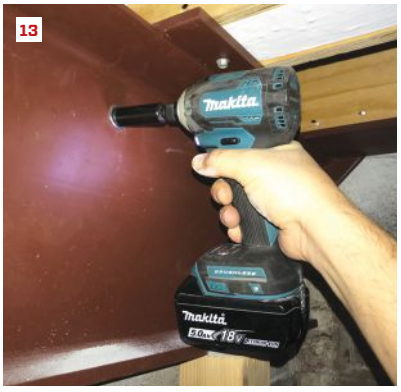
chords. Then MC 12 x 14.3 steel C-channel (12 inches tall and weighing 14.3 pounds per foot) needed to be fastened to the CMU wall below the trusses to support their load.

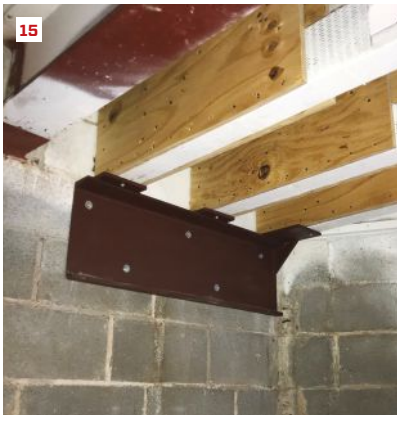
Plywood gussets. The first step was making the plywood gussets for the 15-inch-tall trusses. We cut blanks 15 by 36 inches out of 3/4-inch plywood with the grain running in the long direction. To ensure that we met the nailing schedule on all of the gussets, I made a fastener template by clamping one of the blanks to the side of a truss and tracing the outline of the truss chords **(2)**. Then I plotted out the fastener locations and drilled a 1/2-inch-diameter hole at each location, big enough for a marking pen. With that pattern, we were able to quickly transfer the exact fastener locations to each of the six gussets **(3, 4)**.

Before attaching the gussets, we inserted the 2x4 squash blocks as specified by the engineer **(5)**. We then clamped the gussets to the trusses and drove nails at each fastener location, using a palm nailer **(6)**. With the gussets in place, we spanned across the underside of the trusses with beams and lifted them using a four-point screw jack assembly **(7)**. When the trusses were at the proper height, we cut the rotted part off the ends with a reciprocating saw **(8)**.

Steel support. The channel specified by the engineer had a flange depth of 2.12 inches, which meant that the modified trusses would have only 2 1/8 inches of bearing. I needed to increase the bearing in a way that could be concealed by the contractor coming in after us to do the interior finish. Additionally, one of the trusses was in much worse shape than we had originally thought—with no solid wood until 8 1/2 inches from the end. So I called the engineer and asked if I could use sections of 1/2-inch plate welded to the channel to extend the bearing area. For two of the trusses, the plate would be 4 1/2 inches long; to adequately support the worst one, however, we'd need a 9 3/4-inch section. These sizes would provide enough length to support the trusses and to allow for drilling holes to lag the plates into the trusses.

The engineer specified adding a diagonal gusset to support the longest plate section, but he said I could put the gusset at the end of the channel to keep it concealed in the wall. Armed with all of this





The author's approved drawings guided the fabrication of the support beam **(11)**. With the beam lag-bolted to the trusses, the crew drilled holes for the anchors **(12)**. The anchors were first snugged with an impact driver **(13)**, and then given their final torque with a ratchet wrench **(14)**. The final assembly will be concealed in the wall after the finishes are applied **(15)**.

information, I drew up the beam with the supports, the gussets, and the fastener locations and sent the drawings to the engineer **(9, 10)**. After getting his approval, I gave the drawings to my steel fabricator, and he made up the support beam with the welded support plates **(11)**. The drawings were pretty basic, but doing them gave me control over exactly how the beam would turn out, and it saved me the expense of hiring someone to draw the beam.

Installing the steel. The steel support beam arrived painted with a rust-resistant finish. Two crew members lifted the beam and held it in place under the trusses while I drove 1/4-inch lags into the trusses through holes drilled in the support plates. The lags held the beam in place temporarily while we fastened the vertical part of the beam to the CMU wall. At this point, the trusses were already at their final elevation, but to make sure that they wouldn't drop a bit when we removed our temporary supports, we jacked a 4x4 post under the channel to keep it snug against the trusses.

The engineer specified 1/2-inch-by-2 1/4-inch Hilti HLC-H sleeve anchors to fasten the steel channel to the concrete block wall. I had laid out the fastener holes for the steel fabricator to ensure that the fasteners landed well clear of the mortar joints between the blocks.

With the steel channel held firmly in place, we drilled holes for the sleeve anchors **(12)**. After drilling the holes, we blew the dust and debris out of them and tapped the anchors into place. It is important not to overtighten sleeve anchors, so we first tightened them with an impact driver until they snugged up **(13)**, then finished torquing the sleeve bolts by hand with a ratchet wrench **(14)**. After removing the temporary supports under the trusses, we cleaned the jobsite thoroughly (we always try to leave the place cleaner than it was when we arrived). Our job as the structural repair crew was finished and the site was ready for the restoration crew to come in and reconstruct the interior finish **(15)**.

Jake Lewandowski is a construction manager with his family's business, Great Lakes Builders (greatlakesbuildersinc.com), specializing in structural repairs in Elk Grove Village, Ill.

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*Advertising appears in regional editions

BY SYMONE GARVETT

1. Stainless Steel Gate

Viewrail's railing gate is made of marine-grade 2205 duplex stainless steel with 3/8-inch rod railing infill. The gate pairs with Viewrail's self-closing and tension-adjustable polymer hinges and latches and is available in two styles: a shorter model with a universal top bracket for a top rail (shown) and a domeless model that matches the height of the adjacent railing. The gate comes powder-coated or in brushed stainless steel. Pricing for a single gate without hardware starts around $750. viewrail.com

2. Durable Opening Glass Wall

NanaWall Systems says its opening glass wall, the NanaWall SL73, meets or exceeds standards for water, wind, and debris resistance in high-velocity-wind zones. Reinforced structural posts run down each panel and a multi-point locking system incorporates top and bottom rods. The system also incorporates specialized seals, floor support, and high-performance raised floor sills. Contact a local distributor for pricing. nanawall.com

3. Smart Security Surveillance

The Arlo Go smart security camera is designed for use indoors and out, with rechargeable batteries and an IP65-certified weather-resistant chassis. The camera automatically records motion- or sound-triggered events and transmits them to a connected cloud library via LTE mobile data connection, which users may access through the Arlo app. The app also allows users to set schedules, network multiple Arlo cameras, or activate two-way audio to listen in or talk back through the camera. Pricing starts around $350 but varies based on data provider. arlo.com

4. Voice-Activated Dimmer

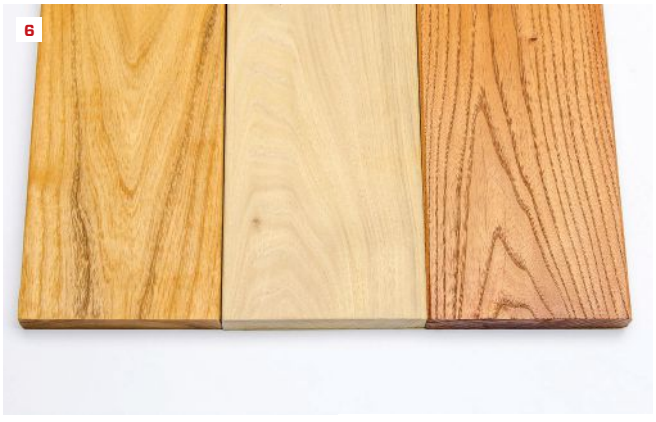
Leviton's upcoming Decora Voice Dimmer combines dimming and three-way capabilities with integrated hubless voice control powered by Amazon Alexa. Using voice commands, homeowners can dim and brighten lights, play the news or weather, and control additional smart-home devices. The dimmer's hardware replaces conventional light switches and may be installed in a new or existing home through a neutral wire. The fixture's three-way compatibility provides dimming control of the same fixtures from multiple locations. It is expected to be available in mid-2019. leviton.com

5. Contemporary Cabinetry

Timberlake's Sonoma cabinets boast a contemporary interpretation of Shaker design with crisp edges and flat surfaces. Doors are full overlay and offered in veneer or mortise-and-tenon construction. Other product features include 21-inch-deep drawers, side-mounted glides, adjustable and hidden hinges, and 3/4-inch-thick wall and base shelving. The cabinets are available in maple, cherry, and painted finishes, with painted doors featuring engineered-wood center panels. Contact a local distributor for pricing. timberlake.com

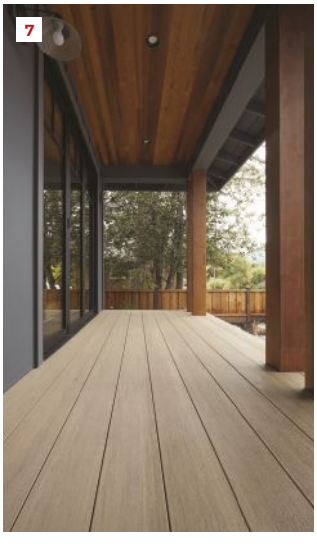
6. Sustainable Decking Material

Decking manufacturer Robi Decking uses lumber from black locust trees, a native North American species well-known for its natural rot-, decay-, mildew-, and insect-resistance. The material is most comparable to ipe in terms of durability but grows faster at a high density, making the product more sustainable than FSC-certified tropical hardwoods. The company also offers eastern juniper and sassafras decking, and black walnut for high-end screened porches. Pricing ranges from $2.30 to $5.09 per linear foot. robidecking.com



7. Multi-Width Deck Options

TimberTech by Azek Building Products has introduced multi-width decking options to its Vintage collection, including narrow (3 1/2 inch) and wide (7 1/4 inch) widths in addition to the traditional 5 1/2-inch width. The wide board reduces install time and the number of fasteners required, while the narrow version brings a high-performance, capped polymer option into the market. With three sizes, deck builders can combine widths to create a range of designs and patterns. Pricing will be announced soon. timbertech.com



8. Thermal Imaging Attachment

The Flir One Pro LT thermal-imaging smartphone attachment is designed to provide the thermal-image quality and tools of the Flir One Pro series at a lower price. The Flir One Pro MSX image enhancement tool provides a combined thermal/HD-visible camera image that is crisp and easy to interpret, while VividIR video signal processing delivers improved thermal-image quality. Flir has also released an updated version of its app, which provides multiple spot temperature meters and temperature tracking regions. The Flir One Pro LT is available in iOS, Android Micro-USB, and Android USB-C configurations and is priced at $300. flir.com

9

10

11

12

9. Structural Wood Screw
FastenMaster now offers flathead versions of its LedgerLok structural screws. The code-compliant LedgerLok Flat Head was engineered to fasten a deck ledger board to a house rim with no predrilling. Its built-in washer head eliminates the need for an additional washer, and its internal Torx ttap drive system installs flush to the ledger surface. A three-step coating process protects against corrosion. Pricing ranges from $21 for a 12-pack of 3 5/8-inch screws to $194 for a bucket of 250 5-inch screws. fastenmaster.com

10. Hands-Free Opening System
The Libero electronic opening system, designed for use with Richelieu's E-Cargo and Euro Cargo waste bins, provides hands-free opening for cabinet-integrated waste bins. The low-voltage sensor device can be secured with four screws to the bottom of a base cabinet. It is activated via motion sensor; the drawer opens when the user waves a foot in front of the sensor in the kick board. An integrated LED light indicates the sensor's position to the user. Pricing starts around $300. richelieu.com

11. Compact Combination Boiler
Rheem's Professional Prestige Combination Boiler is the latest innovation in the company's tankless gas water-heater line-up. At 95% AFUE, the Combi Boiler is Energy Star–rated and provides efficient hydronic heating and continuous hot water even in the coldest climates, says the manufacturer. The high efficiency is a result of the Combi Boiler's ability to extract more heat from the unit's exhaust gases, according to Rheem. Its compact design makes it easy to install and ideal for smaller homes or multifamily applications. Pricing ranges from $2,280 to $2,450. rheem.com

12. Shiplap-Style Paneling
Modified-wood manufacturer Kebony has launched a new style of shiplap-style paneling, Tongue-and-Groove Nickel Gap Shiplap, for interior use. Kebony uses a bio-based liquid to modify the cell walls of sustainable softwoods, giving them hardwood characteristics, a rich brown color, and increased durability. Each panel is grooved at top and bottom, allowing the pieces to fit together with a horizontal reveal between each lap. Six-inch widths are available as standard, with narrower widths available as specified. Kebony's Tongue-and-Groove Nickel Gap Shiplap is available in a clear grade. Pricing ranges from $7.50 to $12 per square foot. kebony.com

World of Concrete: Tool Roundup

BY MARK CLEMENT

In 2018, I presented some JLC Live-style demos at The International Builders' Show. The demos were supported by Ridgid Power Tools. And, like every other exhibitor there, the good folks at Ridgid filled out their bills of lading and trusted a couple of pallets of table saws, miter saws, cordless tools, and nailers to the process that takes several acres of empty room and turns it into a neat grid and miles of carpeted aisles bordering hundreds of exhibitor booths and displays.

Unlike most of the other items—everything from faucets to siding to 3/4-ton pickups—being whizzed through the doors from a line of 18-wheelers at the freight dock, our tools got lost. That's when I met the guy who coordinates it all. As day turned into night, we were running out of options and we needed those tools.

Around 9:30 that night, he found them—in the back of a semi-rig. And even though the stress of our now torpedoed prebuild schedule was brutal, my takeaway from it is one line he said I'll never forget: "10 million pounds of freight comes through these doors."

Well, if IBS is 10 million pounds, World of Concrete is 25 million. I didn't weigh it myself, but it's big. And the tool companies want to be there. Hilti and Bosch build small cities (Bosch's had a tattoo parlor ... not kidding) with a fleet of Dodge trucks skirting their impact drivers and, well, a tattoo parlor. Hilti broke up Stonehenge-big concrete slabs with its hammers for three days and knocked over laser levels time and time again. What DeWalt and Makita lacked in urban planning, they made up for with a party-style atmosphere and booths crammed with tools and people.

And while the big guys made their big splashes, there were some smaller players there too, with some smaller items that elicited an immediate reaction of "that'll work."

So despite the feeding frenzy of pumper trucks, heavy-lift telehandlers, and four-story "booths" as far as the eye could see, here are six small things that fight above their weight.

Mark Clement is editor of Tools of the Trade.

Improved Dirt Chisel

I associate Fiskars with home, garden, and crafting stuff. But a recent spate of entries into the pro lineup has found a home in my truck. Namely, a great shovel that, apparently, the manufacturer improved since last year. The one I have is all steel. I thought it couldn't be improved, but I stand corrected. If you want a shovel that will last forever, take a look.

The Fiskars Pro Digging Shovel features ultimate durability, making it ideal for digging and prying in tough soil. An extruded aluminum handle ensures superior strength, while double-bolted connections guarantee the tool will not come apart. The heavy-gauge spade has a sharpened edge that makes it easier to dig and chop roots. A large step provides more stable footing—this is a great feature—while the shaft angle is optimized for digging and prying. The shaft is also teardrop-shaped to better fit the contours of your hand. Additionally, Softgrip touchpoints on a high-visibility handle enhance comfort and control, as well as reduce repetitive fatigue. The simple, heavy-duty construction of this shovel makes it a reliable choice for daily, quality performance under all conditions. Full lifetime warranty. Cost: $60. fiskars.com

Fiskars long-handled shovel has a sharpened leading edge and a large "step" that is nice for starting holes, especially in muddy conditions. It comes with a lifetime warranty, too.

Arctic Warmers says its Caulk Warming Bag will keep caulks, tapes, and foams at a temperate 80°F even if the Polar Vortex spins out -13°F temperatures.

Caulk, Spray Foam, and Tape Warmer

Among Arctic Warmers' suite of heated bags, wraps, hose wraps, and bucket warmers, its Caulk Warmer Bag seems to be the most versatile. It's a general-use satchel that can hold 12 standard caulk tubes, seven quart-size caulk tubes, 12 grease cartridges, eight cans of foam, and twelve rolls of sealing tape. Who said you can't properly flash windows in the winter? The company says the satchel maintains an even 80°F, even at outdoor temps of -13°F. The wraps feature a nylon outer material with a closed cell insulator and a vinyl interior, and come with a cord pocket and carry handle. The company also has a 5-Gallon Pail Warming Heater Wrap, which is designed to keep paint viscous enough to flow freely on freezing sites (or in the van overnight using shore power). Cost: Caulk Warmer Bag, $106; Pail Wrap, $108. arcticwarmers.com

Jobsite Illumination

Technically a corded/cordless "Emergency Area Light/Under Hood Work Light," Nightstick's SLR-2120 seems like a fully-featured worklight that could solve loads of jobsite and truck lighting problems. Run via on-board battery or plugged into the wall via its charger, the body rotates 360 degrees. The 2120 has two settings: Full power is 1,200 lumens; half power, 650 lumens. It has on/off buttons on either end. The flat surface at the end of the Nightstick enables you to stand it upright—a useful feature for cramped jobs—and a hook enables you to hang it from a screw. Three flush-mounted magnets are located at the end of each pivoting handle. This, Nightstick says, allows one or both ends of the light bar to be attached to virtually any magnetic surface. It requires six hours to charge fully and will run for 4 1/2-hours in full and 8 1/2 hours in half modes. Finally, the hood-mounting hooks extend from 48 to 70 inches. I see no reason why they wouldn't hang on, say, ceiling joists in an open frame. Maybe lay the hooks over blocks to simulate them wrapping around a car hood. Or, just wrap them around your car hood. Cost: $114. baycoproducts.com

Nightstick's underhood light looks like it needs to get out of the garage. Magnets mean you can stick it to metal—like the inside of a van—while the adjustable handle has a hook for vertical positioning. The nightstick runs on batteries or AC power.

A Lighter Loader

The secret in the Avant loader sauce is the articulating body, says the company. And, five seconds watching one wend its way through a course of cones leaves little doubt the claim delivers.

The 200 series hits that subcompact-loader sweet spot—and you don't have to stand up or walk to operate it. It's not fair to call it a tractor or ATV-style unit, though it looks similar in stature—it's better. It's small and mobile and its PTO can drive 100 attachments, including a snow plow and lawn mower.

Avant say the design enables it to make lighter machines that perform better, with lower ground impact, because the loaders make sweeping turns instead of skids. And the body style enables it to deploy a telescoping boom from the front arm, ideal for anything from loading lumber to dumping dirt over the side of a taller dump truck or trailer.

The company claims this format uses less fuel and far fewer tires and is overall a superior design for the light loader. It is 100% worth checking into if you're bringing iron into your shop. Check with a dealer for pricing. avanttecno.com

Best Caulk Gun Ever?

It doesn't seem like it'd be that hard to make a decent caulk gun. Yet, finding one seems to be something of a challenge. Almost anything for sale in a big box store is lacking some combination of spout cutter, puncture rod, or the ability to actually release pressure from the tube ... except for these new ones from Dripless, which are available in some Home Depots. At the demo area, the gun fully released pressure on the tube. I'll say that again: Fully. No secret trail of goop slithered out after the button was depressed. The spout cutter not only exists, but it's sharp. The frame is made from what looks to be a tough composite. And it has a puncture rod. Dripless says the ETS2000 models are best for paint applications because they cost less. If you're squeezing urethane on a cold day to adhere sheathing, Dripless says the ETS3000 is a better bet. Cost: ETS2000, $12.50; ETS3000, $16. dripless.com

Like Music To Your Ears

On a show floor that spilled out into three separate parking lots packed with hundreds of items easily costing $250,000 or more, finding Plugfones, a $25 item, was a coup. There are three models of Plugfone: Bluetooth Liberate 2.0 (shown), Guardian Plus (plug into your phone jack), and Guardian. Basically safety-style ear plugs for your ears on a cord, the Guardian is a listen-only model. The Guardian Plus has a microphone. And the Liberate 2.0 is a fully featured wireless headset with a microphone. You can get replacement plugs in foam or silicone. The Liberate looks really dialed in: noise-canceling tech for incoming sound and mic, a long-lasting battery, quick charge, and control of your device from the Plugfone. Cost: Liberate 2.0, $100; Guardian Plus, $35; Guardian, $25. plugfones.com

BY RYAN STEPHENS

Avoiding Nail Blowouts

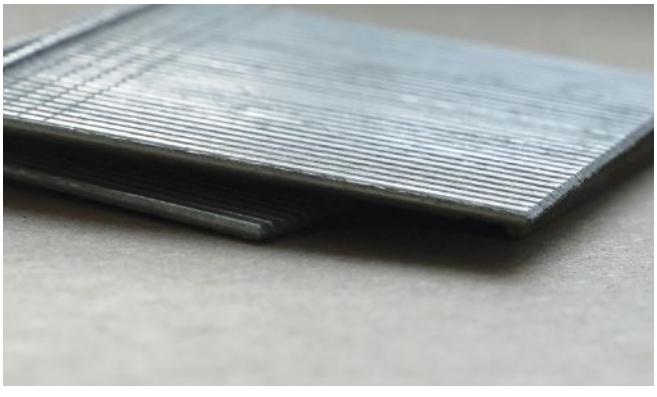
This is one that some finish carpenters already know, but I'm often surprised how many don't: The chisel-point orientation on brad and finish nails plays a big role in nail blowouts. Chisel points on brad and finish nails for pneumatic and cordless nailers are formed by grinding a slight bevel on each side of the nail strip (see photo, below). As the chisel point plunges through the wood, the shank will only bend to one side or another if it meets resistance (from a pin knot or change of grain or the like). That is, it bends in a direction towards the sides of the nail strip, as it sits in the magazine, but not to the front or back of the nailer. Brad nails (formed from 18-gauge wire) are most at risk, but it can happen with a stiffer 16- or 15-gauge nail, too.

A prime example is shooting the casing onto a door jamb, where the nail has to be within 3/8 inch of the edge of the casing (any further from the edge and you won't get good purchase in the edge of the door jamb). Any sideways bend of the nail is at risk of blowing out near the reveal or the side of the jamb.

The solution: Simply orient the gun so the nailer is always perpendicular to the edge that might blow out. That means the gun needs to be horizontal to the floor, not positioned vertically, when nailing off side casings (see photo, below). But at the head, the gun needs to be vertical. Once this change is made, the chisel orientation of the nail might bend into the wood (parallel to the casing), but not out.

Using this method, I'm able to shoot a 2-inch brad nail without mishap; I haven't had a blowout in years. Although, it's worth noting that I usually use 1 1/2-inch nails for wood-to-wood contact and 2-inch nails for going through the drywall.

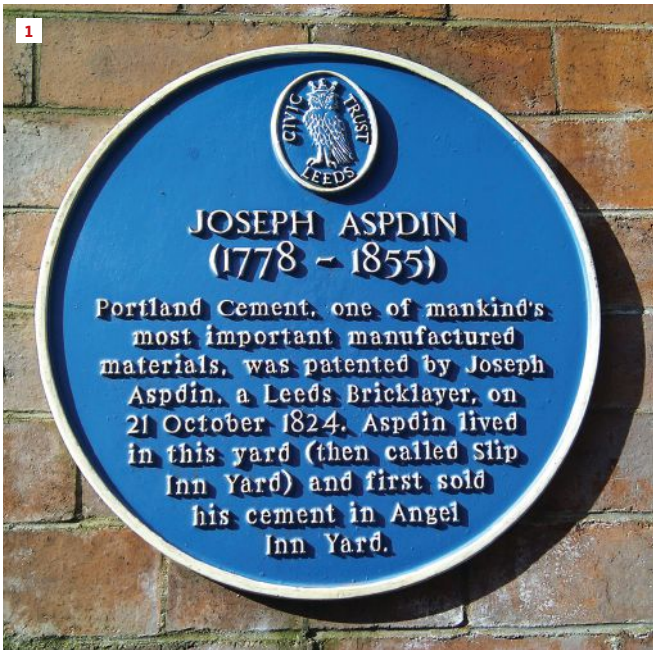
Ryan Stephens is the principal of Stephens Homes in Olympia, Wash.

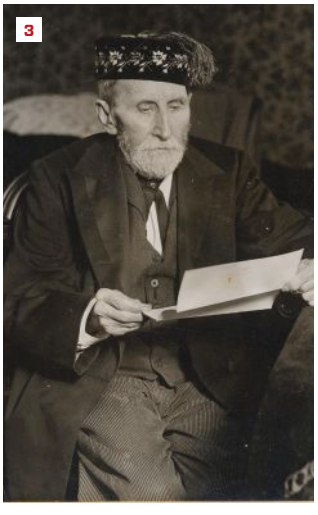


Photos: top left, Aleksandra DeKorne; top right, Ryan Stephens

Send us your tips: *JLC*, in partnership with our sister publication *Tools of the Trade* and Milwaukee Tools, is giving away a power tool each issue to the reader who sends us the most ingenious or most useful trade tip. Next month, we'll give away a cordless Milwaukee M18 Fuel 15-Gauge Finish Nailer Kit (see photo, 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. But please send us high-quality photos to explain your tip.

BY JLC STAFF





A plaque in Leeds, England, proclaims Joseph Aspdin as the father of Portland cement **(1)**. But it appears to be Aspdin's son, William **(2)**, who actually discovered the method for producing the material. Some years later, Isaac C. Johnson **(3)** independently rediscovered the secret. Late in life, Johnson wrote an autobiography claiming to be the "true" inventor of Portland cement.

Who Invented Cement?

A plaque in the English industrial city of Leeds proudly proclaims a son of the city, bricklayer Joseph Aspdin, as the inventor of Portland cement. Like much history, however, this claim is at best only partly true, says Robert Courland, the author of "Concrete Planet: The Strange and Fascinating Story of the World's Most Common Man-Made Material." What is more likely, according to Courland, is that the secret of Portland cement as we now know it was stumbled on by Aspdin's son, William. In his book, Courland describes a cast of characters worthy of a Charles Dickens novel—and at the center of the plot is William Aspdin, a self-promoting swindler and con man who also happens to be the true father of Portland cement.

Joseph Aspdin did, as the plaque states, patent a material called Portland cement in 1824 (the cement being similar in color to Portland stone, popular in England at the time). But his lime-based mortar was not much harder or stronger than any other product of its day, though Aspdin worked mightily to improve the product, experimenting with various formulas and ways of producing the powder. (As a humble bricklayer, Aspdin had trouble procuring the rough limestone for his efforts—apparently even going as far as to pilfer stone from local roadways, a practice that twice got him fined by the authorities.)

Aspdin the elder would grind up the stone, mix it with water and clay, dry the mixture, kiln it until it was hard, and grind it up again to make his cement powder. Apparently, he discarded some of the product—the overbaked "clinkers"—because it was too hard to grind. It was William, the son, who seems to have had the bright idea of saving and grinding up the clinkers. And it was the clinkers that yielded the cement that actually rivaled Portland stone for hardness and durability.

William broke with his family in 1841 and moved to London, where he set up in the cement business on his own. Writes Courland, "William apparently kept the secret of the clinkering process to himself, for there is no evidence that his father made clinkered cement after his son's departure to London."

Over the years, William would make a name for himself in a less fortunate way: as a serial embezzler, who pocketed everything from co-investors' cash to his employees' wages. His advertising claims for his cement—good as it was—amounted to creative fiction, according to Courland. But for many years, until a competitor named Isaac Johnson finally figured out how he was doing it, Aspdin's Portland cement dominated the industry. Still, his penchant for cheating his partners brought him to trouble. He ended his days, at the age of 49, alone and friendless in Europe.

Images courtesy: 1, Ben Dalton via Wiki; 2, "Concrete Planet," by R. Courland; 3, the110club.com

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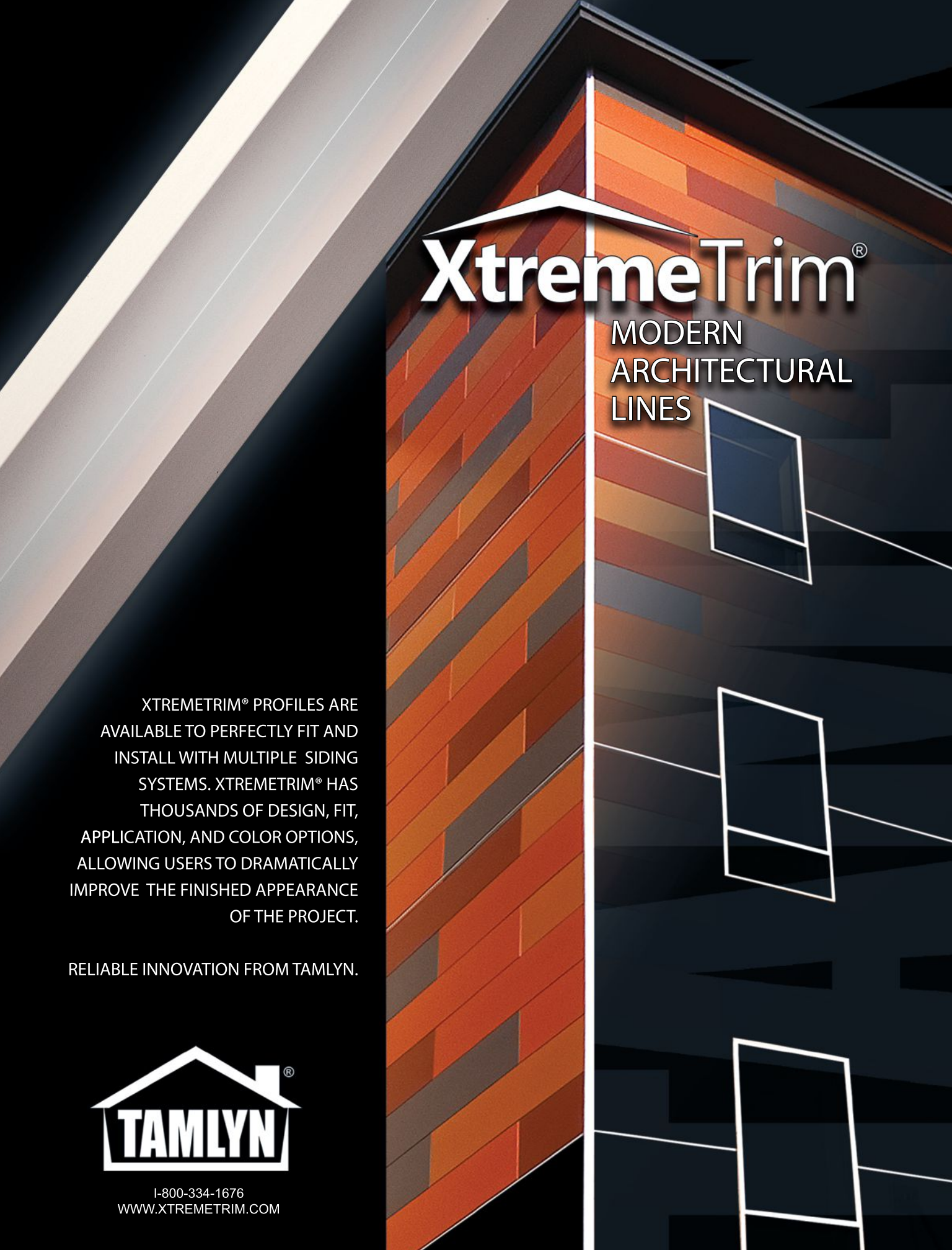

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