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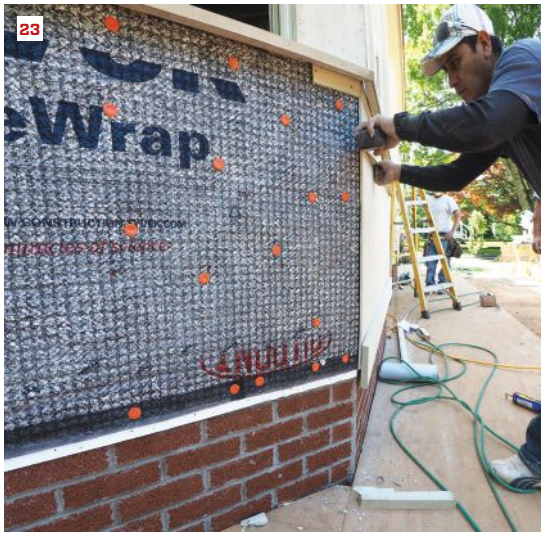

On the cover: Jorge Garcia of Garcia Welding, based in Lake Villa, Ill., field welds a new column connection on an extensive structural renovation by Great Lakes Builders. Photo by Jake Lewandowski. See the story on page 32.

FEATURES

DEPARTMENTS

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BUILDING ENCLOSURES

BY JOHN SPIER

Working Smarter, Not Harder

In my last article, "Rules for Better Framing" (Nov-Dec/23), I introduced some guidelines that are important to follow to be a good house framer. These were general concepts that apply to any complex job that is part of a larger, integrated project, and they were mostly aimed at the person managing the job. In this follow-up article, I summarize principles and habits that are necessary to adopt to be an efficient and valuable worker, whether a laborer or a highly skilled artisan. As in the previous article, these are general concepts that apply to any trade.

1. MAKE EVERY MOVE COUNT

Some workers always seem to be in a hurry, and others seem to saunter around a jobsite. Who is more efficient?

In my experience, speed of motion is mostly a matter of personality; whether you are a fast mover or a slow mover, being efficient means not wasting any of that motion. If you need six blocks, for example, collect six scraps, line them up, take out your tape, pencil, and square once, pick up the saw once, cut them all to length at the same time, and then take them all to where you need to nail them up. Instead of letting them drop to the floor, catch and stack them as you cut; this way, you avoid having to bend over to pick them up **(1)**.

Practice minimizing your moves. If you can hold something where it goes and mark it, why use a tape measure and square? Better yet, if you can hold it in place and cut it, or nail it on and then cut it, you've saved a bunch of steps **(2)**.

If a cut doesn't need to be squared, don't square it. If you're climbing stairs or a ladder, don't make two trips if you can make one.

Efficiency is not brilliant ideas for saving a lot of time (that's genius); it's saving little increments of time all day long.

2. HAVE WHAT YOU NEED WHERE YOU NEED IT

As we carpenters get older, toolbelts weigh heavier on our hips and shoulders. But the most inefficient thing you'll see on a jobsite is that guy who takes his belt off all the time, typically because it is too heavy and uncomfortable or because it's bulky and gets in the way.

I would feel naked and unprepared doing most jobs without having at least the following on my person: hammer, tape measure, square, utility knife, pencil, marker, chalk line, chisel, nail

When you're installing blocking, it's more efficient to measure, mark, and cut all the pieces to length at once than handle them one at a time **(1)**. When "speed cutting," the author aligns the left end of a scrap 2-by with the left edge of the stud on his left and registers the base of the saw against the left edge of the stud on his right, using the 1^1/$_2$-inch offset between the saw blade and the right side of the saw base to deduct that thickness from the block he's cutting **(2)**. Shown here are the tools the author usually carries in his toolbelt **(3)**; your selection of must-have tools may vary. You can add a few task-specific specialties as you need them, but loading your toolbelt with tools that you rarely use adds weight, not efficiency.

Photos by Henry Austin

When working with sheet goods, pick up one corner and roll it onto your shoulder in one smooth move to help preserve your body over the long term **(4)**. In the author's tract-house days, he'd get yelled at for carrying just one sheet at a time. To trim a full sheet of sheathing to 91 inches, measure 5 inches from the short end instead of pulling a tape measure and T-square to measure and mark 91 inches from the long end. To mark the cut, you can slide a rafter square along the edge of the sheathing **(5)**, or simply lock your hand on the tape and slide your finger along the edge, holding your pencil on the end of the tape. Similarly, it's a waste of time to mark a notch in sheathing with a T-square or chalk line; marking a notch like this by sliding your hand along the edge with a pencil and a tape takes about five seconds **(6)**. When cutting studs or joists to length off a stack of lumber, skip the pencil line and use a rafter square to guide the saw and make a square cut **(7)**.

sets, small vise grip or pliers, and a selection of nails. Depending on what I'm doing, I'll add a few other items as needed **(3)**.

Some people can and do carry an arsenal around—and more power to them, I say—but most of us need to find a balance. The tools that you use all day long should be in their proper place on your person at all times, and using them should be a smooth, automatic process, a set of moves that you don't even think about. If you're not carrying the basics with you while you're working, you're wasting time.

The same concept applies to power tools—set them up where you need them to minimize the amount of time you spend walking and carrying materials. It's generally more efficient to cut where you're working, rather than walk back and forth to a distant cut station all day long.

3. LEARN TO USE YOUR TOOLS

There are thousands of tools out there, we love them all, and we say that there's a right tool for every job. However, you don't need all of them to build a house; in fact, you need only the contents of your toolbelt and maybe a couple of saws and drills. By all means, if you have a tool that will help you do a job faster and better, get it out and use it, but don't make anything more complicated than it has to be, and don't use more tools than you need. Understand that

You don't need a pencil to mark cuts that don't have to be perfectly square and a precise length, such as when you're furring out a ceiling or wall with 1x3 strapping for drywall. For longer lengths, just pull a tape and mark the cut with the corner of the tape measure **(8)**. For shorter lengths, use the tape's hook to mark the cut **(9)**.

even the simplest tool is a versatile machine that requires finesse to use well. More tools won't make you a better carpenter; learn to be a better carpenter, and you'll get more work out of your tools.

4. PAY ATTENTION TO BODY MECHANICS

Watch someone work who has spent a lifetime doing manual labor well, and you'll see efficiency in action. Learn from these guys—when they pick up a couple of sheets of plywood or a stack of lumber, there's no struggle, no strain, no wasted energy. When they use a shovel, they're rarely bending over, they're facing the right direction, and they never lift it half full. They pace their efforts so at the end of the day, they're still working efficiently. Learn to do that, and at the end of your career, you'll still be outworking the young pups **(4)**.

5. UNDERSTAND AND RESPECT THE VALUE OF TIME

The cost of the work that's being done is remote to most carpenters, but it's very real to the boss, the customer, and the success of the project. We don't want to work like dogs or slaves, but keep in mind that wasted time is money coming out of someone's pocket. Or worse, being tacked on to their mortgage. In my market, that's somewhere between $1 and $2 a minute, so when you add up those bits of time you spend answering your phone, checking your social media, chatting up the neighbor, throwing a stick for the dog, and talking politics or sports, you've basically reached into someone's wallet, extracted a few bills, and torn them up.

6. MAKE TEAMWORK WORK

Two or more people doing a job together should be able to get it done in fewer person-hours than two people doing it separately; otherwise, what's the point? Two workers taking turns watching each other do their parts of the job are essentially operating at half speed, whereas one worker cutting for two or three others is boosting everybody's productivity.

7. LEARN NEW TRICKS

Good carpenters learn a thousand little tricks for saving time and energy and getting good results faster; the best ones never stop teaching themselves. You can learn a lot by watching how experienced craftsmen do things, but the real secret of tricks is ingenuity and application. For example, watch a drywaller, and you will never measure a 91-inch piece of plywood again—you'll cut 5 inches off a full 8-foot sheet. And to do that, you'll mark it with a square, or your tape and a finger clamp, or the 5-inch edge dimension of your saw base **(5, 6)**.

Or maybe you want four pieces of wood out of one length. Use a saw and square to cut it somewhere in the middle, and then measure, mark, and cut all four pieces at once. Or, say you want two pieces the same length—lay one on top of the other, align the ends, and cut the top piece. Even if your saw doesn't cut full depth, sliding the first one aside and finishing the second cut is fast and exact. The number of time-saving tricks is endless, and they all add up **(7, 8, 9)**.

8. BALANCE TIME AND QUALITY

Understand that every task you do has an appropriate standard of quality. For a stain-grade miter, perfection might be the standard; for a rough opening, "close enough" is probably the standard. Learn how good everything has to be and aim a bit higher than that just to be sure. Not too much higher, because then you're wasting someone else's resources, but never less than you should be, because if it's worth doing, it's worth doing right.

John Spier owns Spier Construction, a building and remodeling company on Block Island, R.I.

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Q We are sealing a poly vapor retarder over exposed earth in a basement before pouring a slab. The customer has been monitoring the home's indoor air and says she's seen spikes in radon levels, so we are prepping for a subslab ventilation system and sealing the poly to allow a radon mitigation contractor to come in later if the customer feels it's necessary. How do you seal poly to poly? At the perimeter, we are using spray foam insulation to pin the poly to the walls (insulating the walls is part of the job), but we're not sure what the best sealant is to use for field seams. Silicone and polyurethane caulk don't stick well to poly once cured.

A *Clayton DeKorne, chief editor of* JLC, *responds*: I reached out to a few people to get their recommendations. Jake Bruton, owner of Aarrow Building in Columbia, Mo., has used Tremco Acoustical, Geocel 2300, and Lexel sealants, which stick well enough, he reports, but can be a challenge because of the tendency of the sheet to move back into the shape it held on the roll. "You apply a bead of sealant, mush two pieces together, and five minutes later, the initial grab of the sealant isn't enough to capture the second layer of poly, and the two layers spread apart," he explains. He has had much better luck with Stego Tape and Siga's Fentrim tape on polyethylene and polyolefin sheeting, such as Stego Wrap. "The ability to positively attach the two layers with an adhesive rather than a sealant provided us with greater success. However, in a crawlspace that isn't receiving a slab, my go-to detail is to generously overlap the layers of poly and allow our spray-foam contractor to quickly flash a layer of closed-cell spray foam over the joint," he continues. "Generally, the spray-foam contractor is on site and in the crawl for the rim joist anyway. A couple more quick joints aren't going to break the budget. This doesn't work for a basement where a slab will be located because of the elevation of the foam, but it works better than the tape if you have the option."

Photo by Rick Mills

Stego Mastic (black goop around penetrations) and Stego Tape (red) prove effective for sealing Stego Wrap—a thick, polyolefin plastic specifically designed as a subslab vapor retarder.

Rick Mills, project manager for Jackson Andrews Building + Design in Virginia Beach, Va., reports his company has used Stego Mastic on slab prep around any irregular shapes (such as pipes and conduit) and Stego Tape to seal seams in Stego Wrap and attach the wrap to CMU walls (see "High-Performance Crawlspace Foundations," Sep/20). His "go-to," however, is Zip System tape. "It does stick to just about anything," he says. "The big challenge is, once it's stuck to the poly, there is no chance of repositioning it."

Bernard Montoya, foreman for Rodolfo Contracting of Yonkers, N.Y., which specializes in radon mitigation, says the best he has used is 3M 72 Blue, a pressure-sensitive spray adhesive that's compatible with a wide range of foam and plastics. "It has to be the most expensive choice—like $35 a can [for 17.2 ounces]," he laughs. "But it's super-fast." His crew lays out the sheets so they overlap, then folds back the overlap. "One person runs a line of spray; another folds the lap back over and presses it down, rubbing it out with a cloth, and we're done," he explains. "It bonds even if there's dirt and dust on the plastic," he continues. "We've used tapes, but they can be a problem when dust clings to the plastic. That is like always in a dirt basement."

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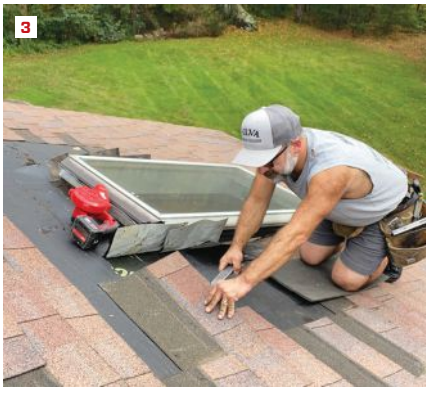
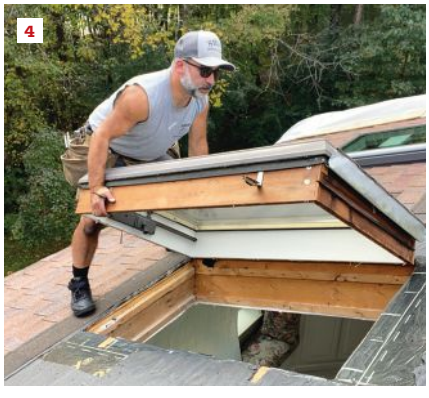
Replacing a Skylight

BY EMANUEL SILVA

When a homeowner reports a leaky skylight, the problem could be the skylight itself, the flashing around the skylight, or simply excessive condensation on the glass. In the case of replacing the two 25+ year-old Roto roof windows shown here, the main problem was that the insulating glass had failed, though some water staining was present. Using that project as an example in this article, I describe my belt-and-suspenders approach to flashing a new unit to the roof deck, because that is where most leaks occur, regardless of why the existing unit failed.

Emanuel Silva, a JLC contributing editor, owns Silva Lightning Builders in North Andover, Mass. He can be reached at silvalightningbuilders@gmail.com.





Photos by Emanuel Silva

Removing the existing skylights. Before ordering new Velux units to replace the two existing Roto skylights, I cut inspection holes in the corners of the shaft drywall to accurately measure the rough openings, then temporarily sealed the holes with spray foam **(1)**. Removing drywall creates a lot of dust and debris, so I sealed off the wall and floor below the skylights with plastic to make cleanup easier. Some water staining was visible at the corners of the shaft **(2)**. Weather conditions were ideal when I removed the existing shingles around the skylights: not cold enough to make the shingles brittle and not warm enough to make them too flexible. I tried not to damage them so that they could be reused **(3)**. The roof had a relatively shallow, 5/12 pitch, so traction was good, and I set up staging below the eaves for fall protection **(4, 5)**. Because the new Velux units are a stock size that is slightly shorter than the existing Roto skylights, I installed 2x10 fillers at the top of each rough opening **(6)**.


7


8


9


10


11


12

Prepping the roof deck and installing the skylight. Though it's not required by the window manufacturer's installation instructions, I sealed the opening in the roof deck to the roofing underlayment with 12-inch-wide strips of Vycor Plus self-adhering flashing membrane. Layout lines drawn with a Sharpie on the existing underlayment help with positioning the flashing **(7, 8)**. Timing and prepping materials in advance are important when you're replacing a skylight; you don't want a big hole in the roof with rain in the forecast. It took me about three hours to remove one of the skylights and install its replacement so that it was weatherproof. I typically work alone, but lifting a heavy skylight up onto a roof is a two-person job; fortunately, the homeowner was available and able to help out **(9)**. The Roto windows had been fastened to the roof with a few screws driven through angle brackets; the new, Velux skylights are fastened to the roof sheathing with 1¼-inch roofing nails (included with the installation kit) driven through pre-punched holes in the units' aluminum mounting flanges **(10)**. After the new skylight was in place, I laid out the position of the flexible flashing (supplied as part of the Velux installation kit) used to seal the skylight frame to the flashing-covered roof deck, to ensure that it wouldn't interfere with the manufacturer's metal flashing **(11)**. The roll of flexible flashing was backed with release paper, so I cut the flashing into 2-foot-long strips to make the pieces easier to handle. After installing the bottom piece of flashing, I made diagonal cuts at the corners with a sharp utility knife so that the flashing could wrap up the sides of the curb **(12)**.

Multiple layers of flashing. I carefully followed the layout lines that I marked on the roof-deck flashing as I installed the white flexible flashing, folding it at a 90-degree angle so that it would adhere tightly both to the side of the skylight and to the roof-deck flashing **(13)**. Another diagonal cut allowed the flashing to wrap around the corner. I used a similar detail at the top corners of the unit. After the remaining pieces of flashing were installed up the sides and over the top of the unit with a 6-inch overlap, I filled the small gaps at each of the four corners with clear, flashing-compatible Geocel sealant **(14)**. When I reinstalled the lowest shingle course, I used the shingles that I had carefully removed previously, because they hadn't been cut or damaged **(15)**. Then I installed the bottom section of the manufacturer's metal curb-flashing kit, which is designed to slip underneath a rubber flange that wraps around the curb of the unit **(16)**. A couple of roofing nails, located according to the manufacturer's installation instructions so that they will be covered by step flashing, hold the first section of curb flashing in place. When reinstalling shingles, I first fill any holes in the roofing underlayment with sealant and avoid driving nails through the old holes in the shingles, filling them with sealant instead **(17)**. Metal step flashing that's supplied with the skylight manufacturer's installation kit is installed along with each shingle course. To provide for good drainage, I cut the shingles short to leave a 1/2-inch gap between them and the step flashing around the skylight curb. At the top corners, I seal the last step flashings to the shingles beneath with Vycor **(18)**.

A metal flashing kit finishes the installation. Before installing the metal head flashing, I pulled back the roofing underlayment so that I could first slide a length of 12-inch-wide Vycor underneath and lap it shingle-style over the white flexible flashing that seals the skylight to the roof deck. This extra layer of self-adhered flashing offers additional protection against snow that might pile up against the curb or water that might be blown underneath the shingles by the wind **(19, 20)**. A U-shaped metal counterflashing covered the bottom and sides of the curb **(21)**, followed by the metal head flashing, which fastened to the lower piece with clips **(22)**. A couple of roofing nails on either side of the flashing fastened it to the roof deck and would later be covered with shingles. Next, I applied another layer of Vycor to seal the metal head flashing to the roof deck, again making sure that the Vycor was overlapped by the roofing underlayment above **(23)**. Whenever I reinstall shingles, I always apply dabs of sealant to the tabs to ensure that the overlapping shingles will adhere to the ones underneath **(24)**. Note the foam rubber pad that I'm kneeling on in many of the photos; years ago, I cut a number of pads from 24-by-24-inch interlocking floor tiles and have used them on an almost daily basis ever since to protect my knees from stones, splinters, nail heads, and—in this case—the coarse granules of the asphalt shingles.

Prefabricated MDO skylight shaft. I prefer to use 1/2-inch medium density overlay (or MDO) panels instead of drywall to cover the rough framing of a skylight shaft, partly because MDO is tougher and more moisture-resistant, but mainly because this allows me to prefabricate the shaft and install it as a single unit. I start by making a trim template to find the angle and check the fit of the MDO within the slots of the skylight jambs **(25)**. Then I rip the MDO to width with a track saw, using the template to mark the angles, which I also cut with a track saw **(26)**. I nail together the sides of the shaft with 18-gauge brads, then reinforce the joints with 1 1/4-inch trim screws **(27)**. Centering the trim screws in the middle of the 1/2-inch-thick panels without blowing out one of the sides is tricky, so I carefully lay out and drill pilot holes for the screws. Before lifting the shaft assembly for this project into position and fastening it to the framing with a few trim screws, I took measurements for the trim kit that I would use to finish the installation **(28)**. The stiles and rails were made from primed 1x5 WindsorOne trim and joined together with pocket screws and glue. I sealed the gaps around each shaft to the opening with spray foam insulation, then fastened a simple T-jig above the window to act as a third hand, allowing for enough room between the leg of the T-jig and the ceiling drywall for the trim kit to slide into position **(29)**. Once I was satisfied that the reveals were even, I nailed the trim kit to the ceiling framing with 2-inch-long 18-gauge nails **(30)**.

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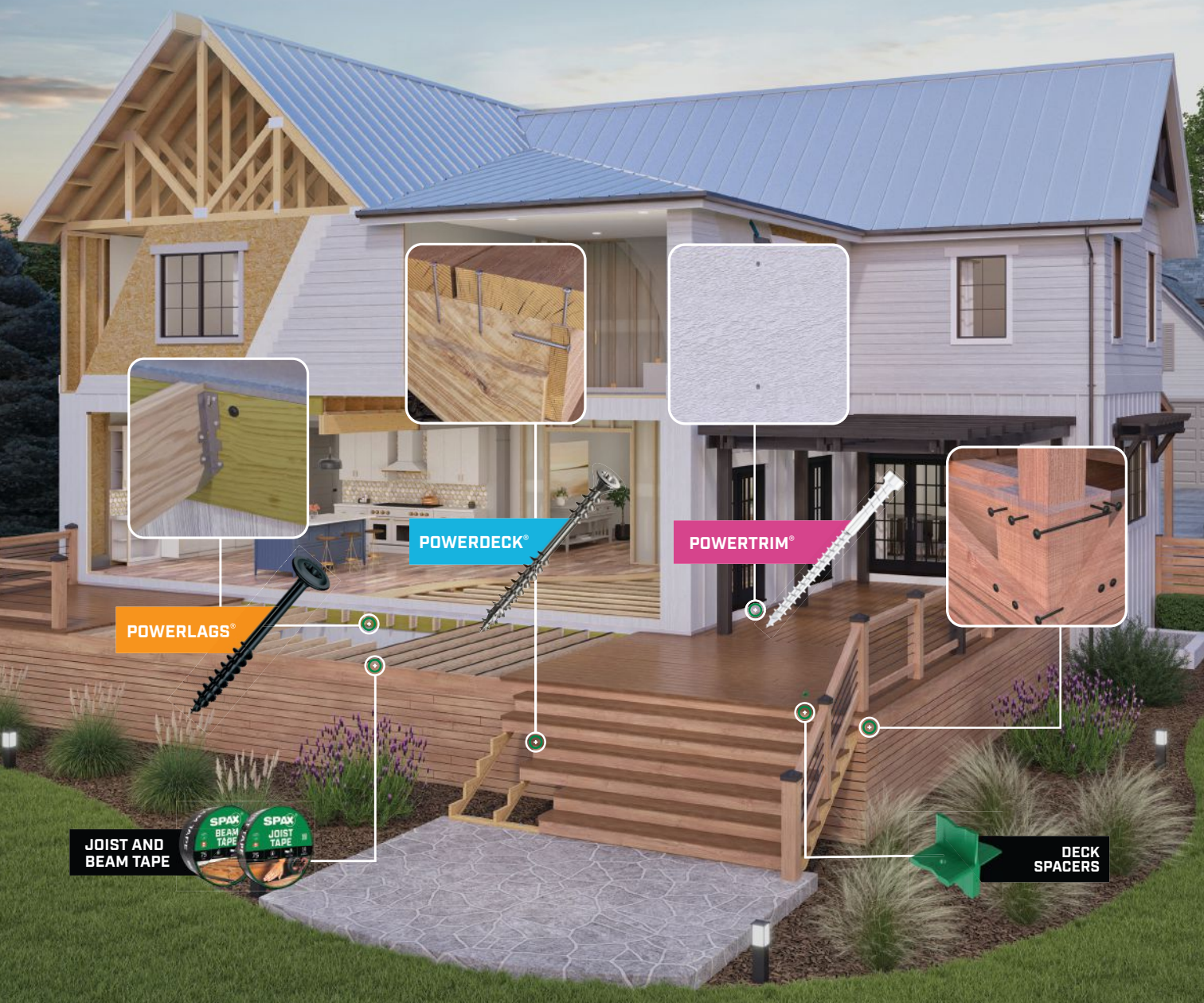

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BY NICOLE TYSVAER

Going to Scale With Panel Construction

The enclosure of the Queen of Zero—a custom single-family rebuild in Maryland and the 2024 *JLC* Case Study home—has taken shape using structural insulated panels (SIPs). Each panel consists of two roughly 4-by-9-foot sheets of OSB sandwiching a core of EPS insulation. The SIPs at Queen of Zero were manufactured by Acme Panel and shipped flat to the site.

Over the past decade, SIPs have become my company's preferred building strategy for new homes aspiring to a net zero standard (see "Nicole's Top 5 Reasons for Choosing SIPs (and 3 Caveats)," page 21). Yet, despite the many advantages and proven track record of SIPs, only a small percentage (1% to 2%) of homes in the U.S. are built with them. So why, with their decades-long track record of success, aren't they more common?

PANELIZED CONSTRUCTION—MYTH VS. FACT

Widespread adoption of SIPs has been hindered, in part, by decades of misinformation across the homebuilding industry. The following oft-cited claims are some examples.

■ Installation

Myth 1: SIPs are complicated to install and require specialized equipment and training.

Myth 2: SIPs are super easy to install for just about anyone—including DIYers.

Fact: Although SIPs are not inherently complicated, panel installers should receive SIP training and oversight by a registered SIP builder, regardless of their prior construction experience. In addition to typical framing tools, one or more SIP-specific tools, such as the SIP Groover and 2 Person Hot Wire Handles, may be required for a job. Many panel manufacturers offer training, on-site consultation, and referrals to trained installation crews. The SIPA website offers a wealth of best practice resources, and Al Cobb's SIP School offers in-person and online courses.

■ Cost

Myth: Building with SIPs costs significantly more than traditional stick construction.

Fact: In my experience building high-performance custom homes, an upgrade to SIPs adds about 2% to 3% to a construction budget. Other builders estimate cost savings. The Structural Insulation Panel Association (SIPA) offers a free estimating tool at sipatruecost.org to compare the cost of panels versus conventional construction. And because SIPs have superior insulating properties, the initial upcharge can be offset by future reductions in utility costs.

Photos by Nicole Tysvaer

Each 6 1/2-inch-thick (R-24) panel was manufactured to exact specifications and labeled for its location and sequence in the installation process **(1)**. The panels arrive with horizontal and vertical ducts ready for electrical wiring. During installation, panels are sealed on all four sides with either spray foam or SIP seal adhesives, depending on the connection **(2)**.

SIP modifications in the field are rare, but occasionally minor adjustments need to be made. Builder Matt Kulp uses a heat-activated SIP Groover to trim the EPS foam of a panel to prepare it for installation at an outside corner at the Queen of Zero project.

SAVING MONEY WITH SIPS

Calculating the cost differential for upgrading to structural insulated panel construction can be tricky. You can compare SIP material, equipment, and labor costs with those of conventional stick framing with spray foam insulation, but that may not show the full impact on your bottom line.

According to Jack Armstrong, executive director of SIPA, "you have a lot less waste" with SIP construction across multiple budget items, as well as potential reductions in labor time. "Most builders say they save an entire dumpster of [drywall] waste when they do SIPs, as opposed to traditional construction, but also saving money with the cabinets because the walls are straight, and trim costs because the windows are square. And there's HVAC savings because maybe you can come down a half a ton or a ton."

■ Customization

Myth: Factory-built panels are best suited for "production style" homes with minimal architectural details.

Fact: The size, location, and composition of each structural panel is engineered specifically for a particular set of architectural drawings and, therefore, customization is built into the process. There may be some designs that are not particularly suitable for panels, but I personally have not come across any limitations to date.

We do sometimes opt for manufactured trusses rather than SIP panels for a roof, primarily due to the aesthetics when there is an abundance of framing angles, such as on the traditional pitched roof of a Queen Anne Victorian.

SIP floors are also not recommended above living space due to the percussive noise transfer, so we are framing the decks conventionally and will use GreenFiber Sanctuary blown-in cellulose for interior sound attenuation.

■ Technology

Myth: SIPs are a new, experimental construction technique that has not been significantly tested.

Fact: The first foam-core SIP was developed in 1952 by Alden B. Dow (son of the founder of Dow Chemical Co., which produced EPS foam), using panel designs pioneered by the Forest Products Laboratory in the 1930s. SIPs became popular as infill panels for timber-frame homes in the 1970s, and the SIP industry has grown to 12,000 housing starts per year, as well as thousands of commercial buildings, according to SIPA.

The IRC has required that SIPs meet ANSI/APA PRS 610.1, and most quality panel manufacturers issue Evaluation Service Reports showing compliance to these required standards.

Despite the persistence of these common misconceptions, there appears to be growing optimism in the SIP industry. Gabriel Grossman, CEO of panel manufacturer Preflex and a podcast host, predicts SIPs will "go mainstream in the next 10 years" due to a growing demand for net zero homes, persistent shortages of skilled construction labor, a desire for built-in resiliency to rebound from climate disasters, and a shift toward off-site technology to speed up production and help solve the housing crisis.

SIP LESSONS FROM QUEEN OF ZERO

On the first day of SIP install at the Queen of Zero project, a few of the framers, who were unfamiliar with panel construction, complained that site supervisor Matt Kulp, a veteran SIP builder, was being "too picky," and they walked off the job. Good riddance, I suppose, since building high-performance is all about fastidiousness. And let's face it, those guys probably have their pick of sites to show up at, as their services are in high demand. Framing is difficult, back-breaking work, and the "less picky" jobs may make the day go a bit smoother. But this episode does underscore the tremendous learning curve for our boots on the ground. In some cases, it's not just a lack of knowledge that stands in our way but also an unwillingness to engage in the learning process.

JLC contributing editor Nicole Tysvaer is CEO of Symbi Homes, a residential builder and developer based in Bethesda, Md.

The Queen of Zero framing crew installs SIPs on the second story of this Net Zero Ready Home in Maryland.

NICOLE'S TOP 5 REASONS FOR CHOOSING SIPS (AND 3 CAVEATS)

1. High insulating properties. SIP walls have not only higher R-value, but also less thermal bridging due to the minimal use of dimensional lumber. Compared with a typical 2x6 wall with R-19 insulation between studs spaced 24 inches on-center, a wall built of 6.5-inch R-24 SIPs has 34% more thermal resistance.

2. Less waste and more sustainable. The SIP manufacturing process dramatically reduces construction waste, as any byproducts of production are reused or recycled. Acme Panel also boasts a 30kW solar array that provides renewable energy, offsetting 70% of its electric power. In addition, the SIP materials are low-VOC with the lowest global warming potential of any foam insulating product on the market.

3. Strong and straight. SIP walls do not experience settlement cracks or nail pops, as are common with stick-built new homes. Because SIPs have tightly filled cavities with little air infiltration, the burn rate is much lower than conventional construction. Also, a SIP wall does not require blocking for installation of cabinets, built-ins, etc., as the OSB sheathing provides a sturdy, continuous surface for mounting.

4. Time savings. Building with SIPs reduces our construction calendar by about two to four weeks, compared with a high-performance wall system with stick construction.

5. Cost effective. With all the other advantages, the 2% to 3% upcharge for SIP construction, compared with 2x6 walls with spray foam, is minimal. And the difference in hard costs has been shrinking in recent years due to the sharply rising prices of conventional framing materials.

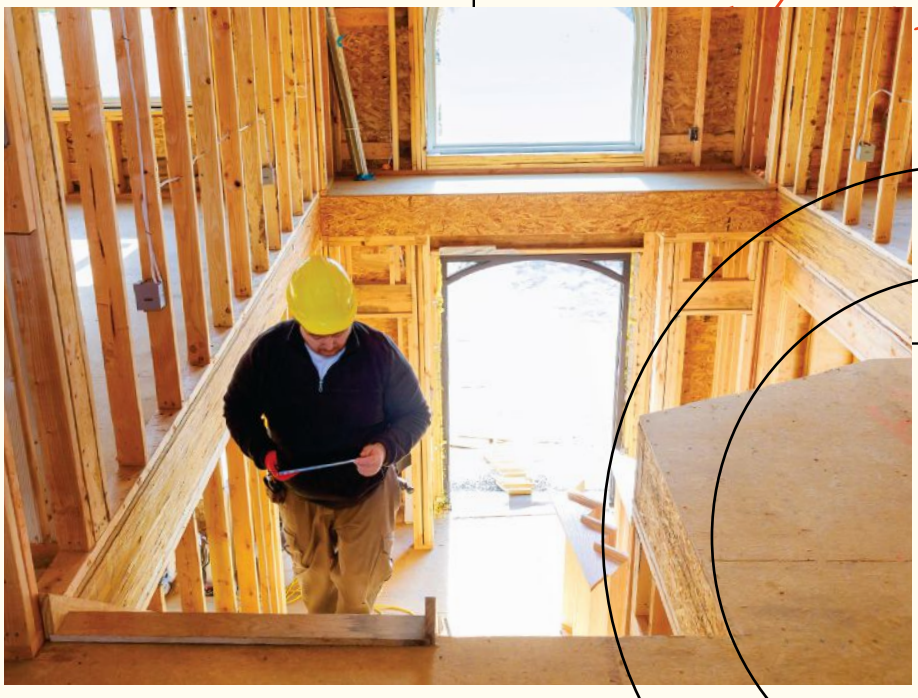
Caveats to keep in mind:

1. Plan ahead. Once SIPs are engineered, fabricated, and delivered, there is little chance to make changes to the exterior shell, such as size and location of window and door openings.

2. Minimize panel penetrations. The panels arrive with ducts for electrical wiring pre-installed. Additional ducts or penetrations in SIPs are strongly discouraged. Plumbing pipes and HVAC line sets need to be located on interior walls or in a false wall inside an exterior wall.

3. Logistics. SIPs often arrive at the site on a large semitrailer truck and need to be offloaded with a forklift and possibly craned to the staging area. Consider potential complications with power lines, narrow city streets, muddy conditions, inclement weather, etc. Keep SIPs clean and dry by wrapping them in plastic and storing them on platforms. Whenever possible, commence installation immediately upon their arrival on site. *—N.T.*

JLC



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Moisture Protection for Walls

Practical solutions for draining and drying different claddings

BY DOUG HORGAN

Photos by Doug Horgan; illustrations by Tim Healey

What should be used behind the cladding on a house to protect against moisture? We know that a fully vented, wide drainage and drying space (what is often called a "rainscreen") works well. But creating such a space can be expensive, and other, less expensive approaches often work, too.

As an industry, we're in a period of transition and learning as we build walls with more insulation than in previous decades. However, we do know this: When we add insulation, the outside of a wall stays colder all winter. This results in less drying and more moisture in sheathing and claddings. Therefore—generally speaking—walls with more insulation need more consideration for drying than those with less. Whether a problem or failure results will depend on a list of factors, including climate, building shape and exposure, interior humidity conditions, even future maintenance—the wrong paint can cause issues, as can caulking drainage weeps closed. In this article, I'll introduce how we address these factors when we decide how to detail different types of siding.

CLIMATE FACTORS

Our company remodels dozens of houses a year from which we remove old siding, stucco, brick, or stone, so we have been able to see how wall assemblies fare in our climate around Washington, D.C. Winters here are milder than in northern states, and

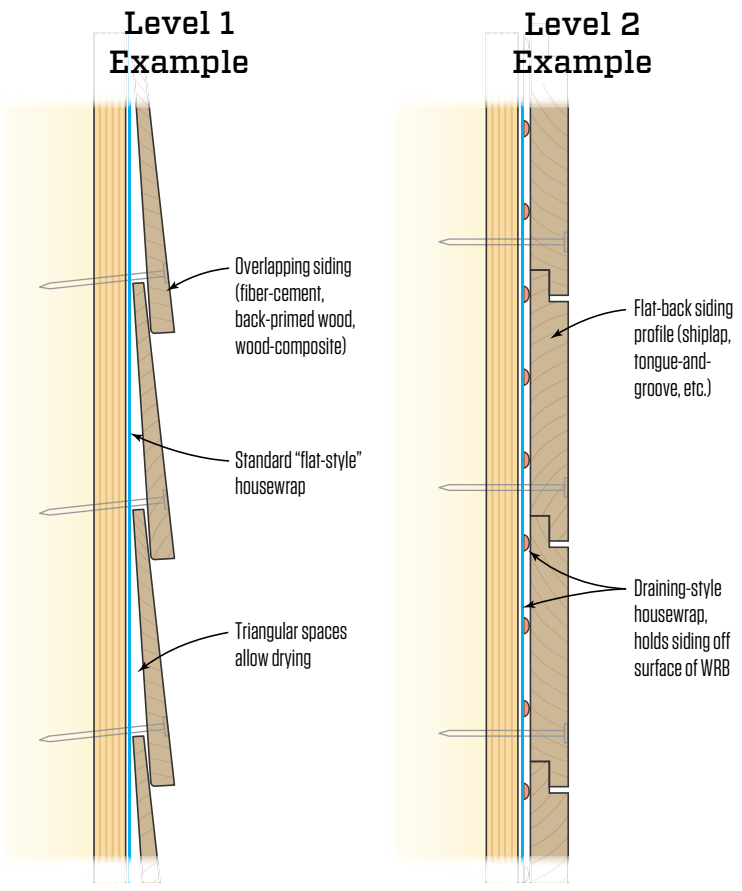
What Goes Behind the Siding?

Siding type	Minimum requirement
Beveled or lapped wood siding (with triangular spaces behind pieces) Horizontal HardiePlank or SmartSide siding (with trianglular spaces behind pieces) Vinyl or metal siding with spaces behind each piece (no foam inserts, no flat-back roof panels or composite deck boards used as siding)	**Level 1:** **One layer of flat WRB:** • Housewrap (Tyvek, Typar, or other nonperforated wrap) • #30 felt • Zip System or similar coated sheathing panels • Fluid-applied WRB ***Or* any of the below.**
Horizontal wood siding with flat back (no triangular space behind; for example, tongue-and-groove, nickel gap, German lap, or Dutch lap profiles) Vertical or diagonal wood siding, or HardiePanel siding, protected by overhang above (12-inch overhang per 18-foot vertical)	**Level 2:** **One layer of "draining" housewrap (1/16-inch gap):** • Benjamin Obdyke HydroGap • TamlynWrap Drainable Wrap ***Or* one layer of flat WRB plus one layer of "draining" housewrap on top** ***Or* any of the below.**
Vertical or diagonal wood siding, or HardiePanel siding, not protected by overhang Cedar shakes and shingles Synthetic siding made of nonpermeable material (PVC, Poly-Ash, Acre, or similar) "Panel" design areas Impermeable sidings without space behind: PVC sheet, standing seam or other metal panel design	**Level 3:** **One layer of flat WRB** ***And* a drainage, drying space behind cladding (min. 3/16 inch):** • Drain mesh (Benjamin Obdyke's Slicker or Cedar Breather, or similar) • Vertical strips of sill seal or 1/4-inch fanfold foam • Furring strips (wood, fiber-cement, synthetic trim, or corrugated plastic) **Insect screening required for all drainage space options.** ***Or* any of the below.**
Stucco Manufactured stone veneer (MSV) Brick veneer Stone veneer	**Level 4:** **Two layers of WRB, one of which is low-perm:** Low-perm options: • #30 felt • Zip System or similar coated sheathing panels Regular-perm options: • Housewrap (Tyvek, Typar, Dow, or other nonperforated wrap) • Fluid-applied WRB ***And* a drainage, drying space behind cladding (min. 3/16 inch):** • Drain mesh (Slicker, Cedar Breather, or similar): full coverage for stucco, MSV, and stone veneer; partial coverage (12 to 16 inches above through-flashings) for brick veneer. • Furring strips (typical for stucco or MSV over exterior insulation; not applicable to brick or stone veneer) **Insect screening required for all drainage space options.**

The author's company defines four "levels" of protection in its guide for crews installing different types of siding.

they tend to be wetter than in western states, so what works for us may not work for others. In colder areas, you will likely need more protection behind the siding than we use (though interestingly, areas with long, cold winters have fewer wood decay issues than places where it's wet and warm for more of the year). And once you get into the high plains of the western U.S., there's much less rain and, from what I have learned, nowhere near the same levels of protection are needed.

In the warmest, wettest parts of the U.S., vapor management to control summertime moisture conditions is often recommended on the outside of walls, too. It's important to take local conditions into account.



Lapped or beveled siding (above, at left) has triangular spaces behind it and requires only Level 1 protection (see chart, facing page). Flat siding profiles, such as shiplap (above, at right), require Level 2 protection. This may include a drainage wrap, such as the WRB products made by Benjamin Obdyke **(1)** and Tamlyn **(2)** that hold the siding about 1/16 inch off the WRB surface.

EXPOSURE

In the areas we work, houses are usually on land without tall hills and surrounded by other houses and trees, so exposures to wind and weather are not severe. However, when we do build on a hilltop or next to a large body of water, we need to use higher levels of moisture protection to withstand wind-blown rain and snow.

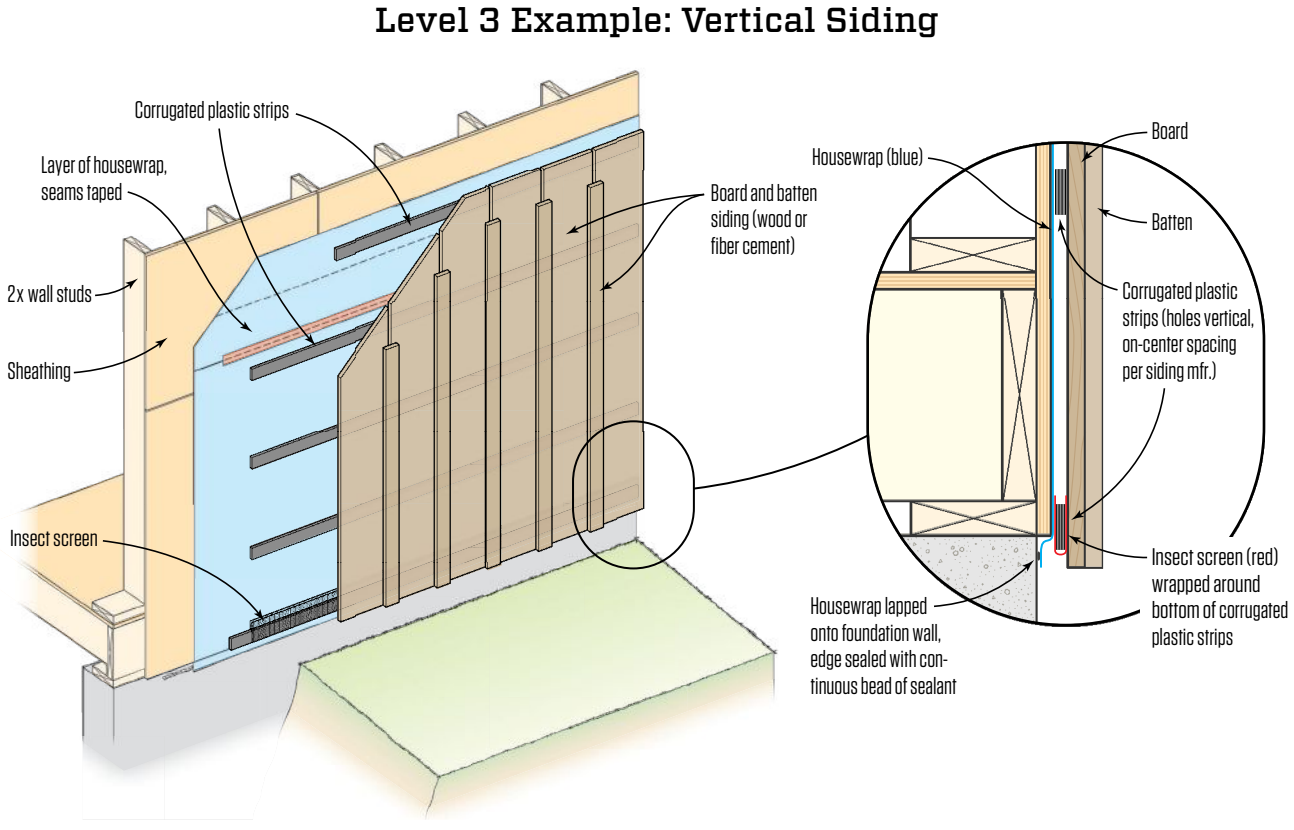
INSULATION LEVELS

Most of the buildings we have built or taken apart lack continuous insulation. In fact, most of them have just 2x4 walls with batt insulation between the studs. Now, with recent code updates, we're building walls with half, or less, the energy flow to the exterior. These walls are not drying as quickly or as often as their predecessors did. Also, we are using a variety of materials on the outside of houses that we didn't use in the past. Of note are the wide range of impermeable, plastic-based materials that are less prone to drying than the wood-based and fiber-cement materials we're more accustomed to installing (see "Why Impermeable Sidings Need Drain Spaces," page 27).

All our experience with past buildings and materials is different from what we face today. In some cases, we are only able to make educated guesses about what will work or fail in new walls. Nevertheless, we must adhere to the best principles we know, and toward this end, we created a chart (see "What Goes Behind the Siding?," facing page) that identifies four different levels of protection behind the different sidings we install. These help us to clarify and simplify our options and retrain our crews and subcontractors, whose instincts may be based on experience.

LEVEL 1

In the chart's first category are permeable siding materials with spaces behind each course and lots of joints and openings. Lap



Vertical (as well as diagonal) sidings have proven to be leaky on the author's past projects, so he specifies "Level 3" protection. Here, the drainage space is created by corrugated plastic battens, one choice among several his company specifies.

siding made of wood, fiber-cement, or wood-fiber composites all fit this category, as does standard vinyl or metal siding (with hollow-back profiles, not filled with foam). Based on our experience disassembling many houses built with these materials, we know they perform adequately in our climate even when installed over flat WRBs (those with no special draining provisions), so that's our minimum requirement.

Two notes on this: Other provisions in our company's standards require wood siding to be fully back-primed; this is important when plastic wraps—which will lose water repellency when raw wood tannins soak into them—are installed. Also, we note that highly insulated walls need more drying capacity than the "Level 1" requirement provides. We'll often have a conversation with clients about paint durability, as well. Our experience (including on my own house) is that adding a drying space behind wood siding provides a tremendous boost in paint longevity. For a client planning to stay in their house for a long period, this upgrade is often worthwhile.

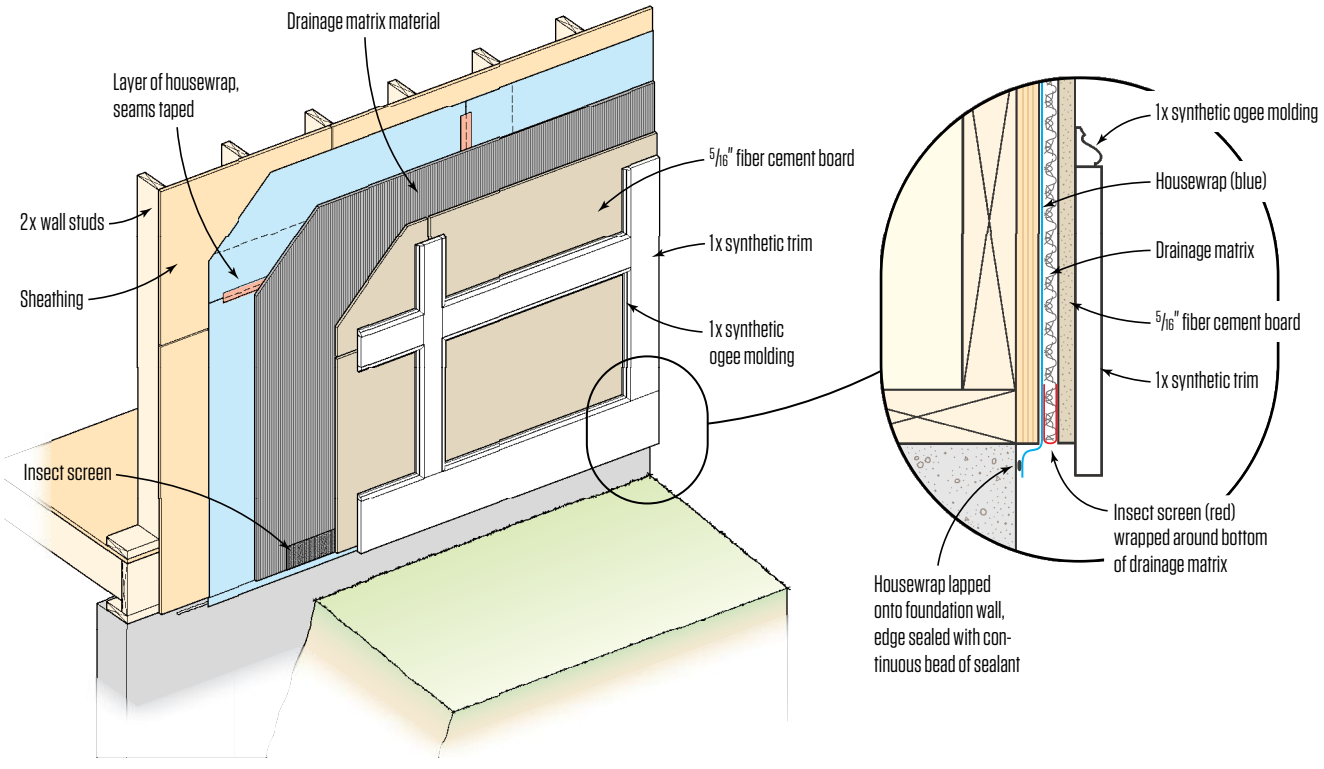
We don't have much opportunity to install conventional vinyl siding in our market, but when we pull vinyl siding off walls, we see how it fared. It generally does well at protecting the wall when properly installed. This may *not* be true in other parts of the country and in homes with significant indoor humidity loads that dry to the outside. George Tsongas' experience in the Pacific Northwest and on multifamily buildings suggests the need for a greater level of treatment than the usual Level 1 treatment that we can safely employ around here (see "Installing PVC-Type Sidings in Cold Climates," by George Tsongas, Jul-Aug/22).

LEVEL 2

The second level for siding protection uses a "draining" housewrap to provide a small drain cavity. These products typically have a 1/16-inch gap for water and air to move through, offering much more drainage than a flat WRB, but they still retain some water due to water's surface tension. Though a 1/16-inch gap isn't wide enough to offer much drying capacity, it's more than a flat wrap provides.

We use draining WRB materials for permeable sidings like wood and fiber cement, which have a flat back surface; the bumpy wraps keep water from seeping through the WRB, which can happen when water is trapped against it (for more about this, see "Water Managed Wall Systems," by Joe Lstiburek, Mar/03).

Level 3 Example: Panel Siding



Large panels have fewer joints and fewer ways to dry out. Fiber cement is more permeable than PVC-type panels, but the author still specifies Level 3 protection. Here, the drainage space is provided by a drainage matrix, such as Cedar Breather.

LEVEL 3

The third level replaces the 1/16-inch bumps on "draining" housewrap with a wider, 3/16- to 1/4-inch drain space. To create this space behind siding, we almost always use drain-mesh products since they're commonly used around here. They have the advantage of allowing horizontal, along with vertical, drying and air movement. We sometimes use other materials, as well, including strips of 1/4-inch fanfold insulation, corrugated plastic, or sill seal foam.

We call out this level for several risky claddings, including solid, plastic-based sidings like cellular PVC, "poly-ash," and the new rice-hull-PVC product. These materials don't allow any moisture through at all, so we have to make a clear path for it to dry out from behind.

We also call out this enhanced protection for "panel" designs (see illustration, above). In addition to the panels having a flat back and limited drying through their materials, they tend to leak at joints near the rails, which trap water. Cedar shingles with their multiple layers, which also tend to hold water, benefit from this level of protection, as well.

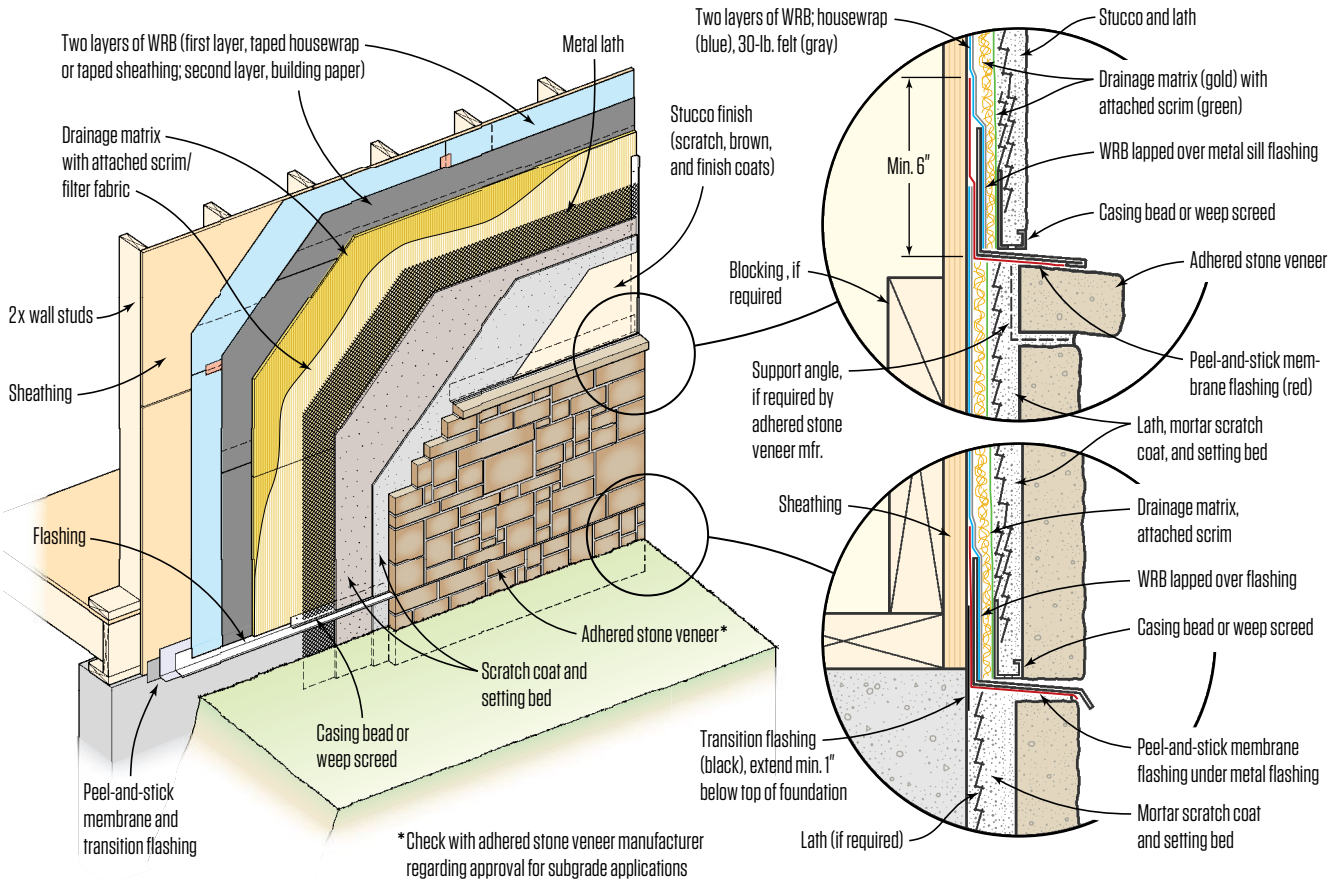
WHY IMPERMEABLE SIDINGS NEED DRAIN SPACES

Plastic-based siding materials don't allow moisture through them, which can be great when they're keeping rain out, but unlike traditional wood or even wood-product and fiber-cement sidings, they also don't allow water that gets behind them to pass through and dry out before damaging the building.

My limited experience with impermeable sidings (mainly PVC "panel"–clad walls) is that they need significant drying space behind them compared with their wood analogs. Once water gets behind plastic sidings without drain and drying space, it can quickly cause serious problems.

We had lots of durability problems with panel designs made of wood trim and plywood panels, but they rarely affected the wall behind the WRB. I believe water that leaked in was absorbed into the wood boards. This kept the water from being absorbed into the wall assembly but usually rotted the wood trim, which is why we moved to plastic trim boards. *—D.H.*

Level 4 Example: Stucco/Adhered Stone Veneer



Stucco and manufactured stone are examples of claddings that can absorb and hold water. These materials require Level 4 protection provided by a two-layer WRB (required by code) as well as a drainage and drying space.

LEVEL 4

The fourth level of protection adds a second layer of WRB material for redundancy and code compliance. Claddings in this category—including stucco, adhered stone and manufactured stone, brick veneer, and stone veneer—hold rainwater, and when the sun hits the cladding, that moisture is driven into the wall. In our climate, one of the WRB layers should have low permeability; for instance, felt or one of the coated OSB sheathing materials, such as Zip System.

SIDING OVER EXTERIOR INSULATION

Layers of insulation outside a structural wall help shut down thermal bridging, which is why that approach appeals to many. But it can add complexities to water and moisture management.

There is a bright side on the moisture front: If the insulation is thick enough and the structural sheathing is kept warm enough in cold months, the risk of interior moisture accumulating in the sheathing is sharply reduced or eliminated. This can allow use of more permeable interior vapor management (latex paint, for example, rather than a complicated layer of sealed, 6-mil plastic), which can be easier to apply and less expensive and enable walls to dry better toward the interior.

However, we must address two potential downsides to continuous insulation: First, many insulation products are moisture resistant and, if they are tight to the sheathing/WRB and water gets behind them, it's likely to stay there long enough to cause damage. Second, some insulation materials can absorb or hold water, which prolongs drying even more.

The two most common approaches that address the first issue are to take steps to prevent water entry and to provide a small drainage space behind the insulation.

Arguably, the best way to keep water out is to properly install a WRB in front of the insulation, though this can be challenging to

detail at windows. Some insulations have tongue-and-groove joints, which can be oriented with the tongue up to shed water. Taping joints and/or using a Z-flashing can also cut the chances of leaks (though preferably not a metal Z-flashing, which can create a thermal bridge). But our imperfect buildings are built by imperfect people, and it's asking a lot for every square inch of insulation to be installed perfectly. Creating a way for water to leave is the preferred strategy.

As for the second approach, we don't want a huge space behind the insulation for air to blow around, or the insulation value will be compromised (an effect sometimes called "wind washing"). What is the right space? There's a tug of war between optimal drainage and optimal protection from wind washing. For example, we commonly use 3/16-inch drain mesh behind EIFS (see "Three Ways to Install Drainable EIFS Wrong (and One Way to Make It Work)," Nov-Dec/22), which I believe is the minimum needed for reliable drainage and drying for a waterproof, sealed cladding with no other drying gap. However, this size gap is known to cut the insulation value of the exterior insulation. A 1/16-inch gap is often suggested to minimize wind washing, but this offers minimal drying and can hold water due to surface tension. We'll learn more in decades to come as we try various new approaches and find out which ones work reliably.

Meanwhile, we already know some things: Mineral board (rigid fiberglass or rock wool) is very permeable and will permit drying directly through it. As long as there's a drying space between it and the cladding, it seems safe to place this type of insulation directly on the sheathing/WRB.

Expanded polystyrene (EPS) foam is somewhat permeable and provides some drying, though less as its thickness increases. I would install a drain gap behind EPS to be safe.

Extruded polystyrene (XPS and faced polyiso insulation boards) are nearly impermeable and should be treated with care. Any water that gets between them and the sheathing will likely cause problems unless a drain space is provided. On the other hand, their nearly waterproof properties mean they can be detailed to block water from getting further into the assembly.

Wood-fiber insulation board is a material I haven't installed or even seen installed in my area. In theory, it's permeable, so it should allow drying, and the absorbent wood fibers should help transport water away from a particular leak spot. Of course, wood fiber is susceptible to damage from repeated wetting—though the wood fiber is reportedly treated with paraffin wax as water protection and with borates to resist mold, rot and insects. It will be interesting to see how this insulation performs long-term.

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

INCREASING THE EFFECTIVENESS OF DRAINAGE SPACES

The more air that moves behind the siding, the more drying capacity the assembly has.

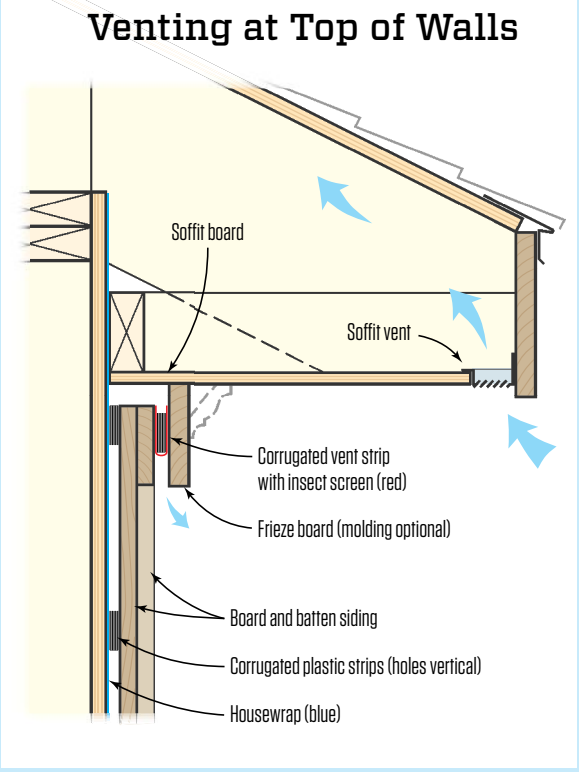
When we install vertical strips of solid material behind the siding, we create small cavities. These cavities may not connect to the outdoor air except at the bottom and won't dry nearly as well as cavities that have vent openings at the top or spaces that connect laterally and allow air and moisture to move in all directions. Similarly, narrow spaces won't allow as much air movement and drying as wider spaces.

As risk levels rise, we should consider moving from tiny, 1/16-inch spaces provided by textured wraps up through 3/16- to ¼-inch gaps from mesh or strip products, up to full ¾-inch spaces created by 1-by lumber strips.

Venting at the tops of walls can be added with corrugated vent products hidden between pieces of trim, as shown in the illustration at right. We've found these vents to be unobtrusive and easy to build.

One caution: I've seen discussion online about connecting wall vent cavities to roof vent spaces. I don't think this is a good idea for two reasons: First, I think it increases fire and insect hazards and probably doesn't meet the intent of code provisions, which call for wall cavities to be cut off from roof cavities. Second, at least in my climate, wall cavities can have huge moisture loads that we don't want to put into the attic.

One of the reasons I like drain-mesh products is they allow lateral, as well as vertical, air movement. This provides much more air movement and drying ability for any water that gets in at any spot in the wall. *—D.H.*



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SCAN ME

Deep Structural Retrofit

Rotted framing called for a complete rework of the load path

BY JAKE LEWANDOWSKI

Our company, which specializes in structural repairs, was recently called to an expensive residence outside of Chicago. A number of contractors had been to this house to bid on replacing a large wrap-around deck, but they had concerns; extensive rot of the ledger board signaled deeper structural problems that exceeded their expertise. Our inspection revealed numerous places where poor flashing had led to extensive water intrusion problems. The worst was at the base of large banks of windows on the A-frame-style wing that the deck wrapped around. Water running off the large expanses of glass had leaked for years through the base of the window walls, jeopardizing not just the deck ledger but the entire floor-system supports, which served to tie together the A-frame rafters. The house was on a hill and exposed, resulting in significant lateral wind loads on the steep roof, so a rotting floor system put this entire A-frame at risk of collapse.

The original structure appeared to be built with clad, heavy timber rafters that continued past the roof overhang and tied into a clad, horizontal timber beam, which completed a triangle. After we removed the cladding from the rafters, though, we discovered they were constructed from two roughly 3-by-14-inch boards sandwiching a 1/2-inch steel flitch plate welded to a flitch plate in the horizontal member. The floor system sat above this horizontal beam. This design may have worked while the wood framing was sound, but

Photos by Jake Lewandowski

This photo **(1)** shows the deck wrapping the A-frame-style wing of the house during the initial investigation by the author's company. Excavation in preparation for drilling helical piers was done by hand to carefully work around utilities **(2, 3, 4,)**. A lumber extension attached to a rafter revealed that a waste line was in the exact location where a pier needed to be drilled **(5)**.

once the wood rotted out, the integrity of the bolted assembly was severely compromised. Rather than try to reproduce this triangular load path, we worked with our engineer on a repair that redefined the load path: By driving helical piers at the same angle as the slope of the roof, the thrust of the rafters would be supported in-line with the rafters. We also supported the floor system with laminated veneer lumber (LVL) beams and completely reframed the supporting walls to create a robust structure with redundant support paths.

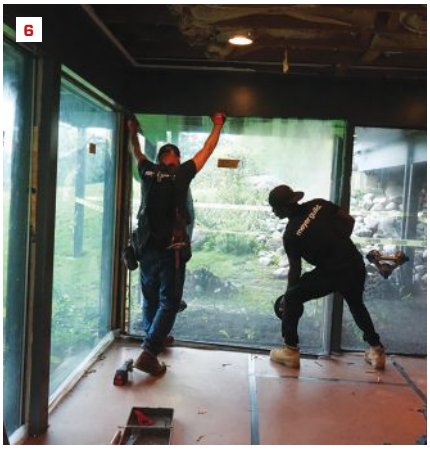
Given the tenuous condition of the existing structure and the possibility of the roof spreading as we unraveled the load path, we had to thoroughly shore up the home during the repair. This involved shoring under the entire A-frame floor, as well as erecting shoring towers on the right and left flanks of the A-frame where the main house roof extended over the deck. We also installed a temporary LVL beam across the face of the windows at the base of the triangular gable end.

Like many jobs on existing homes, our repair work touched a lot of the building systems. As seen in the photos above, several of the initial excavations for the helical piers had cable and electric lines crossing them, and one had a waste line that was directly in the path of the helical pier. A section of this pipe had to be removed to set the pier and then replaced once the pier was installed.

The photos that follow show the crucial steps we took to complete the repair and reframe the enclosure. Our work will be followed by several contractors: One will remove all the windows and the remainder of the existing cladding and replace them with a modern WRB, new flashing, new insulated glass units, and new cladding; and a deck builder will rebuild the wrap-around deck.

Jake Lewandowski is construction manager for Great Lakes Builders (greatlakesbuildersinc.com), in Elk Grove Village, Ill.

After protecting the floor below the A-frame wing, subcontractors from the window company removed the lower windows **(6)**, and shoring was erected to support the floor during demolition **(7)**. Additional shoring was erected to the left and right of the A-frame gable end to support the roof extending over the deck (shown in photo **10** below).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A worker stripped the trim off the face of the gable end to expose bolts holding an existing flitch plate that was spliced into the end of an outermost rafter **(8)**. The author used a plywood template to position a Forstner bit while drilling countersunk holes for larger bolts **(9)**. All the bolts holding the flitch beam were replaced and additional bolts added, per the engineer's specifications. Photo **10**, below, shows the temporary LVL beam installed to prevent the roof from spreading during the repair work.


10


11


12

Two-by lumber extensions (nailed in an "L" shape to keep them straight and stiff) projected the line of the rafters to guide the installation of the helical piers, which were drilled at the same angle as the pitch of the roof **(10, 11, 12)**. A total of four helical piers were drilled, two on each side of the A-frame gable.

These end caps **(13)** were fabricated for the ends of the helical piers. The author's crew were then able to connect steel columns that spliced onto the existing flitch plates at the rafter ends. Each end cap was field welded **(14)** to the end of a helical pier, once the pier had been firmly driven into place.

A strong field weld requires clean surfaces free from rust and paint, so a worker grinds the surface of an existing flitch plate **(15)** in preparation for welding on the HSS diagonal columns. Note the slots fabricated at one end of the columns **(16)**. These allow the column to slip onto the flitch plate; the column will then be cut to length and welded to the cap.

Here **(20)**, the bottom end of the diagonal column has been cut to length and welded to the end cap on the pier. At top, it is being welded to the flitch steel at the end of a rafter. After the diagonal columns were firmly in place, the bottom ends of the columns and the end caps were coated with a rust-inhibiting paint **(21)**.


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24

After removing the rotted ledger and grinding off the corroded bolts, the author made the first cut **(22)** to sever the connection between the flitch plate spliced into the rafters and the plate sandwiched between the ledger and the rim joist. The flitch plates running along the bottom of the gable end were cut and removed in sections **(23, 24)**.

As the crew stripped away the layers, they discovered how deteriorated the rim joist was. Shoring was added to support the temporary LVL spanning the gable end, and a new LVL beam supporting a new rim joist was installed **(25, 26)**.


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To support the new floor beam, the concrete slab had to be repaired and a new framing sill installed **(27)**. New joist hangers were installed to support the floor joists **(28)**, along with new PSL columns to support the new beam **(29)**.

The author planed 2x10 stock **(30)** to pack out the space between the new rim joist and the face of the new beam. (One piece of this planed material can be seen installed on the left-hand side of photo **31**.) It was much quicker and neater to plane down this material than it would have been to cut back all the floor joists to reposition the rim joist in relation to the windows.

A new LVL was installed to support the windows on the right and left of the gable end **(32)**. Once the deteriorated, let-in columns supporting this part of the floor system were removed, the foundation had to be repaired with non-shrink grout **(33)**, and new, built-up PSL columns installed **(34)**.

A view of the new LVL beams and PSL columns on an outside corner **(35)**. The complete structure **(36)**; all that remained were short walls between the columns to support new windows, and Zip System sheathing to protect the new framing **(37)**.

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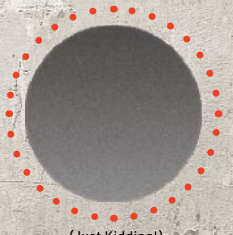

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Making the Most of a Sloped Site

by Jason Varney

This lakeside building site drops 100 feet from the road to the waterfront. To optimize the lot, the author created three level tiers with a series of retaining walls and connected the tiers to each other with stone steps and pathways.

PHOTO COURTESY DOCK & DECK

One of the most interesting deck building challenges I've had to face had nothing to do with my clients or my business. I'm talking about what happened when it was time to design a backyard space for my own family. After decades in the outdoor living industry, I can design and build a dream project for a client in my sleep—but designing my own project turned out to be a different story.

The project started when I broke ground on my family's current home in Knoxville a few summers ago. The house itself came together beautifully—however, our local terrain is full of hills, and this property was no exception. We were faced with a steep hillside, with an elevation change of about 100 feet between the driveway of the house and the waterfront level in the backyard. This presented a significant logistical problem since there were homes on either side of ours, and we would need to transport all of our materials and building equipment in and out by barge.

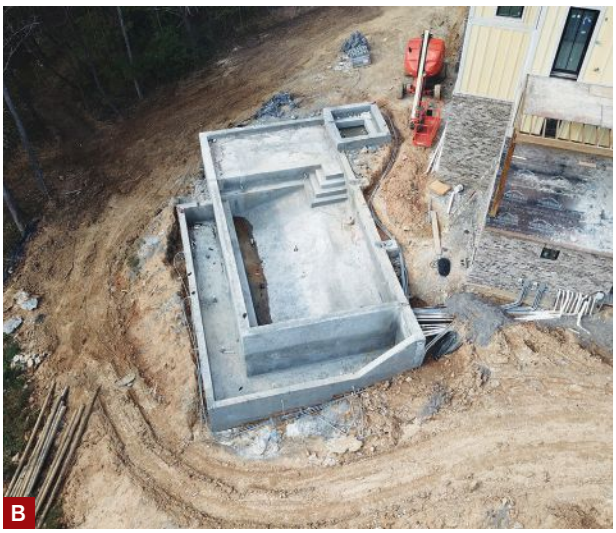
While we were short on horizontal square footage, we weren't short on design inspiration. A few years earlier, our family vacationed to a resort in Cabo San Lucas, and we've been reminiscing about it ever since. I knew I wanted to go all out and bring that "resort" feeling into our own space. We love to host family and friends for gatherings and holidays, too, so it needed to be suitable for that. Most of all, I wanted to replicate the amazing infinity pool we swam in.

Re-creating a Resort

To break up the steep elevation and introduce the incline more gradually, my solution was to section the backyard into three tiers by using a lot of retaining walls and different levels. I designed each tier to include multiple entertainment zones that would serve a variety of functions and connected the tiers to each other with a few sets of stairs and some stone-paver pathways to help guide the flow of foot traffic.

The highest tier of the backyard features the infinity edge pool, with a hot tub and spillover waterfall. We went with a travertine hardscape and incorporated Baja shelving and lots of LED lighting into the pool to make it swimmable at night. Past the hot tub, we installed a grilling area for cooking and barbecues. There's a big fire feature on the corner of the pool—when it comes to pool design, I really think that fire and water go hand in hand.

We created a lounging area on the second tier, with plenty of seating options thanks to built-in benches that were



Site work began while the house was still under construction (A). After the infinity edge pool was formed and poured (B), workers began the process of building the retaining walls and backfilling them with gravel and soil to create the two lower terraced levels (C). Here, the crew is installing the stone steps that connect the lowest tier to the dock system (D).

crafted using Deckorators Voyage decking, the same material that we used for the rest of the deck space. Matching furniture material with the deck material like this helps tie a design together and make everything feel cohesive.

Closer to the water are a miniature golfing area and a section of turf with some Adirondack chairs, followed by a boardwalk that leads to a covered dock. The dock itself is a full boathouse that can fit two jet skis, a small watercraft boat, and a large, 30-foot boat slip. On the rooftop of the dock, we added a 20-by-32-foot deck, again finishing it with Voyage decking. It's a great place to hang out and take in the view.

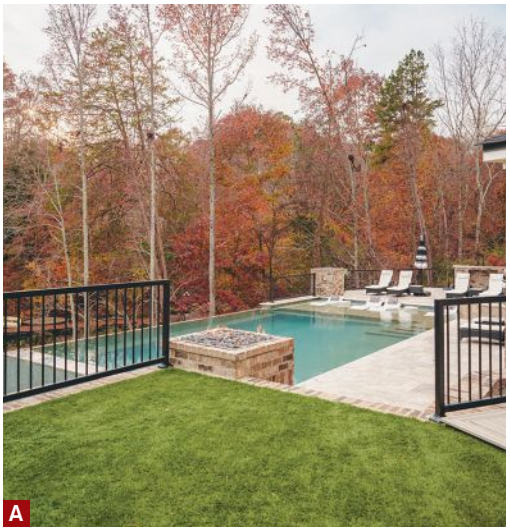
My company builds many projects in and around the water and, in our experience, Deckorator's Voyage decking is able to resist the wear and tear that comes with that challenging environment. Made with crushed limestone, this decking offers excellent traction, doesn't get too hot in the sun, and won't thermally expand or contract.

Terraces Are Key

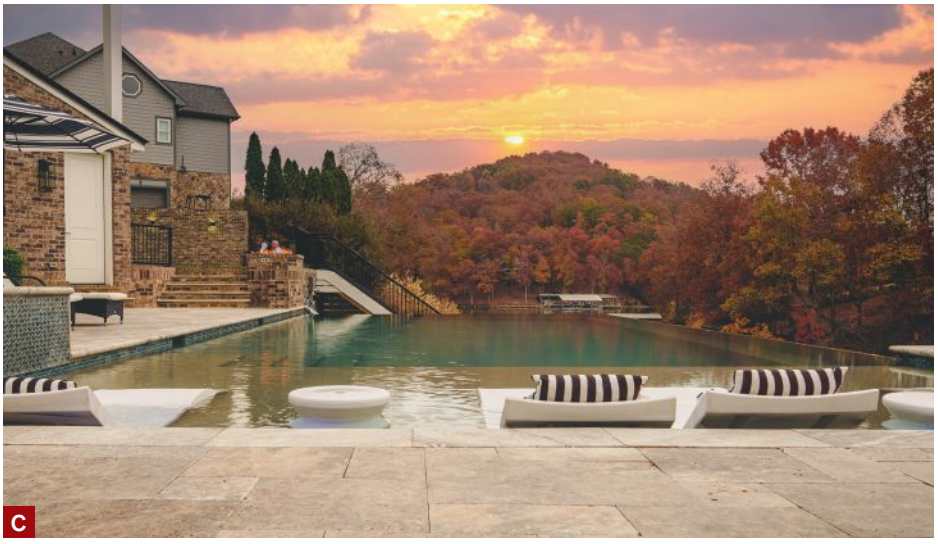
The only way to deal with such a dramatic drop in grade at such a short distance is to terrace everything. To maximize usable space, we built retaining walls at each level and then built the ground up to get the levels flat.

Stabilization is crucial on hillsides like this, and settlement issues can be

PHOTOS: A, C, D, JASON VARNEY; B, COURTESY DOCK & DECK


A


B


C

Though nestled into a hillside above a Tennessee lake, the infinity edge pool was designed to capture the feel of a seaside resort (A, B). For reduced maintenance, the landscape features artificial turf instead of natural grass, the extensive use of natural stone pavers, and—where appropriate, such as on the dock system—composite decking. At the end of the day, the author and his family can relax by the pool and take in the view as the sun sets behind the hills that surround the lake (C).

completely devastating. To keep everything in place and make sure the house wouldn't slide right down the hill, we installed helical piers throughout the backyard to reinforce the system of retaining walls.

With the lot being so steep, we had to make some adjustments to the construction process. For example, we pumped—rather than poured—the concrete all the way from the street level—11 times. We had to look into alternative methods to transport gravel down the hill and ended up using a gravel slinger. I'd never been around one before. It's essentially a massive conveyor belt that loads the gravel up at the top of the hill and throws it down to the next level. In total, we used 330 yards of concrete and 3,600,000 pounds of gravel on this project.

And that was just the beginning. Since the house sits so close to neighboring lot lines, we needed to bring the rest of the building materials in and out by barge. We loaded up materials at the nearest boat ramp, transported them by water, and then offloaded them onto the land below the house. The same went for debris removal: Anything that needed to go to a landfill had to be hauled off on the barge. It was a necessary evil that significantly increased our total cost and stretched out the time frame of the whole project.

All in all, the backyard took about a year to complete. In addition to struggles with the steep grade, we dealt with water traffic, weather setbacks, and issues with product availability. Despite all the challenges, this backyard oasis is everything I could have imagined for my family and more. ❖

Jason Varney owns Dock & Deck and Tennessee Pool & Spa, in Knoxville, Tenn.

PHOTOS: RYAN HULL/COURTESY DECKORATORS

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PHOTOS BY KOLBE RAICHE

The 4-Hour Deck

Modular sections built in the shop speed up assembly on site

by Kolbe Raiche

Where I work in North Dakota, composite materials are expected on spec-house decks because the harsh winters are tough on wood decking. Many potential homeowners don't want to have to stain or paint a deck, but composite decking is expensive, leading to a disconnect between the features buyers want on a new home and the price at which developers can turn a profit without decreasing demand. As a result, many developers end up installing wood decks, which, in our climate, often fail after five or six years from lack of maintenance. Since nearly 400 new homes are built in this area every year, I wanted to find a way to way to meet this untapped demand for cost-effective, low-maintenance decks.

Modular Construction

In the value triangle, three basic factors influence a purchase decision: cost, quality, and convenience. A smart deck builder picks any two out of the three to compete on. In the solution my company settled on—modular deck construction—we optimize convenience and low cost.

This is *not* to say that our decks are low quality; they comply with building codes, and we employ best practices to build them. The way we save on costs is by omitting some custom details like picture-frame borders. As the photo above shows, the result is a design with exposed deck-board ends.

For our business plan to be successful, we must be available at short notice and able to install decks quickly. Many developers in our area are short-staffed and under tight schedule constraints while dealing with hundreds of subcontractors. Consistently providing a quick turn-around is the key to best serving this client base. With modular construction, our final design can be installed on site in about four hours.

Design

Design is the most important part of the process of building a modular deck; structural, aesthetic, and sizing problems are expensive to fix after installation. SketchUp is our 3D design tool of choice, helping us to make sure everything will be right the first time. It enables quick concepting and fine custom detailing without the unnecessary frills of other deck design software that we've tried (**Figure 1**).

The idea behind modular decking is to build sections approximately 30 inches wide by the length of the deck; in this example, about 10 feet. This is about the maximum size that we can handle in our shop and load onto our trailer without machinery. On a standard deck framed with joists 16 inches on-center, each joist

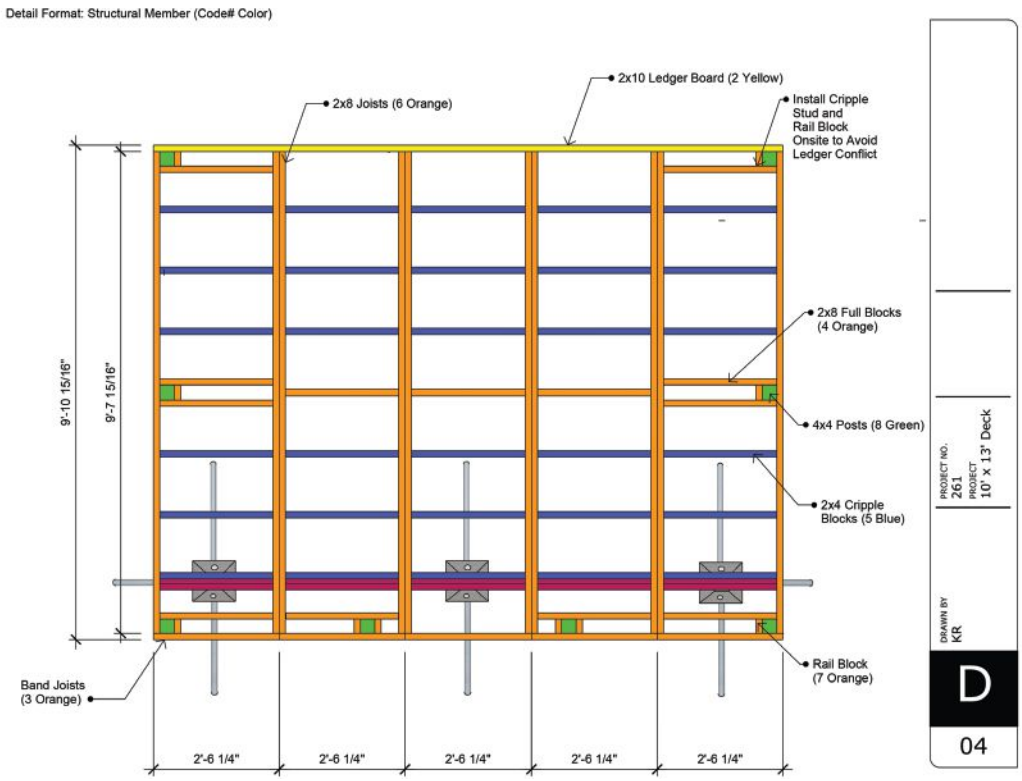

Figure 1. Here is a typical framing plan for a 10-by-13-foot modular deck, which the author designed using SketchUp. This design consists of 2-foot 6¼-inch-wide modules that are fabricated in the shop, then later assembled on site.

supports 16 inches of tributary area. In our framing plan, the two 2x8 joists that make up the long sides of each module can support up to 32 inches of combined area, so normal span tables still apply. On our modular decks, the supported area is completely inside each pair of joists that make up the long sides of each module.

As we assemble the sections, we install 2x4 blocking (to support the decking) and 2x8 blocking (for the railing posts). While this extra step uses more lumber versus building on site, the time and labor savings make it worthwhile, since decking and railing posts can be added to the modules before we transport them to the jobsite. Another advantage is that the extra 2x4 cross-blocking helps to stiffen the joists.

Assembly

We use the plan created in SketchUp to output a cut list for all the framing, decking, fascia, and railing, which allows us to precut all of the material prior to assembly. We invested in a pre-owned Tiger-Stop SawGear automated cross-cutting system to speed up this process, but this system isn't required. Any setup that ensures repetitive cuts are as accurate as possible would work.

In the shop. During assembly, we place the precut joists and blocking into a squaring jig, which allows us to quickly and accurately nail together the framing.

As we assemble the sections, we install 2x4 blocking 16 inches on-center between the 2x8 deck joists so we can run the deck boards parallel to the joists. At the same time, we install full 2x8 blocking where needed for railing posts. In some cases where there is a potential conflict, such as at the ledger, we hold off installing blocking until we are on site.

Once we've built the individual modules, we arrange them so that they are aligned with each other as they would be on site, but not actually screwed together. Then we install the railing posts, followed by the decking.

Decking. We've found Trex Enhance Basics decking to be the least expensive and most readily available option in our area. We use Trex's clip system to fasten the decking to the framed sections, except for the first and last board on each module, which we face-fasten with screws on the outward side, because a clip would cause interference during installation.

Typically, we size each module to be the exact width of four or five deck boards and clips, plus 3/32 inch on each side to maintain the proper spacing at joints. If modules are not sized properly for the decking for some reason, we wait to install the deck boards over the joints until the modules have been installed on site.

After the decking is installed, the

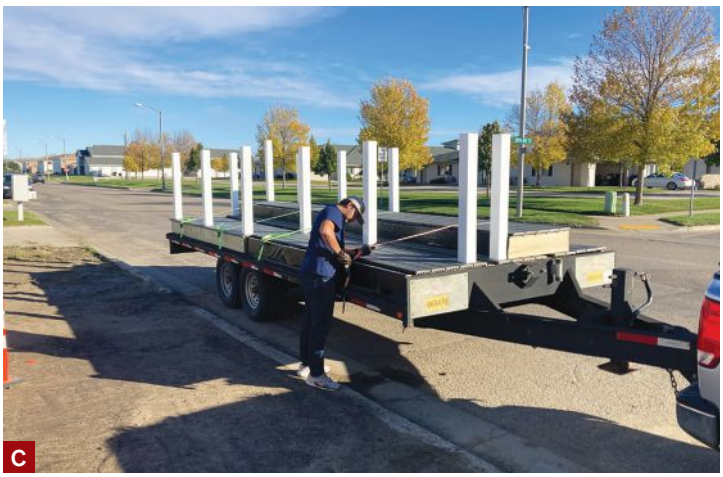

Figure 2. Parts needed to assemble the modules are precut using a TigerStop SawGear automated cutting system (A). Shown here are the modules needed for two decks, with blocking and railing posts installed (B). After the decking is attached to the framing with clips, modules are loaded onto a flatbed trailer for delivery to the site (C).

modules can be loaded onto a trailer and transported to the site. Each module weighs about 10 pounds per square foot; in this case, the modules weighed around 300 pounds each. We moved them by hand in the shop but used a rented Bobcat L28 articulated loader to move them on site. This machine works perfectly as it allows for very fine positioning. For longer modules, we would need a forklift to move them in the shop (**Figure 2**).

On site. Before the modules arrive on site, the ledger needs to be prepped and mounted to the house. Typically, the builder installs a dummy ledger with properly installed flashing before the siding contractor does their work. After siding is completed, we come in and replace the ledger and fasten it to the house framing with LedgerLoks. Our ledger has premounted double joist hangers to hang the modules.

We support the modular decks with Diamond Pier pin-pile footings, a code-compliant frost-protected system that doesn't require digging or pouring concrete. Each footing consists of a precast-concrete pier head that supports a deck post, and four steel pins that are driven at an angle through the pier head into the ground. We use 50-inch-long pins in our area, with each pier taking about 20 minutes to install. Larger decks sometimes require larger Diamond Piers or helical piles.

Once the ledger and Diamond Pier footings are installed, the crew installs posts, knee braces, and support beams. While we determine post heights with a laser level and then cut them to length on site, we are able to precut the knee braces in the shop. All beams are precut and nailed together in the shop so that we can simply set them in place during final assembly.

Finally, we use an articulating loader to set the modules into the joist hangers on one end while resting on the beam on the other end. Since each module acts as a kind of "mini deck" and doesn't depend on adjacent modules to support loads, we only need to use a few structural screws to join the modules together (**Figure 3**).

Economics

Training a new employee for shop work typically takes only about a week. Coming in with no experience, a worker can quickly learn how to build the modules, which produces profit for the company sooner. Of course, field workers require more

training and experience to become proficient in equipment operation and proper ledger details.

Throughout the design and assembly phase, material lengths are optimized for cuts. This is possible on traditional sites but is easier and more effective in a controlled environment. The automated TigerStop cross-cutting system that we've invested in for our miter saw saves around three hours of cutting per deck while producing consistently sized parts. We were able to find a 20-year-old pre-owned unit for about $6,000. It has software to get the most out of the material on hand and can make suggestions based on material cost, length, and finished size.

Our approach also limits worker downtime, which can amount to a huge expense for traditional deck builders. In the shop, we've also implemented a pay-for-performance model, where employees are paid a base hourly rate and rewarded for completing work in less time. In our experience, pay-for-performance attracts highly effective employees who work hard. Full deck-sized jigs, automated cutting systems, and clear plans help cut down on production time significantly and give employees a clear vision to accomplish each day.

Along with those advantages, there are three challenges we have run into with this model. First, there is a limit to how complex the deck can become. Decks around pools or bounded by three walls or close to the ground are possible but require more customization and are therefore less profitable. In general, traditional construction makes more sense for more complex decks.

With the increase in overhead for the larger shop space, extra equipment, and machine rental, a lot of volume is needed to break even, not to mention make a profit. Modular construction would not make sense at a low volume.

Finally, many properties simply do not have enough access to the backyard to accommodate the modules. Narrow lots with fences, power lines, septic fields, and landscaping that is already in place all pose difficulties. Modular construction is not a solution for every deck, and there will always be a need for custom projects. But, for spec homes, apartments, and some homeowners, we've found that modular decks can provide a cost-effective, low-maintenance solution. ❖

Kolbe Raiche owns The Deck Dudes, a modular-deck building company in Bismarck, N.D. (thedeckdudesus.com).

Figure 3. The deck ledger is precut and fitted with double joist hangers off site (A). After the ledger is screwed to the house framing, the crew installs Diamond Pier pin-pile footings, support posts, and the preassembled beam and knee braces needed to support the modules. Workers then use an articulated loader to lift the modules into position (B). The partially completed deck shown here took 15 man hours in the shop and four man hours on site to install (C).


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4 COMMON MISTAKES TO AVOID DURING LEDGER BOARD INSTALLATION

by Dave Kile

Ask any deck builder the most likely place a deck will fail and, odds are, they'll point to the ledger board. If not correctly installed and protected, this single structural element can be the Achille's heel of a deck resulting in premature deterioration or collapse.

Over the past 30 years, I've seen my share of questionable ledger applications and have identified four common—and easily avoidable—mistakes:

1. IMPROPER ATTACHMENT

Correct anchoring of the ledger board is crucial to a deck's composition and safety. For optimal support, the ledger board must be attached to the rim joist. It is also important to use the right fasteners (more on this later).

2. INCORRECT JOIST OR BEAM SPACING

Because the weight of a deck is distributed per square foot between the joists and the ledger board, the importance of accurate spacing between joists and beams cannot be overstated. Leaving too much space between these bracing elements is a recipe for disaster. Be sure to follow IRC guidelines as well as any instructions provided by materials manufacturers.

3. USING THE WRONG FASTENERS

This mistake is quite common whether due to misinformation or cutting corners. For ledger applications, it's best to use hex or carriage bolts. Lag bolts and nails can more easily strip out of wood. I've heard of cases where builders have been able to pull a deck away from a house with just a good yank because the original installer used nails that had corroded. Look for sturdy metals such as stainless steel or hot-dipped galvanized that are resistant to rust and corrosion. I also recommend applying our butyl joist tape to help keep screws dry and in place.

4. NEGLECTING TO WATERPROOF

Easily one of wood's worst enemies, moisture is a recurring theme across ledger board failures. In most deck installations, there is a gap left between the house and the deck that allows water to seep down onto the ledger board where it can penetrate the wood and lead to decay. This is why it's critical to protect the ledger with waterproof flashing.

While there are several types of flashing available, only tapes have the ability to create a waterproof seal. These self-adhered membranes also eliminate the need for fasteners that create holes, and they won't corrode.

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PHOTOS BY ANNE DAWSON

Better Stair Stringer Layout

This calculated approach guarantees uniform risers and treads

by Mark Dawson

When you're building stairs, the most important thing is to make sure they are as safe as possible. Why focus on safety? Because each year, according to the National Safety Council, more than 1,000,000 people are treated at a hospital for stair-related injuries, and 12,000 stair-related deaths are reported.

Safe stairs depend on factors including good design, appropriate materials, firm attachments, adequate lighting, and code-approved handrails where required. One way I endeavor to build safer stairs is to ensure the layout is as accurate as possible. While building codes typically allow for up to 3/8-inch variance in the dimensions of the rises and runs on a stair, if I find more than 1/8-inch difference, I'll correct it. With the method described in this article, however, that rarely happens.

Total Rise

Start by determining the total rise, which is the vertical distance from a finished surface to a finished surface. For a deck, this would typically be the distance from the top of the decking down to a landing slab; note that it's important to measure down to the elevation where the stairs will land, which is not necessarily straight down from the deck.

For example, the ground may be sloped away from the edge of the deck; 12 feet out, the ground may be several inches lower. That difference in elevation will affect the total rise of the stairs. It may be necessary to use a laser level or some other method to establish the height of the deck above the actual landing spot.

Unit rise. Code says the maximum allowable unit rise—the vertical distance from one step to the next—is 7.75 inches. Assume, for example, that the total rise is 8 feet 6 1/2 inches, or 102.5 inches. To determine the unit rise, first divide 102.5 by 7.75, which equals 13.22 units of rise. Since there can't be a partial rise, I divide 102.5 by 14, yielding a unit rise of 7.3214 inches, or just over 7 5/16 inches. That's less than the code maximum and acceptable. If I divide the total rise by 13, the unit rise would be 7.88 inches, or 7 7/8 inches, which exceeds the code maximum.

Depending upon how much horizontal room there is, a stair could have more than 14 risers. Going to 15 risers yields a comfortable unit rise of 6.8333 inches, or 6 13/16 inches (102.5 divided by 15 = 6.8333). Going to 16 risers yields a unit rise of 6.4062 inches, or 6 3/8 inches

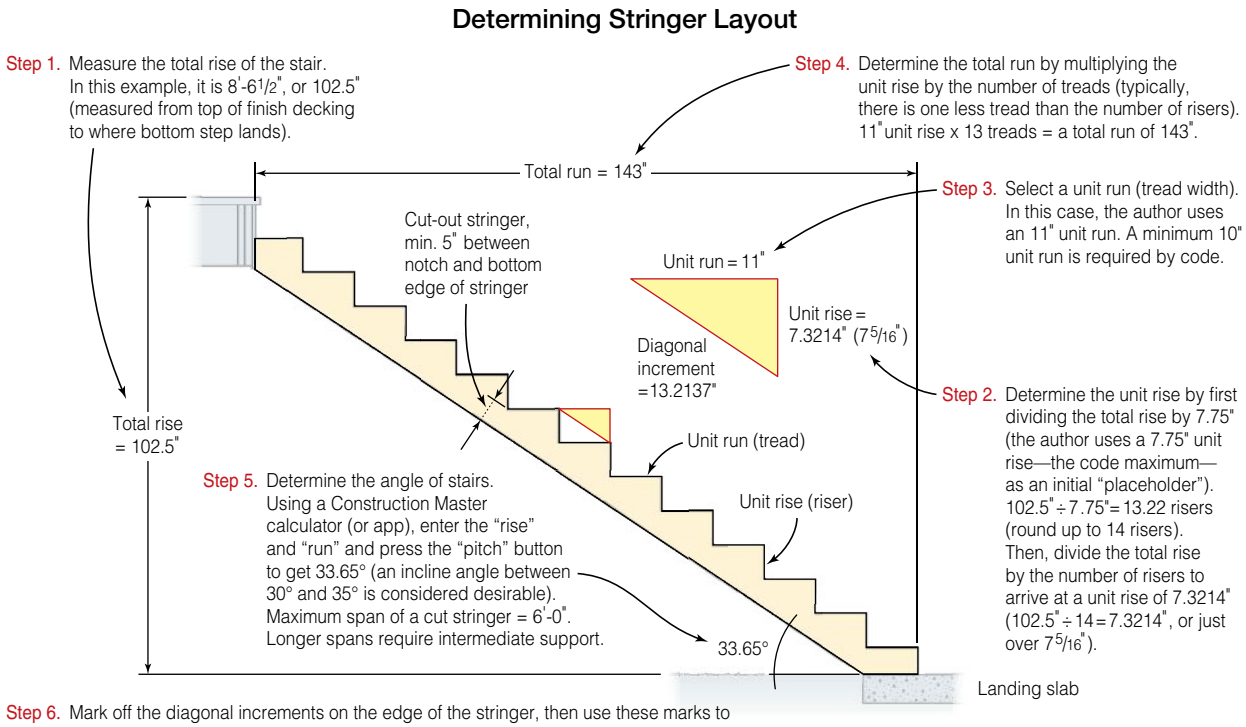


Figure 1. The author determines the stair's total and unit rise and run following the steps above, then calculates the diagonal increment using the Pythagorean theorem. In this example, the increment is 13.2137 inches. He makes a pencil mark every 13.2137 inches along the edge of the stringer stock to guide the placement of the notched cuts.

"strong"—a little shallow but still perfectly acceptable. Unless circumstances dictate otherwise, I try to avoid rises less than 6 inches because they make a stair feel choppy and so create a bit of a hazard.

Total Run

If no obstacles limit the horizontal length of the stairs, the unit run can be determined somewhat arbitrarily (note that the actual depth of a tread, which typically includes a nosing/overhang, is almost always greater than the unit run). This measurement yields a stair's total run, which is determined by multiplying the unit run by the number of treads.

Code specifies a minimum unit run of 10 inches; in terms of functionality, I consider that too short and would use it only if I had no other way to fit the stairs in a given space. A long run, on the other hand, can feel unnatural and awkward and therefore be a hazard. In this example, there is room for an 11-inch unit run, which I consider safe and comfortable and is the minimum unit run for commercial stairs.

With a unit rise of 7.3214 inches and unit run of 11 inches, you can determine the angle of the stairs. Many carpenters—myself included—enter the rise and run into a Construction Master calculator (or app) and press the "pitch" button to get 33.65°. An angle between 30°and 35° is desirable, so we are right in that sweet spot. Another way to determine this angle is by using the inverse tangent function on a scientific calculator (I use a TI-30Xa): First, divide the rise (7.3214) by the run (11) to get 0.6655. On my calculator, I'd press the "2nd" button followed by the TAN key to get 33.64°.

Diagonal increment. Because of the Pythagorean theorem ($a^2 + b^2 = c^2$), we know that the diagonal (hypotenuse) of a right triangle with a 7.3214-inch rise and 11-inch run is 13.2137 inches, or 13 1/4 inches light. This basic formula is the key to figuring rise and run angles for stairs, rafters, and whatever else you build that involves an angle other than 90°. And this diagonal increment is my key to accurate stair stringer layout.

Stringer Layout

A 2x12 cut-out stringer with 14 risers will have 13 treads, as stairs almost always start one riser down from the deck surface. So, the total horizontal run of our stair is 13 feet 11 inches, or 143 inches. Keep in mind that the horizontal span of an unsupported cut stringer is limited to 6 feet, so stairs with 13 treads will typically require one or two intermediate supports or other structural reinforcement.

ILLUSTRATION BY TIM HEALEY

Figure 2. After calculating the unit rise and run following the steps shown in the drawing on the facing page, the author lays out a few treads and risers on scrap plywood ripped to the width of the stringer stock (A). He uses this template to check the fit at the top (B) and bottom (C) of the stairs prior to laying out and cutting expensive stringer stock (D).

Using the pitch of the stairs, I use the COS function on my calculator to find the mathematical length of the stair along the angle—and thus the length of the 2x12 stock needed for the stringers. This is a relatively simple rake length calculation, which can be done using trigonometry. On a TI=30Xa calculator, I find the angle as described above (33.64°), then push the COS button followed by 1/x to find the rake length multiplier of 1.2012. Multiplying the 143-inch run by 1.2012 equals 171.7716 inches.

Alternatively, I can multiply the length of the diagonal of one riser/tread combination (13.2137 inches) by the number of tread/riser combinations in the stair (13) and find a diagonal length of 171.7781 inches. This is the mathematical diagonal length; the actual stringer will be a bit longer than that and will need to be cut from a 16-foot-long 2x12.

Template. Before I begin laying out and cutting stringers, I like to make a template so I can check the calculated plumb cut at the top and the level cut at the bottom. I rarely have a scrap piece of 2x12, so I make the template out of plywood ripped to the width of my stringers, typically 11 1/2 inches. I then make the top and bottom cuts (instructions to follow) to check that my math is correct (**Figure 2**).

When I started as a carpenter, I was taught to set the stair gauges on a framing square to the rise and run—in this case, 7 5/16 inches and 11 inches—and mark the layout with a utility knife rather than a pencil as I slid the square down the board. This was because a pencil line was considered inaccurate and could cause an accumulation of errors. While a utility knife is better than a pencil, this method can still cause errors. By using a calculator and its plus/equals function, as described below, I eliminate any possibility of an accumulation of errors. In the "old days," you would also use one stringer as a template for the other(s), which could also cause minor layout errors. But laying out the diagonal increments on each stringer with a calculator eliminates the possibility of an error creeping in to the transfer of the layout.

Start by making a mark on the edge of a 2x12 near one end, with the crown up. Pull a tape from that mark and make another mark 13.2137 inches—or 13 1/4 inches light—along the board. Using a calculator that does plus/equals, add 13.2137 and 13.2137 to get 26.4274 (or 26 7/16) inches, and make another

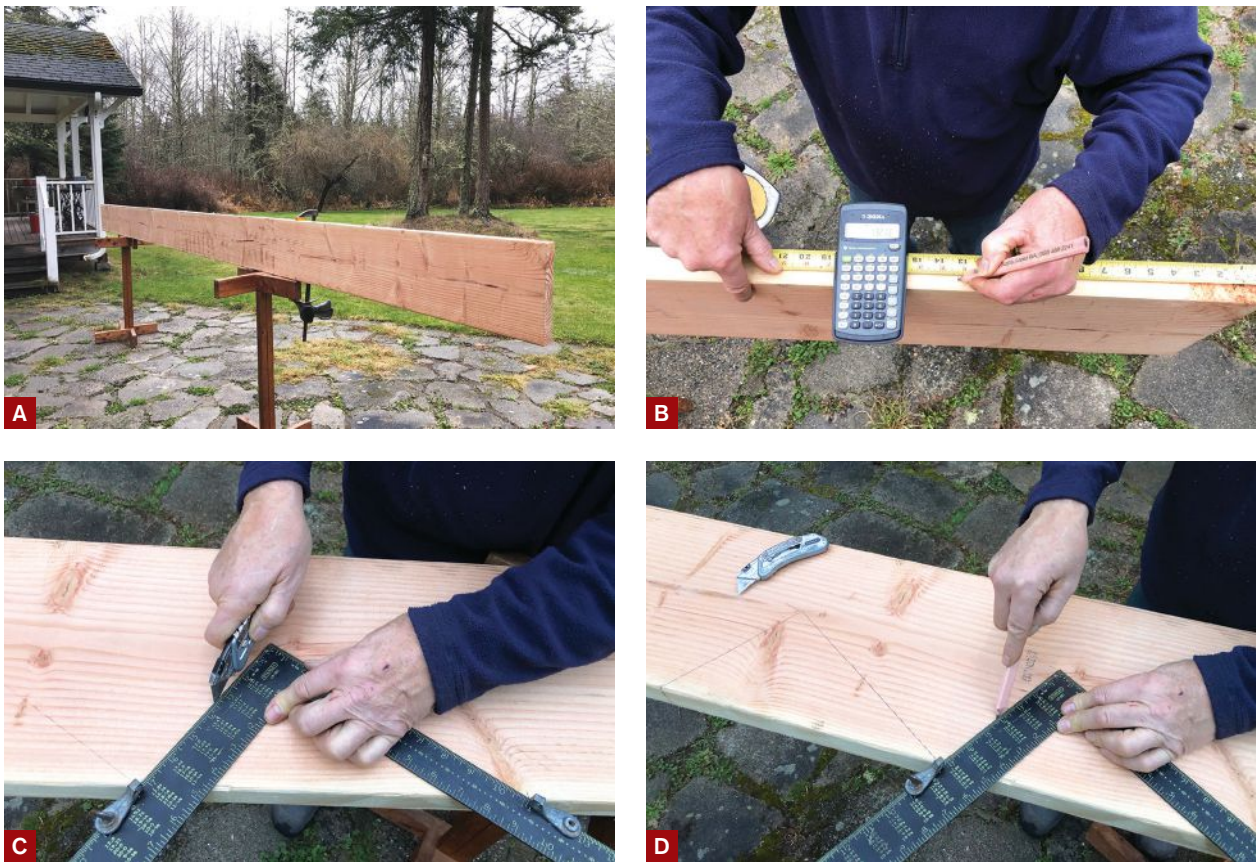


Figure 3. The author places his stringer stock on edge with the crown up (A) to mark the diagonal increments, using the plus/equals function on his calculator to determine the exact distance of each increment from his starting point (B). The increments guide the placement of the framing square as he marks the notches with a utility knife (C). Highlighting the layout lines with a pencil makes them easier to see when cutting the notches (D).

mark there. Keep hitting equals and we get the following:

- 39.6411 ($39\frac{5}{8}$ inches strong),
- 52.8548 ($52\frac{13}{16}$ inches strong),
- 66.0685 ($66\frac{1}{16}$ inches),
- 79.2822 ($79\frac{1}{4}$ inches strong),
- 92.4959 ($92\frac{1}{2}$ inches),
- 105.7096 ($105\frac{11}{16}$ inches strong),
- 118.9233 ($118\frac{15}{16}$ inches),
- 132.137 ($132\frac{1}{8}$ inches),
- 145.3507 ($145\frac{3}{8}$ inches light), and
- 158.5644 ($158\frac{9}{16}$ inches).

We now turn the board on its side, set the stair gauges (I prefer ones made by L.S. Starrett) on a framing square at $7\frac{5}{16}$ inches strong and 11 inches, and mark the notch cuts with a utility knife, using the pencil marks to guide the placement of the framing square. The stringer layout will be perfect, with no accumulation of errors (**Figure 3**).

Cutting the Stringers

I cut the notches in stringers with a circular saw, stopping at the crotch of the cut and finishing with a jigsaw so as not to weaken the stringer by overcutting.

The stringer's bottom cut is determined by the thickness of the tread material. If it's 2-by stock, I cut $1\frac{1}{2}$ inches off the bottom of the stringer. In other words, measure the thickness of the tread material and cut off that amount from the stringer. If the bottom of the stringer were not cut, then once the treads were added, the top step would be too short—$5\frac{13}{16}$ inches—and the bottom step would be too tall—$8\frac{13}{16}$ inches.

The connection detail at the top determines the top cut. If the stringer is attaching directly to a finished top riser, and the last deck board or boards project 1 inch over that riser, then we want the first tread nose to be 11 inches away, measured horizontally, from the nose of that deck board.

Making the vertical cut at the top of the stringer at $10\frac{1}{4}$ inches from the cut for the first riser allows for $\frac{3}{4}$-inch-thick risers. Since code doesn't allow any opening larger than 4 inches on the stairs at the treads, risers are required on cut-out stringers. I typically make these using $\frac{3}{4}$-inch-thick stock. They need not be the full height of $7\frac{5}{16}$ inches, but they must not allow a sphere greater than 4 inches through the space under the tread.

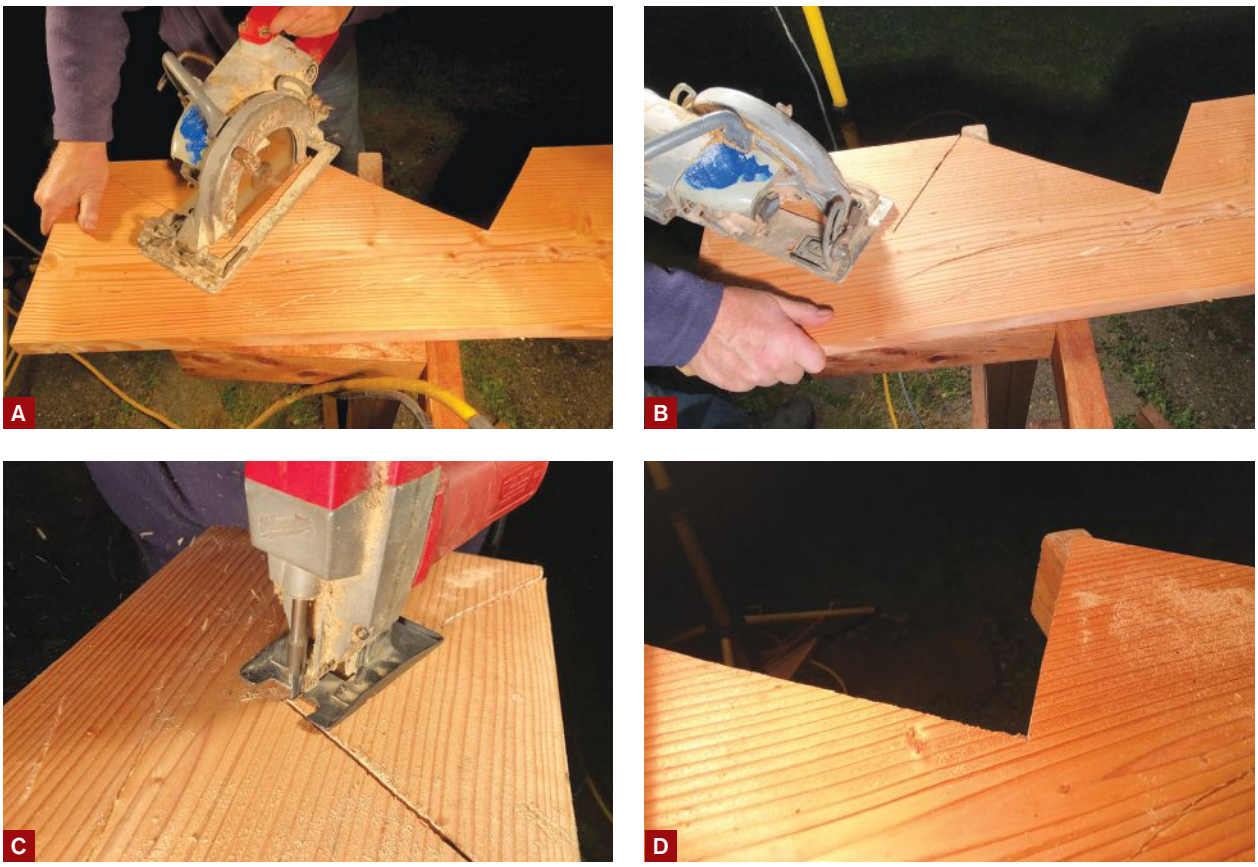


Figure 4. To avoid overcutting the notches, which would weaken the stringer, the author starts the cuts with a circular saw (A, B), and finishes the cuts with either a handsaw or a jigsaw (C). Marking the diagonal increments on the stringer before laying out and cutting the notches ensures that tread and riser dimensions vary by no more than 1/8 inch (D).

A typical nosing projection, or the distance the tread overhangs the front of a riser, is 1 inch. If we use two 2x6s for the tread, we can space the rear 2x6 1/2 inch from the riser above, leaving a 1/2-inch gap between the two 2x6s and allowing the front 2x6 to overhang the riser below by 1 inch. The spaces between the riser and the back tread and between tread boards allow for drainage.

Code says the nosing shall be between 3/4 inch and 1 1/4 inches. If the nosing is 3/4 inch, then the space between the boards and the space at the back riser will be 3/8 inch. If the nosing is 1 1/4 inches, those spaces would grow to 5/8 inch; for smaller gaps, a 2x8 ripped to width could be used for one of the treads instead of a 2x6. A nosing is not required on stairs with a run of 11 inches or greater. I prefer using two 2x6s rather than a single 2x12 tread because not only do they provide for better drainage, but the narrower boards are less likely to cup over time. ❖

Mark Dawson is a foreman with Willemsen Construction on Lopez Island, Wash.

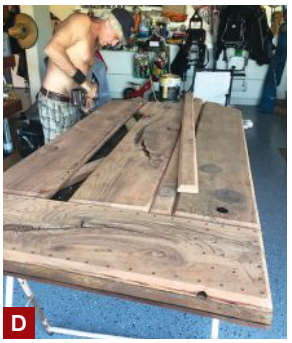
Converting Decimals to Fractions

Using a scientific rather than a construction calculator requires converting hundredths into fractions, which can feel unwieldy at first but eventually becomes easier. We all should know the halves and quarters; e.g., 0.5=1/2 inch, 0.75=3/4 inch, etc. The eighths should also come pretty quickly; e.g., 0.375=3/8 inch, 0.625=5/8 inch, etc. Once you have those down, it's a logical progression to learning the sixteenths, and the beauty of no accumulation of errors is even if you miss a sixteenth measurement slightly, it probably will barely be noticeable, and it won't affect the next layout mark. *—M.D.*


A


B


C


D


E

The Viking Gate

by David Bullene

One hundred years ago, the Santa Cruz Lumber Co. built a log pond and sawmill on Pescadero Creek, a spring-fed stream that originates in California's Santa Cruz Mountains and empties into the Pacific Ocean. Though logging operations shut down in the 1970s, some old-growth redwood logs remained in the old mill pond and stream and, about 20 years ago, I salvaged a few. I then milled the wet logs into 5/4 and 8/4 slabs and stored them under cover.

When a friend recently asked me to build him a garden gate out of old-growth redwood, I immediately thought of my stash of now-dry redwood. Far from clear lumber, the weathered slabs were highly figured with knots and checks, perfect for the Nordic-style door I had in mind. My design was inspired by my travels in Scandinavia—in particular, a curved detail at the top of the door **(A)**.

I built the inner frame out of 2x6 PT lumber, sizing it to fit the garden arbor that I had built earlier. I joined the bottom rail to the stiles with mortise-and-tenon joinery reinforced with four countersunk 6-inch structural screws at each joint—two in each direction—and Titebond III glue. At the top, I freehanded the curved detail on the 2x12 redwood rail, adding a short PT 2x6 to complete the design. After joining the top rail to the frame with biscuits, screws, and glue, I fastened a diagonal 2x4 brace to the frame to keep the door from sagging **(B)**.

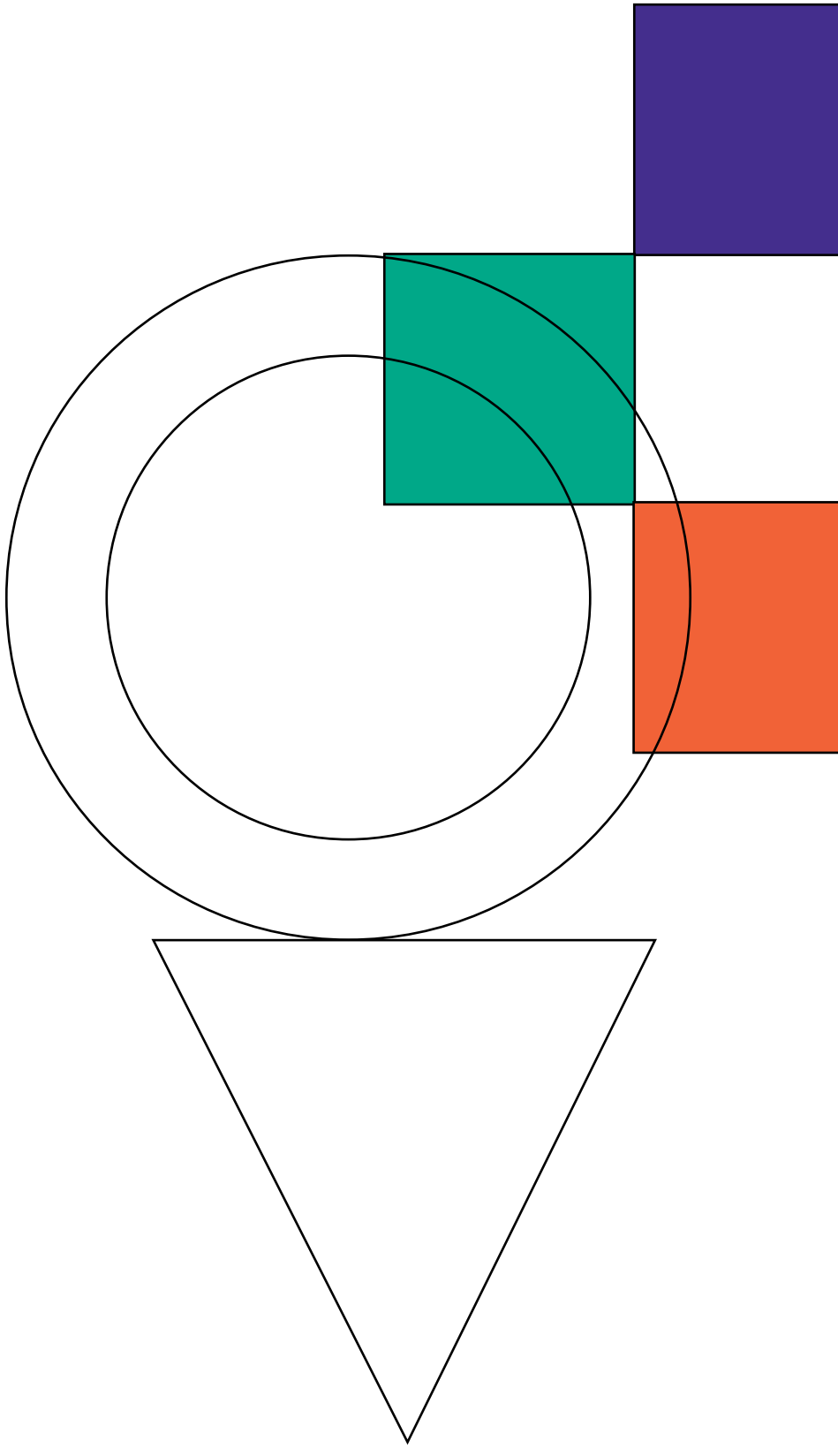
Among the door's unique features are the dozens of screws used to fasten the outer boards to the inner frame **(C)**. I wanted to create an old-world rivet look, so I used a T-square to carefully lay out fastener locations uniformly spaced 1 inch on-center. Then I drilled countersunk pilot holes for the screws, which I partially inserted into the holes prior to final glue-up to speed up assembly **(D)**.

As I glued and screwed the boards to the frame, I snugged them together with bar clamps for a tight fit. After assembly, I gave all sides of the door three coats of PPG ProLuxe (formerly Sikkens) transparent matte finish to bring out the redwood's beautiful grain and color. To match the door's rustic look, I sourced hand-forged gate hardware and four giant carriage hinges that were made in England but stocked by a local supplier. Heavy-duty hinges were required since the assembled door weighed more than 250 pounds; I was happy that my friend was able to help me install his new Viking gate in the arbor **(E)**. ❖

David Bullene is a custom builder with over 35 years of woodworking experience. He lives in Scotts Valley, Calif.

PHOTOS BY DAVID BULLENE

JLC



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BY VINCENT SALANDRO

1. Impact-Resistant Multi-Slide Patio Door
Large openings pose no problem for MI Windows and Doors' V3000 Series Multi-Slide Patio Door, offered in sizes up to 18 feet wide and 8 feet tall. Homeowners can select aesthetic options—such as decorative hardware, grid styles and patterns, and multiple interior and exterior colors—as well as glass options, including the manufacturer's StormArmor impact-resistant glass, designed to withstand wind speeds up to 140 miles per hour. miwindows.com

2. Lightweight Deck Stair Treads
Fabricated with a mineral-based composite material, Deckorators Step Treads have textured embossing, which the company says enhances traction. Each lightweight tread sports a solid edge profile and measures 7/8 inch by 11 1/4 inches by 13 feet; available colors are a dark slate and Voyage khaya and tundra. Treads have a stain- and fade-resistant capstock and are warranted for installation with ground contact or in the water, according to the manufacturer. deckorators.com

3. Steel Siding With Wood-Grain Look
Klauer Prestige steel siding is finished in a four-coat silicone-modified polyester paint process that provides the appearance and texture of wood. Polyester resins provide resistance to chalking, fading, and weathering, according to the manufacturer, while a wood-grain-print overlay adds depth, and a final polyester clear coat protects against scratches, dirt retention, and staining. Several profiles and five two-tone wood-stain colors are available. Accessories include accent shingles, two-piece outside corners, J trim, and sill trim. klauer.com

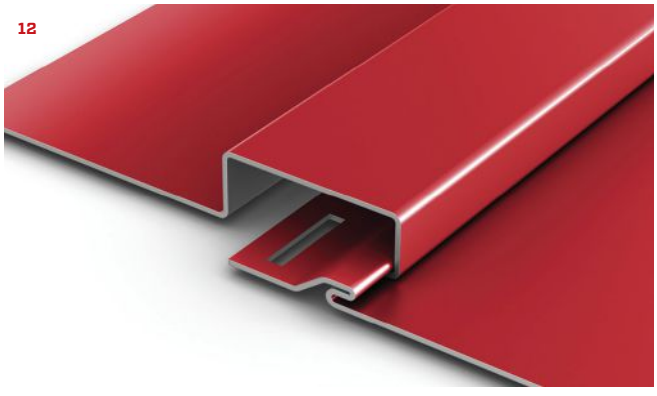
4. Luxury Engineered-Stone Bath
About 66 inches long with a gently angled backrest and Art Deco–like geometric detailing, the Magda free-standing tub from MTI Baths is available as a soaker tub or an air bath with a hydrotherapy package featuring 20 air jets. Tubs are crafted from cast engineered stone using a proprietary mineral composite blend of dolomitic limestone. The finishing process results in a durable, nonporous surface that is easy to clean, according to MTI Baths. We found a soaker tub online for about $5,000. mtibaths.com

5. Epoxy and Hybrid Adhesives
Code-listed for cracked and uncracked concrete, Simpson Strong-Tie's new 3G epoxy and hybrid acrylic anchoring adhesives are easy to install and suitable for a range of applications. The company touts its versatile SET-3G two-component epoxy adhesive for its bond strength for heavy-duty, structural work; ET-3G epoxy for general rebar doweling and threaded rod; and AT-3G hybrid acrylic as a fast-cure option, even in extreme cold temperatures and wet concrete. We found a 56-ounce package of SET-3G online for $142. strongtie.com

6. Enhanced Deck Fastener Collection
Trex, in collaboration with Phillips Screw Co., is expanding its Hideaway Fastener Collection. Components include color-matched decking screws, counterbore bits, depth setters, drive bits, collated decking and fascia plugs, and butt-joint clips. All are compatible with all Trex decking products and have been tested and shown to work with other competitive offerings as well. trex.com

7. Outdoor Screen Retrofit
Barrette Outdoor Living's EncloSure screen solution can be installed in an existing covered patio, deck, or upper balcony. The powder-coated aluminum frame houses charcoal-colored screening that is kept in place with a flat spline. Railing infill kits, screen doors, and screen-door-frame kits are available. Contractors can select from three frame and divider sizes (8, 10, and 12 feet) and two railing infill sizes (6 and 8 feet). Colors are matte black, white, and charcoal bronze. barretteoutdoorliving.com

8. Rainscreen Drainage Plane
The 10mm Sure Cavity rainscreen drainage plane from MTI maintains a space (a bit more than 3/8 inch) between veneer materials and the structural wall to drain incidental moisture and keep the building enclosure dry. Channels provide a gap for ventilation and enable moisture to travel down and out the bottom of the wall. According to the manufacturer, the rainscreen's high-impact polystyrene ensures durability and prevents compression and waviness, and the adhered fabric blocks mortar or stucco from filling the drainage space. Sure Cavity is compatible with stucco, brick, stone, fiber cement, and cedar. We found a 25-foot-by-31 1/2-inch roll online for about $125. mtidry.com



9. Simplified Instant Deck
Providing an alternative to a paver patio or a traditional framed deck, MoistureShield's InstaDeck heavy-duty plastic tiles snap together to create a foundation for a free-standing, ground-level deck. The tiles are compatible with MoistureShield's Vision, Meridian, Elevate, and Vantage lines of composite decking and can be assembled on any flat surface with minimal tools to create a deck of any size. Deck boards then snap into place, without screws. moistureshield.com

10. Impact-Resistant Jobsite Helmet
Milwaukee Tool says its Bolt Safety Helmets with Impact Armor can help protect users from head injuries caused by oblique impacts accompanying a slip, trip, or fall. Helmets have padded suspension with an adjustable swinging ratchet and a chin strap with five adjustable buckles, along with an integrated headlamp mount, a clip to hold a marker or pencil, and four Bolt and two universal accessory slots for securing additional equipment. The helmet costs about $150. milwaukeetool.com

11. Cellular PVC Lap Siding
Versatex Xceed cellular PVC lap siding is fabricated in 16-foot lengths that interlock with the course below to maintain a level installation. Nail slots are spaced on 16-inch centers and butt joints are secured with a nail hem bracket and screws. The manufacturer says the panels have a heat-reflective acrylic capstock and are water-resistant and maintenance-free. The initial product rollout includes a lap siding profile with a $4\frac{1}{2}$-inch reveal, with plans to add a wider profile with a $7\frac{1}{2}$-inch reveal. Trim options and a variety of colors are available. versatex.com

12. Metal Board and Batten Profile
PAC-Clad Board and Batten wall panels from Peterson use concealed fasteners to maintain clean lines and a pattern of alternating wide, vertical boards and narrow, elevated battens. The $\frac{3}{4}$-inch depth and 2-inch width of the batten keeps trim offsets to a minimum. Available in 24-gauge steel or 0.032 aluminum, panels are installed with mechanical fasteners through pre-punched holes. Maximum lengths are 30 feet for steel and 22 feet for aluminum; available widths are 12 and 16 inches. Only vertical installation is possible. pac-clad.com

Simpson Strong-Tie Timber Drive Structural Screw Fastening System

BY IAN SCHWANDT

Carpenters who are employed by design-build remodelers often do things that they've never done before by virtue of working with an in-house design team. This is the case at TDS Custom Construction, where our carpenters and project managers are encouraged to give the design team input on what materials are specified and how assemblies go together. For example, a recent screen-porch project called for exposed rafters with tongue-and-groove beadboard showing between them. After consulting with the team, we suggested sheathing the roof in 2x6 T&G material over Doug fir rafters. This provided a good opportunity not only to try out a new roof-sheathing approach but also to test Simpson Strong-Tie's Timber Drive structural screw fastening system.

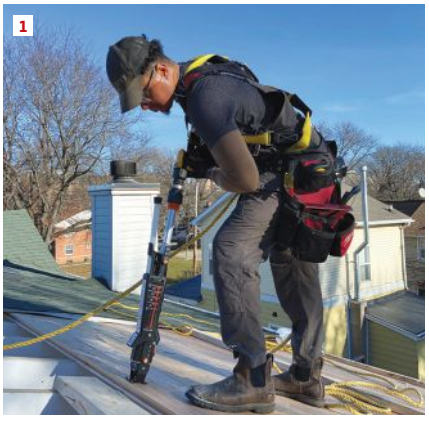
The Timber Drive allows the user to drive structural screws ranging in length from 3 to 6¼ inches from a standing position. It's driven by corded or cordless drills fitted with Simpson's Quik Drive adapters, with the screws loaded one at a time into a tube on the side of the tool. Because the screws are gravity fed to the bottom of the tool, it's capable of fastening downward only. A removable nose plate exposes a cone-shaped tip that can act as a positive placement tip for fastening metal connector straps. The screen porch had a 3/12-pitch roof, and—judging by how the tool operated on that project—I would expect that it can drive screws on any walkable roof slope.

Simpson's website states that the Timber Drive is designed for "wood-to-wood or engineered-wood applications such as on wharfs, docks, walkways, mass-timber spline connections, multi-ply truss, and any application where stand-up driving of structural fasteners is required." Stand-up driving of large structural screws en masse is also more comfortable—though not necessarily faster—than bending over and using an impact driver. Two of our 20-something carpenters were confident they could screw down the 2x6 T&G material faster by crawling around with impact drivers, but tools like the Timber Drive that allow tradespeople to work from the correct ergonomic position are a crucial part of maximizing the length of a tradesperson's career.

In use, the Timber Drive is compatible with more than a dozen of Simpson's structural screw offerings, with a variety of head types and applications. The tool has several adjustment settings, including two for screw length (one at the feed mechanism and one at the drive tip), a knob for setting the screw diameter (#10 to #12, #14 to 0.315 inch, and 0.316 to 0.394 inch), and a countersink-depth adjustment knob at the connection point to the Quik Drive–equipped drill motor. After dropping the screw tip into the loading tube, the user pushes the tool's nose into the work surface to set the screw into place within the machine before attempting to drive it. We found that getting this rhythm correct was challenging and required focus to achieve. I would expect, though, that this rhythm would develop with continued use.

At $875 for the Timber Drive with a storage case but without a driver, this qualifies as a specialist tool in my book. The driver motors are compatible with other Quik Drive tools, adding some versatility to the kit, and I expect our production crew will find additional uses for the Timber Drive as their familiarity with it grows and as they become increasingly focused on performing their tasks in an ergonomically sound manner. strongtie.com

Ian Schwandt is the production manager for TDS Custom Construction in Madison, Wis.



Simpson Strong-Tie's Timber Drive is designed to be used vertically **(1)**. The tool can be used with SST structural screws ranging in size from #10 to #14 and from 3 to 6¼ inches long **(2)**. Fasteners load one at a time into a feeder tube **(3)**.

Photos: 1, Jeff Bush; 2, 3, Ethan Butler

Weigh In!
Want to test a new tool or share a tool-related testimonial, gripe, or technique? Contact us at jlctools@zondahome.com.

Upgrading Your Metal Brake

BY ARON JONES

I regularly use a metal brake for bending flashing and trim. Over the past year or so, I've been using several accessories from InnovaTools—including a two-way cutter and a pair of Anvil extensions—on a Tapco Max-i-mum XL brake. Installing the Anvil extensions was simple and, once installed, they can be easily adjusted using an Allen key to ensure perfect alignment with the brake rails. After adding the two-way cutting tool to the brake and spending a few minutes fine-tuning my setup and making a few cuts, I was impressed with how much smoother they made the cutting process and how they solved several problems commonly experienced when a metal brake is used.

For example, when cutting metal stock to size on a 10-foot 6-inch brake, I typically want to rip it in 10-foot lengths. To start the rip, a cut-off tool generally takes up the first 4 to 6 1/2 inches of the right side of the brake. That doesn't leave enough brake for the cut-off tool to finish a 10-foot cut while still in contact with the anvil rail, requiring extra support to prevent camming on the rail. This makes it hard to rip long stock down with any efficiency and creates extra wear.

The Anvil extensions ($97 per pair) are a simple but elegant solution to this problem, improving the cutting capacity and efficiency of the brake by allowing for the use of the entire brake length. With the extensions, I was able to start and end cutting material outside of the brake itself, eliminating the cam or twist that can occur on the cut-off tool as a cut is finished. And as a bonus, the built-in stop on the extensions prevents the cut-off tool from running off the end of the brake.

As the name implies, the two-way cutter ($525) can cut in both directions. When I first saw this tool, I thought that it looked like a fancy high-tech—but not particularly useful—gadget compared with other cut-off tools I have seen or used in the past. However, now that I have used it, my opinion has changed. I have one word to describe this tool now: efficiency.

I encountered a bit of a learning curve when I first started out with the cut-off tool, mostly because of muscle memory and having done tasks a certain way for so long. But after using it for a little while, I could operate it easily with no issues and found that it reduced the number of steps I had to take to rip stock. For example, with more traditional cutters, I can rip stock only from right to left on the brake because of how the cutters are set up. With the two-way cutter, I can cut from either direction, which eliminates the steps wasted walking back to the right side of the brake to reposition the cutter and start a new cut.

The two-way cutter offers a couple of other benefits. One is that the cutter is set up with a 1-inch offset, which makes calculating the rip width easy when I'm laying out cuts. Second, the two-way cutter can be flipped up and out of the way, allowing it to remain on the brake while I'm bending stock, a feature that is not standard with traditional cutters. The InnovaTools Anvil extensions and two-way cutter are an excellent duo that will make anyone's metal brake work more efficient. innovatools.ca

Aron Jones is co-founder and site supervisor of Big Dog Construction on Grand Manan Island, New Brunswick. Follow him on Instagram at @bigdogconstruction.gm.

Made from CNC-machined aluminum, InnovaTools' bidirectional cut-off tool **(1)** works on most Tapco and Van Mark brakes. The Anvil extensions add 6 inches to both sides of the brake, and have built-in stops **(2)** that prevent the cutter from coming off the rail **(3)**.

Photos: Aron Jones

BY MARK LUZIO

Michelangelo's Jobsite Drawings

Michelangelo's last commissions in Florence, Italy, were the designs of the Medici Chapel and Laurentian Library—both in the Basilica of San Lorenzo. He worked on these interiors from 1520 to 1533, and his scope of work included the design of the tombs for the Medici family, with the famous sculptures *Dawn*, *Dusk*, *Day*, and *Night*—full-size figures that many art historians consider the pinnacle of his work. These figures and all the architectural details he designed and constructed for this job were produced on site.

Behind layers of flaking paint and plaster in an alcove behind the altar in the chapel, researchers in the 1970s discovered Michelangelo's jobsite drawings, and these especially were on the list of works I needed to see on my first trip to Florence last year. Their purpose seemed evident. For the last 45 years, I have built custom millwork and sometimes I've needed more than architectural-scale drawings. The best approach is often to draw or make full-size templates to resolve details and work out problems on a jobsite.

In her book *Michelangelo, Drawings, and the Invention of Architecture*, Cammy Brothers writes, "The drawings remain striking for their immediacy in conveying a sense of how Michelangelo worked on site. They confirm the impression, formed by his drawings on paper, that he continued to rethink problems obsessively—apparently up to the very moment of execution … They also show that Michelangelo found it useful to work ideas out at full scale."

For more than two hours, I sat in the alcove or walked the room, crossing from the full-size drawings, and returning to the room to marvel at the tombs and their figures.

As I walked back and forth, I was thinking of a letter from Michelangelo to Giorgio Vasari (who wrote the first history of Italian Renaissance artists and was mentored by Michelangelo) in which he wrote, "If I work one day with a chisel and mallet, I must rest two." He was 55 and transitioning from the intensely physical work of carving marble as an artist to the more cerebral and managerial work of a designer and architect but still doing both. From the drawings to the work, one day and the next.

The wall sketches were made during Michelangelo's last days working hands-on at the San Lorenzo site. He left shortly afterward, and the chapel interior, as well as the library with its amazing flowing stairway, took more than 20 years to complete after Michelangelo's departure to Rome. He never returned to his beloved Florence to see the project completed.

Before I left the site, one last detail caught my imagination: a series of lines—tic marks—drawn on the wall. My guess is they were to mark the months of his labor so he could finally get paid the thousands of ducats owed to him by the fabulously wealthy Medici family.

Mark Luzio owns Post Pattern Woodworking in Brooklyn, Conn.

In an alcove behind the altar in the Medici Chapel **(1)**, Michelangelo drew full-scale drawings on the wall to work out details for his sculptures and the interior architectural elements **(2)** he designed and constructed in the chapel. In one area, the author found a series of tic marks **(3)**, which he speculates was Michelangelo's way of keeping track of his time so he could get paid by the Medici family.

Photos by Mark Luzio

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