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On the cover: TDS Custom Construction lead carpenter Martín Gutierrez installs beadboard on the vaulted hipped ceiling of a screen porch in Madison, Wis. Photo by Nathaniel Carlsen. See the story on page 29.

THE JOURNAL OF LIGHT CONSTRUCTION (ISSN 1056-828X), Volume 41, Number 4, is published bimonthly by Zonda Media, 4000 MacArthur Blvd, Ste 400, Newport Beach, CA 92660-2543. Annual subscription rate for qualified readers in the construction trades: $39.95; nonqualified annual subscription rate: $59.95. Frequency of all magazines subject to change without notice. Double issues may be published, which count as 2 issues. Publisher reserves the right to determine recipient qualification. Canada Post Registration #40612608/G.S.T. number: R-120931738. Canadian return address: IMEX, PO Box 25542, London, ON N6C 6B2. Periodicals postage paid at Newport Beach, CA., and at additional mailing offices. POSTMASTER: Send address changes to JLC, Box 3530 Northbrook IL 60065-3530.

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JLC welcomes letters and article submissions from our readers at **jlc-editorial@zondahome.com**. Keep copies of all original materials.

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Subscription rates for qualified readers: 1 year/ $39.95; 2 years/$64.95. Canada, International: add $15/ year for surface delivery. Sales tax added if required by your state law. Frequency of all magazines subject to change without notice. Double issues may be published, which count as 2 issues.

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ARTICLE REPRINTS

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Q In recent years, moss and lichen growth on asphalt roof shingles seems to have become an increasing problem in our area. What's the best way to prevent recurring organic growth on roofs and, when preventative measures fail, what's the best way to remove the growth?

A *Mike Guertin, a builder and remodeler in East Greenwich, R.I., and frequent presenter at JLC Live, responds:* I have spent a fair amount of time dealing with moss, lichens, and algae on roofs. It's a problem here in Rhode Island, especially at my own house, and it doesn't seem to be limited to a particular type of asphalt shingle. Laminated shingles may have more nooks and crannies where debris can settle and provide food for moss, and the edges may make it easier for spores to hang tight until they begin growing, but I don't know of any studies on whether three-tab or no-cutout single-tab shingles are less prone to organic growth than architectural shingles.

Prevention. As far as I know, there aren't any "moss-resistant" shingles, though there are algae-resistant ones made with granules that contain copper, such as Owens Corning's StreakGuard shingles. When it rains, copper ions wash out of the granules to inhibit algae growth. To help resist moss growth on a new roof, you can install copper or zinc strips according to the manufacturer's instructions. Depending on the local climate, sun exposure (north-facing roofs are more prone to organic growth than south-facing roofs), and tree cover, you may need only one strip of metal near the ridge to inhibit moss growth, or you may need to install strips along shingle courses every 3 to 4 feet up the roof slope. Again, ions from the copper or zinc strips wash down the roof each time it rains, and it's those ions that inhibit moss growth.

Photo: Andrew Wormer

This north-facing roof is clad with architectural laminated shingles, which are made up of multiple layers of asphalt-coated fiberglass that can trap organic debris and provide food for moss growth.

Removal. Once moss has gained a foothold on a roof, there's no fast and easy way to get rid of it. Manually removing it—with a stiff-bristled broom or even a hard-edged tool—can cause more damage than the moss does. I've found that an effective solution is a product called Spray & Forget Roof Cleaner (sprayandforget.com), a liquid concentrate that comes in a container that can be attached to a garden hose. It's not a quick fix; when I used it the first time, it took about three or four months before the moss on my roof turned brown and started falling off on its own. Now I spray the roof with the solution every three years, and it keeps the lichens, moss, and algae at bay.

There are other, similar products that probably will work as well. What they all have in common is that they're not as aggressive as the bleach/detergent/water mixes you'll find recipes for online. Those bleach mixes will kill the moss in a few days, but what washes off onto plants below can kill more than you intended. Spray & Forget is bleach-free and, since it's applied in a mist, not much reaches the ground, and it doesn't seem to have much of an impact on plantings below.

I have noticed more moss, lichens, and algae in my area than I used to, but whether that is the result of a warming climate is hard to say. It could be that most asphalt shingles last longer than they did in the 1970s and '80s. Back then, we replaced roofs every 15 to 20 years; now, it seems we replace them every 30 to 35 years or longer. My roof was moss-free for 15 years, then it started growing. To eliminate the problem altogether, my next roof will be metal.

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Q On our last two bathroom remodels, clients wanted to upgrade to heat pump water heaters because the tax rebates on them are so good right now. But we have concerns about these units cooling the basement in winter. Are heat pump water heaters viable for cold climates and, if so, how is the installation typically handled to avoid adding to a home's heating load?

A *Connor Dillon, quality manager at the Building Science Institute, a firm offering training and quality control to home energy raters, responds:* Heat pump water heaters (HPWHs) take heat from the surrounding air and pull it over coils to heat the water inside the tank. A side effect of their operation is that they both cool and dehumidify the air around them. That's wonderful for homeowners in warmer climate zones, especially hot, humid zones, where anything you can do to offset cooling bills and lower indoor humidity is great, but it causes concerns about installing the units in climate zones 5 and above. Some people have concerns about whether an HPWH will even work as intended in a cold climate. And some homeowners who are already dealing with cold floors over a basement during the winter worry about the unit making their basement (and floors) even colder.

The first concern is unfounded: An HPWH works even in cold climates. The "heat pump" mode will typically operate between 35°F and 120°F. Below 35°F, the hybrid nature of the water heater kicks in to heat the water using electric resistance rather than relying on the heat pump. Most manufacturers recommend setting the unit to the hybrid mode as a default setting; it will automatically switch from heat pump to electric heating depending on input to the sensors.

As to the issue of cooling the basement, we see this handled in a variety of ways, but not all of them work. The most common approach is to build a sealed, insulated utility closet to house the unit. While this might make sense in theory, there are two problems with it in practice: First, these water heaters need a minimum volume of air to operate correctly. Requirements vary by manufacturer and model, but in the case of one model, the smallest volume it can operate in is 450 cubic feet—a 10-foot-by-6-foot-by-7-foot-6-inch room. Most other manufacturers require almost twice that—700 cubic feet or more. The second problem is that sealing the closet locks the cooler air around the unit, dropping the temperature near it and triggering the electric resistance mode. This reduces the unit's efficiency, defeating the purpose of installing a more efficient appliance.

It is possible to make this work, however. One option is to put the HPWH in an insulated closet, then use louvered doors with the size of the louver area based on the space requirements of the specific model. This will limit the amount of cold air outside the closet but will provide enough air for the unit to operate efficiently. In one example we saw, a full-louvered door lowered the space requirement from 450 cubic feet to 84 cubic feet—an 81% reduction.

A second option is to put the unit in a sealed closet with the inlet and/or outlet ducting to it (this is model dependent). HPWH manufacturers often offer adapters, sometimes called "duct kits," built specifically for this purpose. This adds an extra cost to buying the water heater, but the kit and requisite ductwork could allow you to install the unit in a small, sealed closet with no minimum space requirements.

While project specific, a third possibility is that you may not need to worry if you have a furnace, boiler, or other heating equipment in the same area as the HPWH. Because the unit relies on the air around it to heat water, the waste heat in the air from the heating appliance may offset the cooling from the water heater. This symbiotic setup is not for every project; for starters, it assumes the heating appliance near the water heater is the sole space heating system and is therefore running most of the time that the HPWH is. If the furnace is supplemented by wood or pellet heating in the living space, for example, it might not be dumping waste heat into the basement often enough to offset the cooling. Be sure you carefully consider this option before implementing it as a solution.

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On Site With Diamond Kote

BY AARON MIILLER

Houses take a beating here in the hot, humid south. Strong rainstorms, high winds, hail, freezing rain, and sleet are common causes of deterioration, while ultraviolet radiation quietly does even more damage to siding than all of those combined. The sun is brutal in our environment, and painted siding has never performed well, regardless of the substrate. For that reason, many homeowners select brick or vinyl for their exteriors. However, for the past seven years, we have been installing Diamond Kote, a prefinished LP SmartSide product, and we now have much more confidence offering engineered wood as a siding option. The Diamond Kote finish has a 30-year "no fade" warranty, and we have yet to see any fading on the siding that we've installed. A recent example brought this home: I had to add a mounting block to a seven-year-old project. The company still produces the same color, and to my relief, the brand-new block was a perfect match, despite seven years of UV abuse on the abutting lap siding.

COMPLETE SYSTEM

The benefits of this siding aren't confined to the finish's ability to withstand harsh elements. Diamond Kote is a system with a unique way of joining courses that the company calls "RigidStack." The back of the siding has an angled kerf cut (see photos, below) into

Among the many features of Diamond Kote **(1)** is an angled spline let into the back of the plank **(2)** that simplifies installation and increases the siding's resistance to wind uplift. A small kerf along the top edge **(3)** identifies the exact nail placement.

Photos by Aaron Miiller

4


5


The cladding system includes corner trim that has a nailing fin to enable hidden fastening. Outside corners have a built-in channel **(4, 5)** that locks in the siding boards, saving considerable installation time and eliminating the need for caulk. Window and door trim also have this channel along one edge and a small kerf cut into the opposite edge of each board. Once a miter is cut **(6)**, an aluminum L-bracket fits tightly into the kerf **(7)** to align the two sides of the miter and hold it together **(8)**.

6


7


8


which a rigid spline is inserted at the factory. During installation of the siding boards, this angled spline wedges behind the top edge of the course below, locking the two courses together. The configuration makes it easier to align two courses, allowing a single person to install a 16-foot length of siding without a helper and without gauges supporting the board. The spline also auto-spaces the lap reveal, which speeds up installation. In addition, a shallow kerf cut into the face of the siding near the top edge creates a visible line to nail along. There's no guessing where the fastener needs to be placed; just follow the line.

According to Diamond Kote, the spline system helps resist uplift in high winds and reinforces the siding's ability to withstand impacts, making the installation "375% stronger." It's unclear how that is measured, but it is apparent that it would take a lot of force to separate the laps; with the courses locked together, there's not a lot for wind to grab on to.

Trim. The company also offers a range of trim stock, which has some interesting features that make it intuitive to install. Premade inside and outside corners come with an attached nailing fin for hidden fastening. Without face nails, there's less touch-up, resulting in a faster and better-looking installation. The outside corners have a built-in channel that allows you to lock in the siding boards, which promises long-term performance and saves considerable installation time.

Diamond Kote also includes mounting blocks, shown here for a hose bib **(9)** and an outdoor electrical outlet **(10)**. The built-in flashing and wide flange on the mounting blocks simplify the waterproofing details. The water table trim—called "starter board" **(11)**—is fabricated from a poly-ash material that the manufacturer guarantees won't deteriorate.

A recent introduction to the product line is a "rabbeted trim" line for window and door trim. As on the outside corner, this includes a rabbet, or J-pocket, along the length of the trim boards that allows the siding to tuck into the trim, eliminating the need for caulk at the siding-to-trim transition, for a cleaner and faster install. In addition, without caulk, maintenance is much easier.

We always preassemble window and door trim for a more precise, better-looking, stronger, and longer-lasting result. But making the connections, whether we're using biscuits or pocket screws, has always been time-consuming. The rabbeted trim, however, takes advantage of a small kerf cut into the length of each board. Once a miter is cut, an aluminum L-bracket provided by the manufacturer can be installed to reinforce the joint. The L-bracket fits tightly, creating a nice tension fit so the entire workpiece can be flipped over and snugged together with short T-50 staples to complete the preassembly process.

Utility blocks. The system includes RigidMount light-fixture and utility blocks. If the siding is not ready to be installed, but another trade needs to rough in a hose bib, HVAC line, or electrical fixture, the RigidMount blocks are an easy way to make sure the job looks clean and workflow is consistent for all trades involved. Each block has built-in flashing to make sure water running down the siding is driven out and away.

Starter board. The company also offers a "starter board" that provides a perfect transition at the base of the wall. Engineered wood siding ordinarily cannot be installed within 6 inches of the finished grade, per manufacturer's instructions. The starter board is a poly-ash material, and the manufacturer claims it will not rot or break down, even if installed at grade. We'll often rip the top edge off a starter board and use it as a traditional water table, along with a Z-flashing, as the termination for board-and-batten siding.

COLOR-MATCHING SUPPORT

Since we started using this system, I've become an advocate of using a color-matched siding system for both the time savings and the elegance of the exterior. The siding is available in a wide variety of colors, including custom colors and an exclusive "DuoBlend" line that gives the siding a more natural, rustic look. The starter board, corner boards, window and door trim, and mounting blocks come prefinished in all the same colors as the siding. Many pre-bent, color-matched flashings are also available, including drip cap and Z-flashing; they have saved us significant time not only on the metal brake but with finishing, as well. When touch-up paint is needed, the company offers several options, including some handy applicators that help keep the paint from drying out too quickly when we apply it during our hot summer months. Overall, Diamond Kote has been a win for us and our clients alike, and it will continue to be my go-to system.

Aaron Miiller owns Miillers Construction, based in Corning, Ark., and is a presenter at the JLC Live Building Clinics. Follow him on Instagram at @miillersconstruction.

A Twin-Turret Roof Restoration

BY DARIN KUNS

Last year, my company restored an unusual roof on a 19th-century building in Fowler, Ind. The original thick cedar roof shingles had been coated with countless layers of paint in a poor effort to increase their life span, and most of the flashings had deteriorated, leading to considerable rot in the sheathing and some of the framing beneath it. After setting up staging around the building and stripping the roof, we turned our attention to correcting some problematic details in the original design and repairing the rotted areas.

Most of the building's roof is a single plane that slopes to the back from a steep, Mansard-style front. Twin turret roofs grow out of the base of this steep roof plane and tie back to it higher up with short, level ridges at their peaks. Centrally located between the turrets is a small masonry dormer with a brick gable end that serves as the base for a wood flag pole and a limestone plaque identifying the law firm that originally occupied the building.

Gable intersections. The way the sloping sides of the turret roofs intersect with the sloping sides of the masonry dormer creates an awkward drainage area that had been sheathed over, cricket style, to drain water out through soldered-metal drainage holes on each side of the small gable. Debris collected in these holes, causing water to back up behind the gable, which resulted in rot in the corners.

We didn't have a lot of leeway to rework the brick to open up the drainage near the central gable, but we were able to considerably improve the situation and stave off future rot.

After fixing all the rotted areas, we flashed everything in with ice-barrier membrane, running it up high to tie in shingle-style with membrane running down the valleys at the turret intersections. We then wrapped the area in a self-adhering underlayment. Installing the ice membrane and underlayment was a painstaking exercise in advanced origami, with overlapping courses woven across the front of the turrets.

Copper work. The first line of defense over the underlying protective layers was thousands of dollars' worth of copper flashing. We had to get approval from Indiana Landmarks to use copper because the original flashings were lead or terne metal. All the new copper work, including the turret valleys, downspouts, circular gutters, and ribbed ridge capping, was fabricated off site. The main work for our crew was templating all the sections with 1/2-inch plywood. Once fabricated, the sections were soldered on site. The crickets behind the central gable were lined with copper that was soldered to the valleys and two extended spouts, creating a watertight assembly that could drain well. Beneath the spouts, we completed the copper work with step flashings and counterflashing that tied in with the wide copper gutters encircling the turrets.

Sidewall intersection. The other awkward detail we had to correct was where the building abutted a larger commercial building. The intersection had been formed by a buildup of brick that had been poorly flashed to the roof and, over the years, it had been coated with stucco and roofing tar to try to seal the connection. We took the brickwork down below the level of the roof deck and sheathed over the brick so we could properly step flash and counterflash with a reglet let into the intersecting wall. At the base, the reglet tied in and was soldered to the copper gutters, effectively eliminating the trapped corner that had originally impeded drainage (see photo 3, opposite).

Shingle work. We special-ordered extra-long and thick cedar shingles and hand-dipped each one in a tub of Woodlife, a borate-based wood preservative, before installing it. For the turret shingles, we cut each side at a shallow angle so they could be installed tight at the butt end without overlapping at the top end. A story pole, with a metal hook that we fashioned at the top to allow us to rotate the pole around the curved fronts, helped us keep the coursing straight.

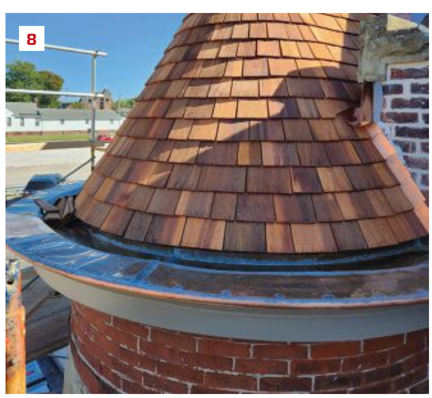
The result was both appealing and durable and should safeguard this unique building for the next century.

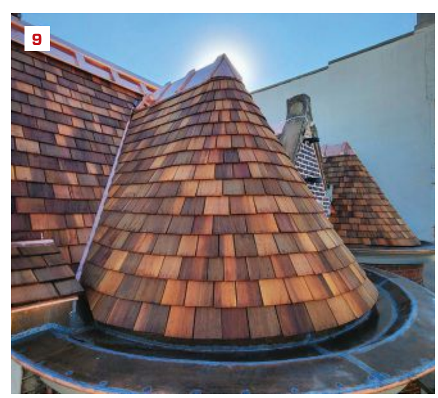
Darin Kuns is co-owner and general manager at D-K Construction, based in Flora, Ind.

Photos by Darin Kuns and Ross Filbrun of D-K Construction

Existing conditions. Elastomeric paint had been smeared over the shingles, valleys, gutters, and ridge caps in a poor attempt to increase the life of roof **(1)**. A view between the central gable and one turret shows the cricket, which drained out a small hole beneath the central gable's limestone cap **(2)**. A brick ledge at the intersection of the roof plane and the adjacent building had been a difficult place to flash well and, where it died into the gutter at the base of one turret, it created a trap for leaves and other debris that impeded drainage **(3)**.

Reroof. The author's crew removed the brick ledge, sheathing over this area **(4)**. A view of one turret after the roof had been stripped shows the ridge that ties the top of the turret back to the Mansard-type roof plane **(5)**. After installing ice-barrier membrane, self-adhering underlayment, and copper flashing, the crew began installing shingles on the turrets using a story pole that hooked over the top of the turret so it could be rotated around the front to keep the shingle courses even **(6)**.





The author special-ordered extra-long, thick shingles that the crew cut at an angle on each side **(7)**. Before being installed, each shingle was hand-dipped into a tub of a borate-based wood preservative. This photo **(8)** shows the step flashing at the intersection of one turret and the central brick gable. Note the extended copper spout below the limestone capping. A view of the completed roof **(9)** shows the ribbed ridge caps and soldered copper gutter assembly.

BY ZACH SNIDER

Managing a Tech Change in Your Business

Some of us have been in this business long enough that we remember when using a computer for much more than email was novel. I remember reading David Gerstel's book, "Running a Successful Construction Company" (the 2002 updated version), which proposed using a computer and MS Excel as an alternative way to do estimating. We have seen smartphones become standard equipment for even the most tech-challenged project managers. Project management systems, cloud-based file storage, estimating software, company chat channels, drones, and 3D scanning are part of most remodelers' tool kits these days. What would you have said five years ago if someone suggested using Zoom for a sales meeting? Now, we are watching another generation of project management systems enter the market.

With so many systems, and options within them, available, technological change is an inevitable part of business. Working through a big tech system change can be difficult and is bound to create interference in your business for months, at best. Most of the time, you won't know where that interference will show up until it does. Upset team members, confused clients, lost files, or muddled books are all possible collateral damage. Adding or changing systems is necessary in our current working environment, however, so we as managers need to be prepared to integrate them into our businesses as smoothly as possible.

IS THE RISK WORTH IT?

There are many reasons to embark on a tech change despite the risks. In some cases, we're forced to. For example, I had used CoConstruct for 10 years before its merger with Buildertrend. My choice wasn't whether to change, but to change now or change in a few years when the old product was no longer supported. I decided to change now and have spent the last 12 months sunsetting CoConstruct and integrating JobTread into our workflow, instead. Another change many of us are facing is moving from QuickBooks Desktop to QuickBooks Online. It seems inevitable that the desktop version will eventually be a thing of the past. In both these cases, an integral part of our business operation is being changed externally, and we are being forced to adopt something new.

It's important to not get stuck in an "if it ain't broke, don't fix it" mentality. Making improvements is different from fixing problems; small gains in efficiency add up to big time savers over the long term. Take buying a computer and learning Excel for estimating instead of using a yellow legal pad: Your legal pad ain't broke, so why invest the time and money in learning Excel? I'd say that the gains from using a spreadsheet over a legal pad are more than incremental, but you get the point. The same is true for switching from email to Slack for internal communication or from an Excel spreadsheet to management software; the gains are real and worth the effort and time to make the change. That doesn't mean that every possible change you can make should be made. There are plenty of reasons to not adopt or change systems, but "it ain't broke" is not at the top of the list.

> "Be intent on making a committed decision. There are so many options, it's easy to get stuck in the multiverse."

MANAGING CHANGE

To smooth over the rough spots for all involved in the transition, we made a number of adjustments:

Embrace change. The idea that a system today will remain the same for 10 years is a fantasy. Systems change rapidly, the machines that we use to interface with them change rapidly, none of this is slowing down, and all we can do is to embrace this as a fact of the world we work in. Make change part of your culture.

Be clear on the reasons. Next, proactively identify reasons to make a change. To start with, look for bottlenecks. Then ask: Are there problems, or processes that aren't followed? Have you unsuccessfully tried to create compliance? There could be a tool that will address these issues. I avoided doing seasonal email newsletters, for instance, because the system I used instead of a CRM could not give me a list of email addresses for past clients.

Commit. It's OK to explore the available systems to address the problems you identified, but be intent on making a committed decision. There are so many options, it's easy to get stuck in the multiverse. Many software tools offer an introductory version for free or a 30-day trial with a "money-back guarantee." Though the free versions may not include all the application's features, you can play around with them to see what they can do and what feels right.

POSSIBLE REASONS NOT TO CHANGE

Cost. Good software is expensive, and most cloud-based systems charge a monthly fee. As you add systems to your "tech stack," the line item for software expenses in your budget will need to increase. Ask yourself if you can get by without this added system or if it will add value to your business. Also, take stock of what you are currently using and remove redundancy if you add a system that replaces the functionality of an existing one.

Not intuitive and takes too long to learn. Every system will have a learning curve, but the investment of time that will require should not prevent you from adopting it. On the other hand, not every system is designed to be implemented and operated by the average person. Make sure that you are not biting off more than you or your team can chew.

Not applicable to your industry or a business of your scale. Not every system works for every type of business. In the remodeling and construction world, there are systems that would be a perfect fit for the contractor who is building a new hospital or a bridge but would not work for a business whose sweet spot is $250,000 additions and remodels. Likewise, the system that works great for a single-line roofing or exterior contractor will be different from what a custom kitchen specialist will need. Find a system that is designed specifically for your type of business. —*Z.S.*

Be clear on features. Create a list of features you want and measure the options against it. I suggest you include "Open API" for integration with outside systems; the capability of uploading to and downloading from the system; and good support responsiveness and training resources. If a system checks your boxes, proceed.

Assign someone to "own" the new tech. As you integrate the system into your business, different team members will interact with it differently depending on their roles and responsibilities. Not everyone in your office needs to be an expert, but one person in the office should own the responsibility of knowing the system through and through. In most small remodeling companies, this will likely be the business owner; however, it doesn't have to be, and there are many reasons that it should not be. Having someone else spend the time to master a new system or link it to another open API system will free the business owner to focus on higher value tasks.

Get buy-in from your team. As I have transitioned to using JobTread at my business, I have had some great conversations with Anna Hunter, director of learning and development at JobTread, about how best to integrate a new system into an organization. I asked her for specifics about how to get team buy-in.

Hunter's recommendation is to introduce change to your team early and often. She says, "Team members adapt to change in various ways. Some may adapt quickly and effortlessly, where others may take time to adjust to change. Communicating about change as early as possible gives everyone on your team the chance to navigate the change process at their own pace. Many leaders think that they need to know every detail about the change before they 'announce' it to their team. This just delays the inevitable and reduces the time some team members may need to process that change is on the horizon."

"When introducing an upcoming change," Hunter continues, "there are three goals: Clarify the current cause and effect relationship of the failed system; gain consensus that a problem exists and that change needs to happen; and secure commitment to resolve the problem. All the details (who, what, why, when, and how) can be addressed later."

When I decided to consider alternatives to CoConstruct, I sent a survey to my team to give me feedback about what worked and, more importantly, what didn't work. Asking about what didn't work got everyone talking about the problem and gave them opportunity to clarify for themselves "why" we were making this change, as well as build consensus that something needed to be done.

Identify team members who can get onboard quickly, advocate for the change, and learn the new system. Some of your team may be 100% onboard at the mention of a new system, others could be indifferent, and some could be vehemently opposed to the idea.

"Consider which employees seem to embrace change and show an eagerness to explore new possibilities," Hunter suggests. "Find your team members who tend to cope well with uncertainty and even take it upon themselves to ensure they are well informed. Team members who try to understand the 'why' behind a change can more easily build support among their peers as they will align themselves with the change and will be eager to share a vision they believe in." As they get excited about the change and learn the system, they will ease the transition for the oppositional team members.

And once you have buy-in from your team, build momentum and follow through. Being systematic and setting team goals for the transition will be important.

Iterations are OK. It's OK to partially establish a minimum functionality or understanding that you need to use the tool and move forward with that. Think about your smartphone: Most of us have apps that we never use or even know what they do. That doesn't stop us from using our phones to make calls, read emails, send texts, and manage our calendars. A tech tool still provides value even if you are not using 100% of its functionality. As you become more familiar with a system, you can use more features or improve on your earlier processes.

Make sure to be open with your team and clients (if client facing) about the iterative nature of the transition and what you know and don't know. While implementing JobTread, my team spent a lot of time adjusting our workflows. When we put our heads together and decided how we were going to handle a process in the new system, I always reminded my team that this is where we are now and, in a few weeks, we may need to make adjustments. Over time, the processes that work will stick, and there will be fewer revisions.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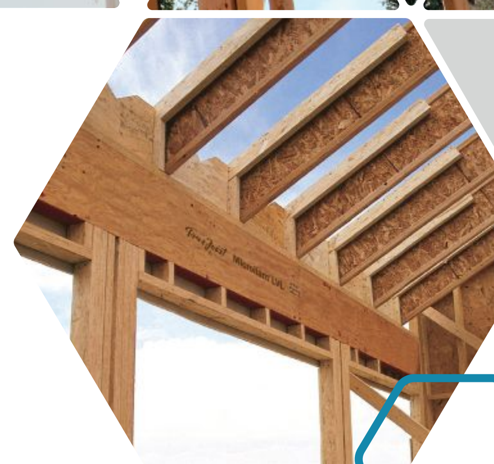


> "Your people will determine the success of the tools you have. Keep them at the center of the change process and they will see it through."
> —ANNA HUNTER

Where are you going? Make a list of what you need to do when you implement the new system. What functions in your current system do you need to replace? What steps do you need to take to build those features in the new system? Some items will take more effort than others, and some items will be more important. Prioritize your list by difficulty of implementation and importance to your operations. Identify "low-hanging fruit" that you can switch over to tomorrow with some basic training. Focus on those first and get them out of the way so you can concentrate on the more challenging changes. Some of the things that you will want the new system to do will be possible only after you have had real jobs or customer accounts running in the system for some time.

Again, Hunter had suggestions about how to do this and build team buy-in at the same time: "Involve your team in the implementation work. Identify each of your team member's strengths and delegate implementation responsibilities to them based on what they are good at and what they enjoy doing. Some of your team members enjoy creating systems and workflows while others enjoy organizing data. By inviting them in to help set up the new technology, they will feel committed to the end result and ensure your implementation is successful."

Hand off as many to-dos from your list as you can. And whenever possible, Hunter recommends, "invest in your team members by sending them to additional training for the software, such as a conference, workshop, or meeting. Not only will they feel valued because you invested resources in their professional development, but they will also connect with a greater community of people who use the technology as well. After all, your people will determine the success of the tools you have. Keep them at the center of the change process and they will see it through."

Create milestones and goals for adoption. Map out when those changes will happen and set a goal for when to have all new projects in the new system.

If you are like most remodelers I know, projects can last for a long time, so when you are changing to a new project management system, you will be sunsetting your old system over several months and operating both systems simultaneously. I would caution against trying to move a project from one system to another mid-stream, but you might have a step in your process when you can make the switch. At our design/build company, we work through a long custom design process that turns into a construction project. Design can take as long as six or even nine months, and construction, depending on the scale of the project, can take another six to nine months. Looking at the projects we had in the design phase, I quickly realized that if we did not switch them to JobTread, we would be running two systems for another 12 to 18 months. To avoid that, we decided to move our design projects from CoConstruct to JobTread at specific design milestones or when the job changed from design to construction. This added extra work to keep track of project financials, but it shortened the sunsetting time substantially and was worthwhile.

Include others. If the new tech is client facing, be prepared to train clients and trades. When a good system is set up properly and well understood by the team operating it, external users shouldn't need a lot of training, but they will have different aptitudes for tech and some may need more assistance than others. I create my own client-facing training videos to address the most important features of JobTread that our clients need to understand to make the system work for them. I use a program, called Camtasia, that provides the ability to edit videos and make templates so you can create a repeatable format for making videos. Having a small library of videos on hand saves me time scheduling and doing one-on-one training with clients and trade partners. People can watch the videos when and how they want to and pause/repeat as needed.

INSPIRES EXCITEMENT OR FOSTERS DREAD?

Not many things in life are certain, and we have control over even fewer. In the 21st century, one thing that is certain is that technology will change, probably faster than we want. We cannot control how, when, or why the systems we use will update, change, or merge with the competition. What we can control is how we manage these changes to minimize disruption.

I was an early adopter of the CoConstruct system, and I can remember feeling that I had no idea what would happen if CoConstruct disappeared. But when confronted with that reality after learning about the merger with Buildertrend, I experienced a feeling of opportunity rather than fear of the unknown. Maybe the merger would be great for the system. Or perhaps I could shed a comprehensive management system all together and operate our systems with home-built spreadsheets and calendars. Or was there something available that was completely different and much better? I acknowledged that changing our system would take effort and cause unforeseeable operational hiccups. But I also saw the potential for improvement. After finding JobTread, learning how to use it, and shepherding my business through this change, I can say that the upside has been well worth the effort. The most surprising thing has been how quickly after starting to learn JobTread my team wanted to jump in with both feet and not look back.

Zach Snider is president and operations manager of Alloy: Architecture + Construction based in Charlottesville, Va.

BY BRIAN CAMPBELL

Stair-to-Baseboard Transitions

In a recent discussion with another carpenter, I was asked about the best way to handle the transition from a finished stair stringer, or skirtboard, to the baseboard. He was specifically asking about a skirtboard that ends near a corner at the top or the bottom of the stair. "My dad always just cut the skirt with a plumb cut," he said, "but depending on how far the stair is from the corner and how tall the baseboard is, we would sometimes end up with a jump from the top edge of the skirtboard to the top edge of the baseboard. Or sometimes, he would need to make a level cut at the top, so the skirtboard didn't project above the baseboard. I'm pretty sure there has to be a better way."

OUR EYE FOR STRUCTURE

The traditional way to make this transition is to bisect the angle between the skirtboard and the baseboard. There's a reason, I think, this looks "right." It has a structural basis that is depicted in the illustration below, which shows a structural connection for bridge timbers. The optimal bisected angle efficiently transfers the load and offers equal bearing surfaces. Of course, the transition between a stair stringer and a baseboard is not structural, and there are no tension, compression, and shear stresses to resolve.

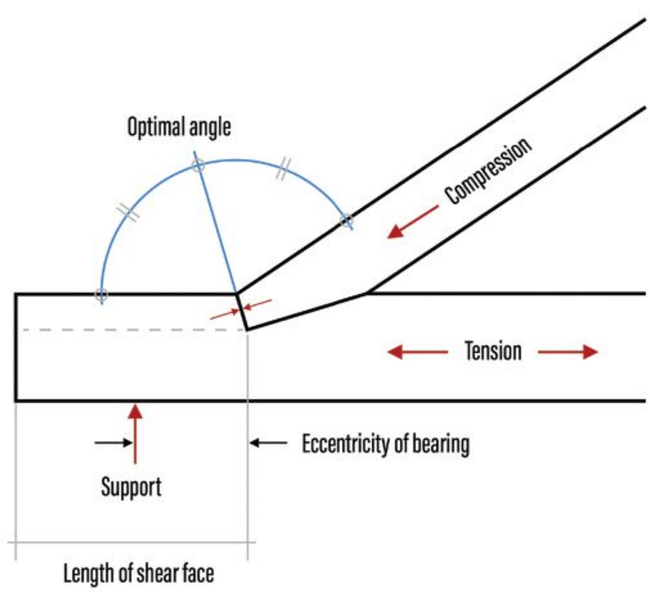
If we imagine that instead of a skirtboard, there was a housed stair stringer, then the baseboard abutting the stringer would be supporting the stair at the optimal angle. Never mind that this optimal bisected angle makes the base cap profile line up. I believe the structural logic of a stair-to-baseboard connection probably predates the aesthetic rational for mitering a cap molding. The bisected base-to-skirt geometry makes structural sense, even though it is ornamental now.

This same logic works with door casing. It looks "right" when the head spans the two side pieces, forming a "header," and would look incredibly off if the sides projected up past the head. Similarly, a window stool works best when it provides a "foundation," and projects under the side casings. I think all these please the eye because they have an ancient structural logic behind them. When in doubt, go with what looks structurally solid.

VARIATIONS ON A THEME

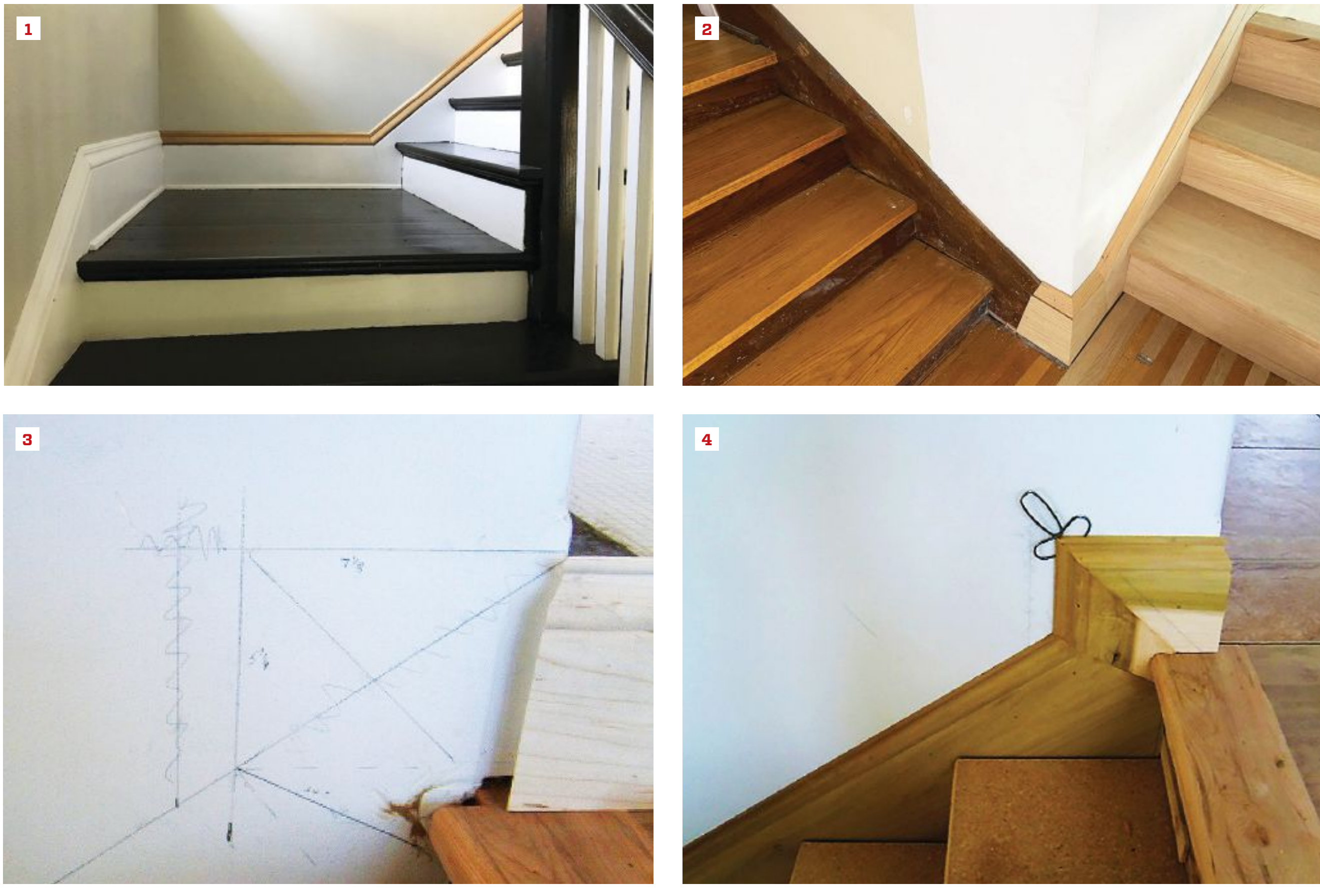
Bisecting the angle between the baseboard and the skirtboard becomes the "standard" transition that works at both ends of the

STRUCTURAL BASIS FOR STAIR-TO-BASE TRANSITION



The optimal bisected angle in this structural connection between a diagonal compression member and a horizontal tension member efficiently transfers loads and offers equal bearing surfaces. While the skirt-to-baseboard transition is not structural, the author posits that the "structural logic" of the bisected angle is what makes it pleasing to the eye.

Photos by Brian Campbell, except where noted; illustration: Ola Kwiatkowska



On these stair platforms **(1, 2)**, the baseboards and skirtboards, as well as the profiled cap moldings, are joined with bisected angles. The layout shows how the author resolves a short wall run with a skirt that rises to meet a level baseboard **(3, 4)**.

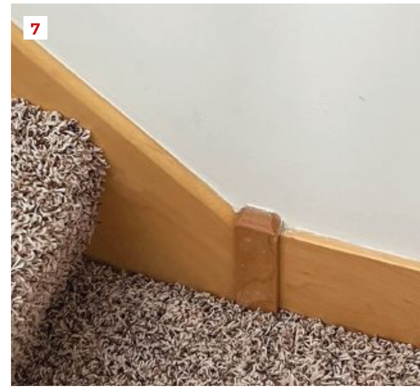
stairs and at landings that wrap inside corners. But we end up having to vary this when the stairs end close to a wall corner or when the landing wraps an outside corner.

Close corners. As shown in the wall layout in photo 3, I started with a line that projects onto the wall and is level with the top tread (the hallway floor level). Where this line intersects the top of the skirtboard defines the point where the trim rises vertically to the top edge of the baseboard, which wraps around the wall corner. I bisected the angle between the vertical rise and the top of the skirtboard. This angle is 127 degrees, so the bisected angle equals 63.5 degrees. (To find the angle you set on the miter saw, subtract 63.5 from 90. This equals 26.5 degrees.)

Note that on the wall layout, I crossed out the first rendition of this. It was the "right" way to begin, but I noticed that if the vertical line intersected the skirt line higher up the wall, the bisected angle would tuck in just below the top bullnose. The first way would have worked, but the joints would have no relation to the stairs. I also wanted to minimize the vertical. I could have moved this even farther up the skirtboard line to minimize it even more but chose to have the two angles converge around the top tread nosing. The important takeaway here is that there is no one way to do this. As a carpenter, I am always making judgment calls and adjusting the trim to align with other elements in a room.

Where the trim rises vertically to the height of the baseboard, it joins the level baseboard at a 45-degree miter. The combination of these two angles—the optimal bisected angle and the 45-degree miter—ensure that the profiled top edges of the baseboard and skirtboard align perfectly where they join.

Inside corners of landing. At the inside corner of a stair landing that wraps an outside wall corner, there is even less room along



The traditional landing transition (5) was done with a bisected angle to "turn" the skirt level. Once it turned the corner level it drops to the skirt, bisecting the angle between "vertical and rake." The same can be done with plain, modern millwork (6). Using a plinth (7) block to make this transition is clunky. The author prefers sanding to blend the two different profiles (8). Keith Mathewson of Seattle Fine Woodworking carved this profile to match the rake angle (9). Gary Katz photographed an elegant example of matched profiles on a stair-to-base transition in a historic landmark home in Indianapolis (10).

Photos: 9, Keith Mathewson; 10, Gary Katz

the wall, so the skirt has to "jump" a level. The traditional way I have seen this resolved in older houses still uses the "standard" bisected angle, but in this case, that angle is made on the last tread above the landing, as shown in photo 5. The trim levels out, so it can turn the corner at a 45-degree bevel. After the trim turns the corner, it extends in a level line and then drops vertically until it intersects the lower skirtboard. Once again, the two angles—the optimal bisected angle and the 45-degree miter—allow the profiled cap molding to align at each intersection. Depending on how the stair is laid out, the bullnose of this tread lands at the wall corner or at the corner on the plane of the skirtboard (both look good).

FURTHER ADJUSTMENTS

The idea of a plinth block is a go-to for a lot of carpenters. This is what I often see when carpenters don't know how to manage transitions. It's OK, but I think it draws too much attention to the joint and looks clunky if it's not supporting a vertical element. (It works, for example, at the base of a door casing to enhance the effect of a "post footing.") However, the plinth used in photo 7, for instance, does have one justification: The profile on the skirtboard doesn't match the profile on the baseboard stock. I prefer to sand, rout, or even carve the profiles to blend the rake profile with the two different profiles. Keith Mathewson has an excellent article, "Raked Baseboard Returns," on *ThisIsCarpentry.com* that gives a nice presentation on how to carve the profiles to match, and photo 9, above, shows a nice example of how he has done that on one stair where the nosing of the tread comes very close to the corner of the wall.

Brian Campbell is a finish carpenter in the Twin Cities of Minnesota.

AZEK EXTERIORS

(PRE) PAINT IT BLACK

Prefinished PVC siding speeds installations with minimal field painting, long-lasting colors.

Sam DeFrancesco was understandably skeptical of black as an exterior color for a home that spends much of the day in direct sunlight.

"The house sits at the top of a hill with nothing around it … So, the challenge we had is that it just bakes in the sun," says Sam DeFrancesco, owner of Northford, Conn.-based Kingdom Ministry Builders.

That the color would arrive on prefinished siding raised his skepticism even more. Would black siding fade over time? Would heat buildup cause expansion issues? How much maintenance are we talking about?

These and other concerns were put at ease when DeFrancesco learned that AZEK Captivate Prefinished Siding & Trim features solar reflective coatings, ensuring even darker colors could withstand harmful UV rays while also minimizing the sun's impact on the PVC substrate. That meant he could achieve his clients' desired style while providing advanced durability.

FROM BLAND TO BOLD

The sprawling house in Middlefield, Conn. had basic cream-colored siding in dire need of an upgrade. With its decorative pitched roofs and charming elevation, a designer saw how new bevel and board-and-batten siding could give the home a bold new look with a modern farmhouse aesthetic.

It was a big job. Thankfully, the workability of AZEK's PVC material simplified the installation process. AZEK's bevel siding installs like cedar minus pesky knots and finger joints. Plus, cut edges do not require sealer. That it arrives ready to paint without sanding or primer needed — or in DeFrancesco's case, prefinished, requiring only one coat for consistency and to hide fasteners — helped speed things along.

His four-man team got the job done relatively quickly compared to installing and painting conventional siding.

"It costs a little more, but it does save you time," he says.

AZEK Trim was used along the fascia. The trim was prefinished black on the front of the board. The backside was

white, requiring his team to paint it black where there was overhang. It was an unexpected step, but he says it beat having to paint the entire board. He's pleased with the results.

"I really enjoy the install of the AZEK corners," he says. "Everything sits well together.

"Aesthetically, it's beautiful. It looks classier in my opinion than vinyl on a corner," he adds.

The only part of the project that gave DeFrancesco pause was the color. Not only could black lose its luster under the sun, but dark colors absorb more heat from sunlight and are therefore more prone to thermal expansion and contraction. But DeFrancesco was assured that the material could go the distance, thanks to both the substrate's engineered polymers and the specially formulated paint coating that deflects the sun's rays more effectively than standard paint pigments. The darkest Captivate colors produced in specialty PPG paints will lead to less heat buildup than many lighter colors in an ordinary paint.

"The reality of it is, it will maintain its color under the sun for years," DeFrancesco says.

Visit AZEKexteriors.com/captivate to learn more about innovative trim and siding solutions.

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Prefabbing a Perfect Porch Ceiling

Cut the frame in the shop and assemble it in the field for a precise fit

BY NATHANIEL CARLSEN

Last winter, the company I work for, TDS Custom Construction, built a screened-in porch with an exterior gable roof overlay and interior hip roof that required precise framing to accommodate a beadboard ceiling finish. Faced with the cold weather and lack of space that plague many jobsites, we decided to cut and test-fit the frame in the shop, then assemble it on site.

ESTABLISHING A FOUNDATION

While production coordinator Phil Busch was transforming the architectural plans into construction drawings (see drawing, next page), our team built four boxes—each 2 feet wide by about 3 feet tall with internal 2x4 frames, 1/2-inch plywood side skins, and 3/4-inch plywood tops—to arrange on the shop floor to represent the four corners of the porch. To establish the centers of each box, we drew lines across the midpoints and from corner to corner. We then used a laser to snap layout lines on the floor and placed the boxes square to each other and spaced such that the midpoint of each box sat where an outside corner of the roof would rest.

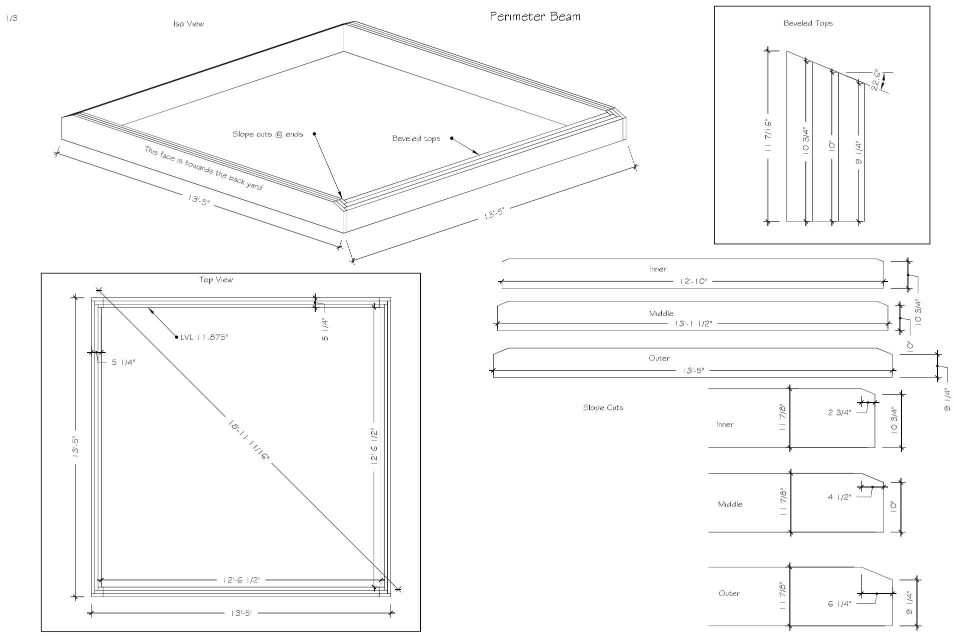
With the corners established, we leveled the boxes using a 2-foot spirit level, laser, and target in combination. We shimmed the boxes to bring the tops into level individually and into plane as a group, then added 2x4 legs. Finally, after adjusting the position of the boxes to maintain square, we ran 2x4s from box to box and diagonally across, locking our shop-foundation in place **(1)**.

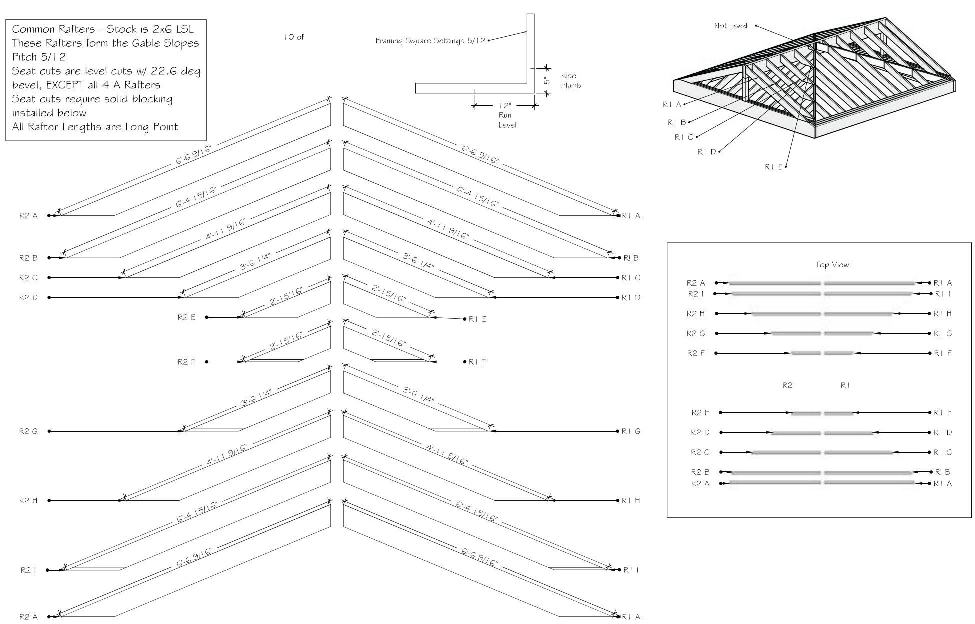
MILLING THE COMPONENTS

A key benefit of working in a shop is an increased ability for a team to multitask. While I fine-tuned the position of the boxes in one half of the shop, my colleague, Ethan Butler, was in the other half helping to mill bevels on the beams and hip rafters with our lead, Martín Gutierrez, who was toggling between us **(2)**.

We cut the pieces based on cut sheets drawn by Phil, who had

Photos courtesy TDS Custom Construction





Drawings by Phil Busch/TDS Custom Construction

Working from the architect's 2D drawings, TDS production coordinator Phil Busch built a 3D model of the roof in SketchUp, then field-verified all relevant as-built and existing condition dimensions. This step allowed him to make the necessary modifications to yield a model that would reliably fit the real (no longer only digital) world. Next, Busch worked with the model to be able to graphically show the setup, fabrication, and assembly of all the parts. Because SketchUp itself does not do this, Busch arranged the components in his model based on his 40-plus years of experience as a builder and exported the information to SketchUp's 2D graphics program, Layout. Shown here are selections from Layout's PDF output, which the crew referred to when fabricating the roof frame.

The crew assembled plywood boxes to represent the four columns that would support the roof framing, squared and leveled them, and tied them together with 2x4s **(1)**. Working from a detailed cut sheet (see drawing, opposite), workers prefabricated the components **(2)**, assembled the woven perimeter beams **(3)**, and raised the beveled structural ridge **(4)**.

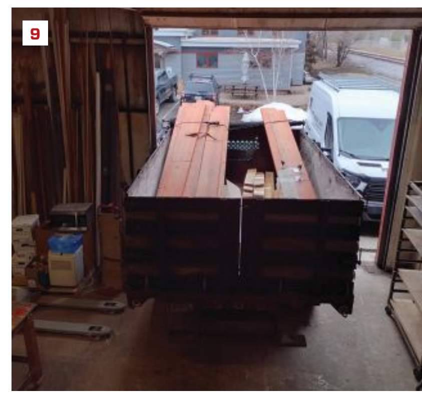
translated the design department's drawings into a thorough outline of each component (see drawing, opposite). This included details such as a V-bevel on the underside of the hip rafters to create crisp ceiling corners, and beveled beams to allow the roof sheathing to shoot across and onto the overhang.

Working in the shop also allowed us to run the LVL material through our big SawStop table saw and, for the larger beams, to use the "million miles" of track-saw tracks that live in the shop. Instead of trying to make long cuts on a sloped and muddy jobsite, we had a flat, even surface to work on.

Test-fitting. Once the larger framing members were ripped and cut to size, we began erecting the frame by tacking the woven beam corners together. We then screwed on the center posts, braced them plumb, and lifted the ridge beam into place before moving to the hip rafters. The 3-foot-tall boxes put the perimeter beams at a comfortable height, allowed us to navigate inside the roof without undue crouching, and kept the ridge within easy reach of a 6-foot stepladder **(3, 4)**.

Due to a slight whip in the ridge beam, the intricacies of the framing plan, and inconsistent material thicknesses, we needed to recut the ends of the hip rafters several times to fit them properly. On site, they might have been deemed good enough, only to doom a finish carpenter to a litany of custom cuts; in the shop, we were able to shoot multiple lasers from every conceivable angle to ensure the rafters ran as desired. A question about straight or square could be answered in under a minute without a ladder, and Phil could drop in frequently to check the framing and suggest alterations to Martín **(5–7)**.

Cutting the jack and overlay rafters. With the backbone in place, we filled in the frame with jack rafters cut from LSL material. Martín cut these from the schematic dimensions, passing them to



The tops of the LVL hip rafters are beveled **(5)** and fit neatly into the woven corners of the beveled perimeter beams **(6)**. Raising the assembly a couple of feet above the shop floor made it easy to work on the roof framing **(7, 8)**. After fine-tuning the fit and labeling the parts, the crew disassembled the roof and loaded everything into the back of a truck for transport to the jobsite **(9)**.

me to test-fit and label according to the surroundings (house, neighbor, yard, and addition). Working off a plan and test-fitting meant few measurements needed to be taken and any requisite corrections to the angle and length could quickly be identified. I was able to comfortably work in the rafters and easily converse with Martín to ask a question or share feedback. There was no shouting, “It doesn’t work” or “Come take a look at this” to a carpenter who’s on the ground and can’t see “what the holdup is.”

While we worked on the jack rafters, Ethan set up a station on the other side of the roof to cut the overlay rafters that form the top-side gable. Despite making progress on multiple fronts, we finished the roof framing without fully assembling the overlay. However, the hip frame was fully standing in our shop **(8)**.

With the roof cut, Martín moved on to another project and Alex Bartlett, another lead carpenter, took over for on-site assembly after dropping by the shop to see the finished product. The screwed-together frame was easy to disassemble and package for transport. I backed a dump truck into the shop, filled it with roof, and drove the components to the site **(9)**.

ON-SITE ASSEMBLY

On a brisk but sunny day, we began erecting the frame. After setting and bracing the corner posts, we assembled the pieces in the order described above. In theory, it should have gone together like a puzzle, but in reality, we had a few alterations to make **(10)**.

First, the underside of the jack rafters sat slightly below the bottom of the hip rafters. We never tracked down why this was the case, although in hindsight, I have a shim or two in mind as the culprits. This discrepancy was uniform and would not overly impede the finish work, so we continued with assembly.

Second, we switched up our plan for the gable overlay rafters. Originally, these were to rest on blocks that were sandwiched

Here, the corner posts have been installed and braced, and the crew has started reassembling the roof, starting with the perimeter beams and posts that support the ridge **(10)**. The gable end wall was assembled on site in two halves **(11)** to make it easier to hoist into place. Next, the crew framed the eaves on the ground **(12)**, then lifted them into place to complete the roof framing **(13, 14)**.

between the jack rafters. Once on site, we changed tack and simply ran sheets of 3/4-inch OSB up the relevant sections and fastened the overlay rafters to those after trimming them accordingly.

Framing the overhangs and sheathing the roof. Despite working as a three-person crew, we were able to divide and conquer because we weren't shoehorned into the traditional one-on-the-ground, two-in-the-air arrangement. Instead, once the heavier pieces and most of the jack rafters were in place, Alex and I continued assembling the overlay while Ethan cut and built the gable-end overhang, which, instead of being a ladderbox up the rake, dropped down to allow the eaves to continue around the gable. To do that, Ethan built the gable end wall in two halves on a pair of sawhorses, with studs on 16-inch centers **(11)**. We then dragged these up the roof, hung them out over the end of the gable, and lagged through the studs into the perimeter beam and through the end gable rafter into the studs, adjusting them into plane with the rest of the roof as we went.

We moved on to building the eaves with the help of Chris Andersen, an intern from Madison College's construction and remodeling program (he ended up joining our team a few months later). We built the overhangs on the ground, hoisted them onto the roof, and attached them with lag screws, adjusting them into plane similar to the gable overhang. Sheathing the roof and the gable end was done in the usual manner **(12–14)**.

BEADBOARD CEILING

Months later, with a flat, sturdy deck beneath our feet and nicer weather, we started on the beadboard ceiling. Martín began by using a laser to check that all the hip rafters ran straight and square to each other. He then installed blocking on the top of the ceiling to support a plywood center panel. He cut this panel to size and beveled the edges to allow the beadboard to transition from the flat panel to the ceiling's slope. After clamping the panel to a worktable, he cut beadboard

Blocking was installed in the center of the ceiling **(15)** for the beadboard center panel, which was fastened to a plywood backer **(16)**. Lines stretched from a screw in the middle of the ceiling along the centerlines of the hip rafters were used to help align the beadboard joints **(17)**. Precision framing resulted in a near-perfect ceiling installation **(18)**. The screen porch was part of a larger outdoor living project **(19)**.

pieces at 45 degrees and nailed them to the panel, gluing the miter joints and holding them together with spring clamps **(15, 16)**.

Once the panel was completed, excluding the central piece, we tacked it to the center of the ceiling and put a screw in the middle. From that, we strung lines to the end of the hip rafters at the midpoint of the V-groove we ripped earlier. Rotating the panel so the mitered corners aligned with this string ensured that the beadboard would start parallel to the beams below and the joints would line up as we moved into the field.

The slope of the ceiling was exponentially more complex. We wanted to install the beadboard with no mid-row joints, so the lengths and angle of the miters had to be perfect. To achieve reliably tight joints, Martín spent a solid day tracking down the compound miters needed, and we set up a pair of miter saws, one for each end of the beadboard. We also set up a third saw for other work on the site so that these two would not be disturbed.

Martín cut measuring blocks, with a known distance from the long point to the square point, and used them to begin cutting the beadboard. This is where we re-encountered the discrepancy mentioned earlier of the inside face of the jack rafters sitting slightly below the hip rafters. To adjust, we shimmed the mitered ends of each piece of beadboard. While this added an extra step, it also provided a little room to maneuver the miters into perfection. With the pieces in place, Martín shimmed the corners until the miter was tight and tracked the strings we ran down the hips earlier when he sighted them from below. By ensuring the joints tracked the strings, we kept the ceiling diagonals running straight and maintained the joint angle heading down the ceiling. Glue, 18-gauge nails, and spring clamps locked the joints in place. The work proceeded through to the last courses, with adjustments along the way **(17–19)**.

Framing took about 15% longer because of the assembly, disassembly, and transport required, but we recouped some of that time at the finishing stage, where shop precision allowed for a near-perfect beadboard installation without our fighting the framing. Being able to work in a warm shop, wait for an ideal sunny day, and all mobilize to launch a roof in the air—doing things the easy way for once—was definitely worth it.

Nathaniel Carlsen is a carpenter with TDS Custom Construction in Madison, Wis.

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Underpinning Basement Foundations

How to avoid a building collapse when digging down a basement

BY DOUG HORGAN

Photos by Doug Horgan/BOWA, except where noted

Basements, including basement apartments, are common in my area, and real estate is valuable. So, we often find that clients who live in older homes with short basements (5- to 7-foot ceiling heights), or even shallower crawlspaces, are interested in turning the spaces into full-height, usable rooms.

It's possible to dig down just the middle of a basement and "shelf" the perimeter so the dirt below the existing footings remains intact and has ample support, but we more often excavate the entire basement, wall to wall, which requires extending the existing foundation walls down to new footings, a process called "underpinning."

There's no question that this is a lot of work and even carries some unusual risks compared with other projects. In fact, there have been some disastrous failures in our area when contractors aggressively undermined too much of a foundation, and the building collapsed—or in some cases, the building and the connected building next door, too. One jurisdiction has twice modified the permitting and approvals process to include more stringent controls in an effort to avoid problems.

We've done several of these projects and have more on the boards. Here's how we do them, along with some lessons we've learned.

Complete collapse. These photos posted by the D.C. Fire and EMS Department show the tragic consequences of undermining the foundation when digging down a basement.

PRE-WORK INSPECTIONS

There's a strong possibility of foundation movement when you dig down a few feet and replace the entire supporting structure of a building. It hasn't happened to us, but everyone involved is thinking about it.

Before we begin, and usually with the clients and a camera, we thoroughly inspect the upstairs of any house we underpin. Any gaps or cracks are noted and photographed. We also check for moisture that might be transmitting through foundation walls.

When we underpin masonry row houses, and some of the walls we're reworking are party walls supporting adjacent houses, we typically inspect the neighbors' houses, as well. This is a normal process in Washington, D.C. On each of these inspections, we are accompanied by the neighbor, and we create a report for them noting any cracks or other issues. On a recent project, we found some water leaking into the neighbor's basement and were able to provide them with some free diagnostic information while we were there.

WHAT'S SUPPORTING THE HOUSE?

Before the job starts, we must dig down in several places to inspect how far the existing walls extend and determine what's under them. Around here, houses often don't have a concrete footing right below the slab, as you'd find in modern construction. On many of the houses we work on, the original builders put bricks on the dirt and started stacking upward.

Occasionally, the walls run a foot or two below the existing basement floor level and, in these cases, we may be able to drop the floor level far enough without needing to underpin the walls.

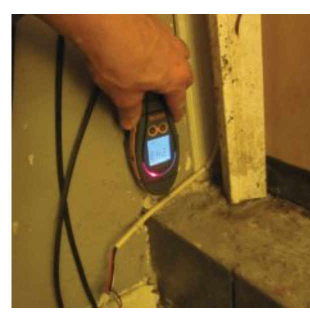
Within D.C. limits, we are required to have the dirt tested by geotechnical engineers to verify it can hold the building. In other jurisdictions, we may need soil tests if the engineer we're working with recommends it. Most of the time, we're digging down to more stable dirt and installing a stronger, wider foundation with more bearing area. Unless we find something unusual, the dirt is generally fine.

DIGGING DOWN BUT NOT TOO FAR

In cases where the walls extend far below the existing surface, we sometimes remove a foot or two of dirt before we start the underpinning. The less dirt in the space, the easier the work. However, we leave dirt near the footings for temporary bearing under the footing. Bearing stresses from the footing are distributed into the dirt at a "distribution angle," which varies by soil type; 45 degrees is typical, but engineers sometimes direct us otherwise. We make sure to never dig inside it.

FOLLOW THE PLAN

The general idea of underpinning work is to excavate and pour a series of small foundation and footing sections in a staggered



Pre-inspection. Before an engineering plan can be devised, the author's company digs several inspection holes like this one (above left) to document how far the foundation extends and what the footing's condition is. In addition, the company inspects all adjoining homes, in this case (above right) using a moisture meter to monitor moisture levels in a party wall.

Photos top and above left: District of Columbia Fire and Emergency Medical Services Department pattern so you aren't undermining a large section of structural support all at once. For each small section, we typically dig a 3- to 4-foot-wide pit under the existing foundation, form and pour a new foundation in that area, and then repeat by digging out another small section and so forth.

All our underpinning projects have a work plan defined by the engineer. This plan includes the section sizes and the order to dig them in. We mark the sizes out on the walls and number them with spray paint. Typically, there will be two to five "number one" sections we dig and pour at the same time, then a bunch of "number two" sections, and so on.

Corners are tricky. It's difficult to dig one side of a corner without significantly undermining the adjacent wall as well. We have started asking engineers to plan for digging the whole corner at once and usually not in the first two sets of holes.

Soil bearing is evaluated at the bottom of one pit by conducting a Dynamic Cone Penetration test.

INSPECTIONS AND TESTING

Local building inspectors (or sometimes engineers or third-party geotech firms) do test the soil at the bottom of the holes—at least the first few. This can range from simple hand-held rod testing (by pushing a piece of rebar into the soil, an inspector can evaluate the bearing based on resistance to driving the rod) to elaborate testing apparatus like a Dynamic Cone Penetration test, which uses multiple blows of a calibrated weight to precisely measure how easily a conical-pointed rod is driven into the dirt.

Most soil in our region is well over 2,500-psf bearing strength and, for the houses we underpin, the soil is rarely a concern. One project we did was clearly on two different types of dirt—we had to use a chipping hammer to dig out a third of the house, while the rest of it was easy to shovel. Both soil types were sufficient to support the standard 24-inch-wide footing called out on the initial plans. In fact, the 24-inch footing was 150% of the size of the original foundation bearing, which was just two bricks laid on the dirt. Some other regions have more complex soils and need other tests, including testing rigs that penetrate down through multiple layers of earth.

We've also had engineers epoxy precision targets to spots on the wall so they can check with a leveling instrument in the future to see if the elevation has changed. Our permit plans sometimes are required to state how much movement is acceptable and what will be done if there's more than that.

Many of our underpinning projects have included significant additional work, such as removing center bearing walls, changing entire framed floors, and the like. We often have engineered temporary support plans that need to be integrated with the underpinning work. The value of these engineered support walls was shown to us when an earthquake hit our area while we had a five-story masonry building on temporary supports. The design must have been effective because nothing bad happened.

A SERIES OF MINI-FOUNDATIONS

There's usually a rebar schedule for the new foundation. Since we're pouring a series of small foundations, we extend the rebar into the dirt next to the section we've dug, so it will connect to the future concrete when we dig that section.

Some engineers call out keyways in the sides of each pour, which we create by placing a wood strip next to the dirt before we pour. This strip is pulled out when we dig out the next section, leaving a vertical channel for the next pour to key into. We've also been asked to install water management gaskets between pours. Since the existing solid masonry walls are usually quite leaky, I don't think these add much value, but it's easy enough to do. We normally install an interior water management system at the end of the underpinning work.

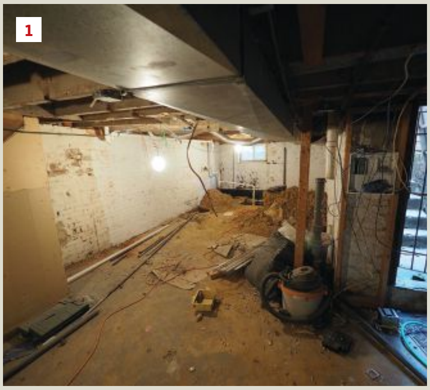
The engineers or local inspectors come to check each pour once it's formed up. They verify the size of the footing and wall and check that the rebar is installed per the design.

Our foundation subcontractors often build formwork that allows them to pour both the footing and the wall at the same time. Dirt serves as a form on the sides and back, while a custom wood form is used on the inside. The height of the pours varies, and the form usually stops a few inches below the bottom of the old wall or has a special removable panel near the top. This allows room to get the concrete in over top of the form and under the old wall.

Once the concrete is poured, the gap left between the new concrete and the old foundation is filled with "dry-packed" non-shrink grout. A very dry mix is made and compacted into place with wood blocks and sledges. The idea is to fully support the old walls; trying to pour concrete up under them would be unlikely to provide solid bearing over the entire area.

Once all the "number one" sections have been poured and dry-packed, we can move on to the "number two" sections, where we repeat the same steps. The third sections are often adjacent to the first pours, and we clean the rebar that was stuck into the dirt earlier, then tie new pieces to it so it acts continuously across all the sections. The overlap is called out on the plans.

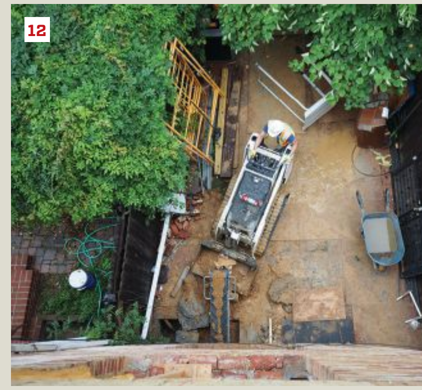
PROGRESSION OF AN UNDERPINNING JOB



Before the job begins **(1)**, the basement must be cleared out, including removing duct work, framing—even the stairs leading to the first floor. Exploratory holes are dug to evaluate the footing and water table **(2)**, and a new sump pit roughed in **(3)**.

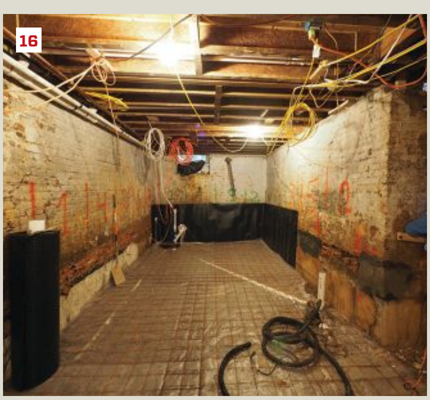
With the basement cleared, work begins on demolishing the slab **(4)**, while the order of excavation of small sections is defined with spray paint on the walls. All the "ones" are dug and rebar cages tied in place **(5, 6)**.

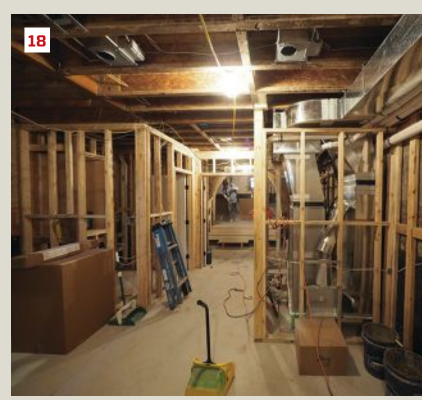
Inner-city access is often tight so concrete must be "walked" in through alleys and backyards **(7)** and delivered via chute to the basement **(8)**. Corners are tricky; it helps to pour both sides at once **(9)**. Note the dry pack above the initial pour.



After the “ones” are dug, poured, and dry-packed, work starts in on the “twos” **(10)**. As work proceeds, the basement fills up with dirt **(11)**; to remove it, the crew uses a conveyor belt that dumps into a stand-on skid steer **(12)**.

Once the crew has worked through the series of footing/foundation sections, the extended foundation is complete **(13)** and excavation continues. With the basement dug out, drainage lines and an ejector pump for a new bathroom are installed **(14)**. In addition, a new sump pit is installed and the subslab stone is placed **(15)**.





The job has progressed from a state of chaos to order. Drainage mat is secured to the walls, and the floor is prepped for a slab with a vapor barrier and welded wire **(16)**. The new slab is poured **(17)**, followed by interior framing and mechanicals **(18)**.

Each section of the underpinning is both footing and foundation. Typically, the rebar cages are wired up with extensions driven into the dirt on each side so they overlap and are wired to rebar in the adjacent sections (top). A variety of forms are used, depending on the depth of the foundation extension and width of the footing, as specified by the engineer (above).

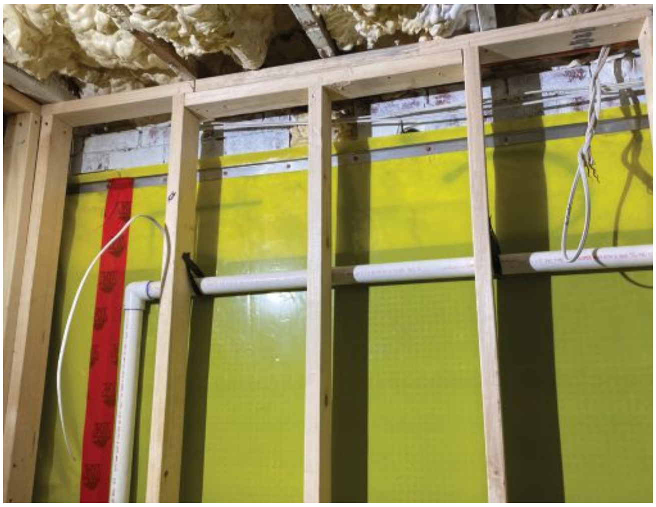
MANAGING GROUNDWATER

In addition to managing the structural work, we need a plan to manage groundwater during an underpinning project. It's not rocket science: We dig a deep sump pit and pump water out. If we play our cards right with the location and depth, the sump we use during construction can be left in place for future use as a permanent dewatering system for the home.

Most of these foundations also get an interior water management system. This entails a heavy plastic sheet (6- to 20-mil poly or a dimpled mat product) that catches water coming through the wall and directs it downward to flow below the new slab floor into a perimeter drain that flows to a sump. On solid masonry buildings, I believe this type of water management is superior to exterior waterproofing because it collects not only groundwater within the perimeter of building but also any rainwater that's running through the above-grade masonry walls. We have seen heavy rains soak upper-level masonry walls, causing water to seep through the masonry and run down to the basement level. Interior drainage solutions manage this water and are usually less expensive than exterior systems on existing buildings, especially when done during a complete basement underpinning project.

WORKAROUNDS AND EFFICIENCIES

Zoning rules are sometimes a challenge. On one project, the existing old brick foundation walls couldn't be replaced because of historical zone rules, but our engineer didn't think the walls were strong enough to resist soil pressure (there was abundant evidence that the foundations were pushing inward before we underpinned). The solution was to add vertical steel anchored to the wood floor system above and the footings/slab below to prevent the old and new foundations from hinging at the joint and pushing in. We're still puzzling out how to manage water on a



Water management typically includes both protection from groundwater seeping through the foundation (in this case, 15-mil Stego Wrap secured by a termination bar, as shown at top) and interior drains running to a sump pump (above).

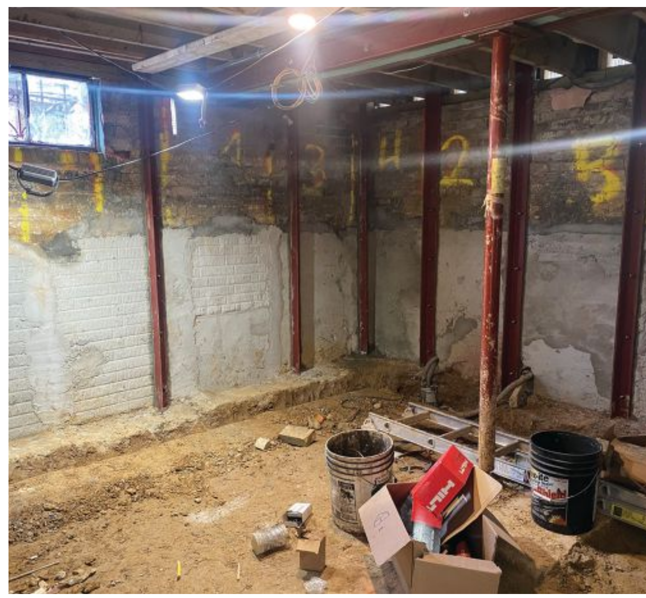
system like that going forward. On this one, we installed an interior drainage system around the inside of the steel, which will work but is inelegant at the least.

The sequence and the work are not complicated, but it's a huge amount of labor to dig down 3 to 5 feet, tie the rebar cages, mix and pour the concrete (or wheel it in from a mix truck, as we do on larger projects), and remove all the dirt. Some of our contractors use micro-excavators that can drive through the basement doorways, or small conveyor belt machines to move the dirt up and out into the yard. We even had two excavators and a conveyor in one basement! On some sites, the yard is only part of the journey; we've had to drive skid-steer loaders 150 feet along alleyways to get to and from dump trucks and concrete deliveries.

The smoothest jobs are done by companies that specialize in this work. They have experienced people and a good set of machines that accelerate the work. But we have also worked with masonry or excavating generalists; the work is essentially just a lot of little foundations, and they've been successful executing this work too, if a little slower.

One common mistake I've seen is rushing to dig more sections than what is shown on the work plan. The engineers want all the "one" sections done before the "two" sections are started, minimizing the areas that are unsupported, but some contractors want to dig more at the same time. It's all in the name of being quick and efficient, but it's risky and we don't permit it. The stakes are just too high.

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



Vertical steel was added prevent the old brick and new concrete walls from hinging (top). The steel precluded the addition of a robust drainage matrix to the walls. Above, the perimeter is prepped for interior perimeter drains.

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BY VINCENT SALANDRO

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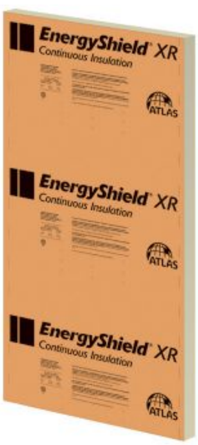

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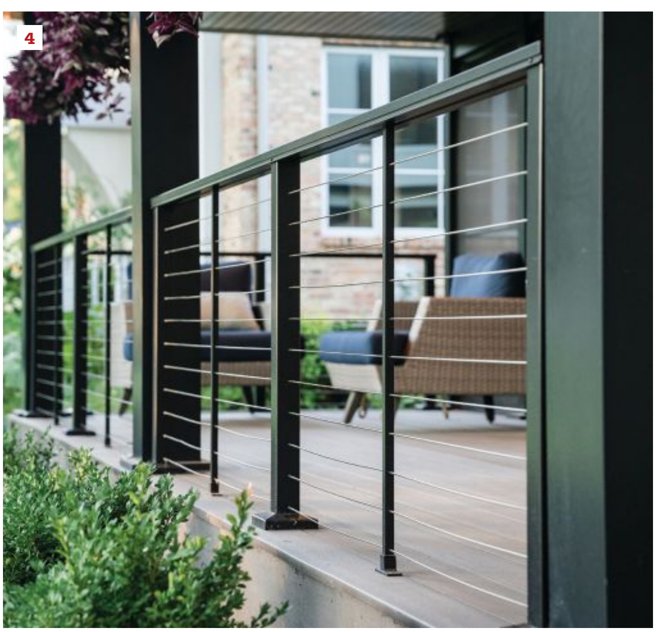

1. Efficient Energy Recovery Ventilator
AprilAire says its 120-cfm V22BEC Energy Recovery Ventilator can help contractors meet code requirements for ventilation airflow and efficiency. The unit has a push-button fan-speed control for continuous operation; when paired with the manufacturer's thermostats or 8120X digital controller, the ERV can be intermittently turned off when outdoor humidity or temperature is too high. A templated mounting bracket is included to simplify installation on ceilings, walls, or floors. aprilaire.com

2. Polyiso Insulation Product
Engineered to provide continuous insulation for below-grade walls and under slabs, Atlas' EnergyShield XR is a moisture-resistant polyiso rigid foam board with impermeable facers. According to the manufacturer, the prescored boards are easy to cut and are compatible with most mastic or solvent-based products. Pricing ranges from $19 to $70 a sheet. wall.atlasrwi.com

3. Clips for Grooved Deck Boards
Camo WedgeClips and WedgeMetal clips are preassembled hidden fasteners for use with grooved composite, PVC, and wood deck boards. WedgeClips are designed to attach decking to wood framing and feature a black-coated 316 stainless steel screw and gusset for corrosion resistance. WedgeMetal clips, for use with 14- to 18-gauge metal joists, feature a 304 stainless steel gusset and a 410 stainless steel drill point screw (both also with a black coating). Both clips can be installed with Camo's Never-Miss Guide (included) or ClipDrive or Drive stand-up tools. For a 90-count bucket, WedgeClips cost $60; WedgeMetal clips, $65. camofasteners.com

4. Easy-Assemble Aluminum Railing System
Feeney's DesignRail Modern modular aluminum railing system comprises components that easily snap and screw together. Fasteners are tucked under a flat handrail for a clean aesthetic, and the minimalist look is enhanced by the absence of a bottom rail and by a long allowable span—up to 8 feet—which reduces the number of posts required. The system's 6000 series powder-coated aluminum posts and rails come predrilled. feeneyinc.com

5. Flush-Surface Gap Siding
On LP SmartSide Nickel Gap Siding, locking flanges with a fastener groove conceal fasteners and provide a flush surface for a contemporary appearance. Available in a brushed-smooth or cedar texture in 16 prefinished ExpertFinish colors and in a primed cedar texture, planks are 8 inches wide, with a true 7-inch reveal. lpcorp.com

6. Wide-Span Composite Enhanced PVC Decking
MoistureShield says its new Stratos "composite enhanced PVC" decking has a 50% greater span than conventional PVC and composite products. Boards have a lightweight cellular PVC core, a glass-fiber-reinforced composite shell for strength, and an acrylic cap to resist stains, scratches, and fading. The manufacturer claims that the boards expand less at higher temperatures than standard PVC decking, allowing for tighter details across wider spans. After a regional launch in the spring, Stratos will be rolled out in a wood-grain finish in three colors to a national audience in the summer. moistureshield.com

7. Time-Saving Interior Window Installation
The Pella Steady Set system for new construction employs factory-attached components to help speed and improve window installation and enable more of the process to occur from inside a house. For instance, a "head stabilizer" engages with the rough opening to keep the window from falling inward; installation brackets just need to be unclipped, flipped, and clicked before being fastened to the framing; shim guides on the jambs hold shims in place; sill shims raise the unit $1/4$ inch off the rough opening; and an exterior fin with continuous corners pops out ready for flashing tape after the window is set. Steady Set will be available on Pella Reserve and Lifestyle Series wood windows nationwide starting in the summer. pella.com

8. Matte Black Exteriors
To promote cohesive designs reflecting matte-black aesthetic trends, Ply Gem's line of exterior blocks, mounts, and vents are now available in 498 black, matching the manufacturer's Mastic black vinyl soffit, gutter, and trim coil. According to the manufacturer, the black color will not lose its pigment over time. The manufacturer says the color creates "dramatic contrast" against muted colors. plygem.com

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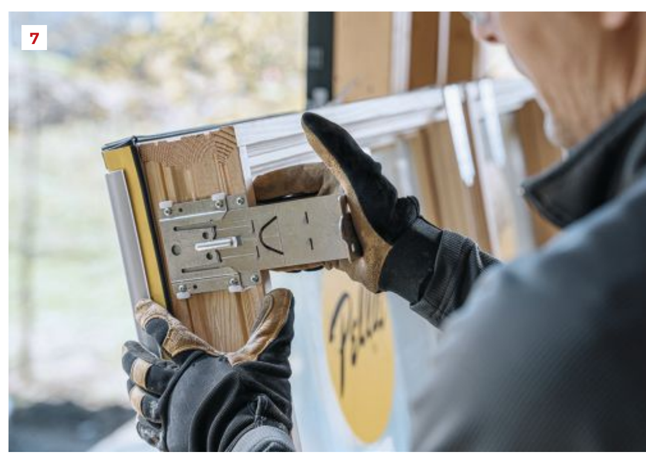

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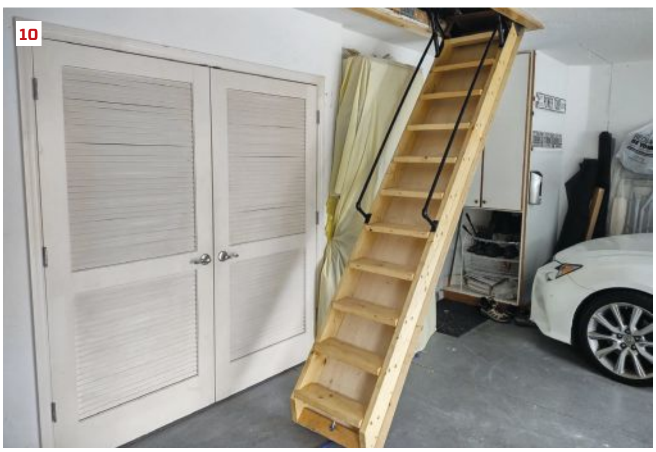
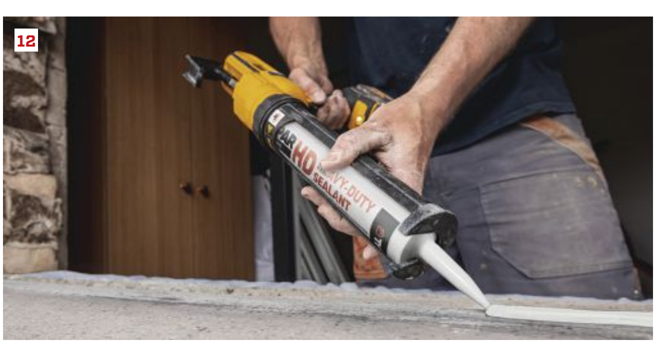




9. All-in-One Wood Stain and Sealer
Suited for both interior and exterior applications, StoColor Wood Stain from Sto Corp is available in new colors. The manufacturer says the product combines the benefits of a stain and sealer, helping to achieve a wood-grain appearance as well as UV resistance. The stain can be applied to StoCast Wood, to any Sto Corp cladding system as the finish layer, and to common construction surfaces, such as CMU, stucco, and drywall. stocorp.com

10. Attic Stair Kit
Rather than folding, Tri Line Services' Safe Step Stairs retract into and open out of a garage ceiling to provide access to attic space. The manually operated stairs open and close easily and can be climbed hands-free, according to the manufacturer, though handrails are included for safety and comfort. Safe Step Stairs are also available configured to meet Class A fire rating code requirements. A wooden kit for an 8-foot ceiling costs $1,300. trilineatticsolutions.com

11. Cabinet Light Installation Tool
True Position Tools' Cabinet Light Jig facilitates the installation of light wires within the structural panels of a cabinet while eliminating the need for a light rail or double bottom. The jig can be used to conceal wires and lights in panels as thin as $^5/_8$ inch. The base model kit ($250), which works with strip lights only, includes a jig, drill bit, and case. Kits that also work with puck lights (starting at $300) include steel-body Forstner drill bits with a wave cutting edge and adjustable stop collar. For installing strip lights, you'll need to use a router to create a channel. truepositiontools.com

12. Heavy-Duty, Versatile Sealant
Typar's Heavy-Duty Sealant for doors, windows, and seams is an approved alternative for Typar Double-Sided Tape on seaming applications with Typar DrainableWrap and DrainableWrap Commercial. According to the manufacturer, the sealant's modified urethane acrylic composition makes it ideal for creating airtight and watertight building envelopes. Typar also says the sealant is gunnability down to 32°F, seals joints up to 2 inches (if properly applied), stays tack-free for more than 60 minutes, fully cures within 48 to 72 hours, is paintable and stain-resistant, and has low (less than 1.5%) VOC content. typar.com

EZ-Wings Miter Saw Station

BY GARY STRIEGLER

Ask carpenters to name their three most frequently used power tools, and I believe a miter saw would be on most of their lists. While most of us have learned to invest in a quality saw with a good blade, I am constantly amazed at how frequently I see great saws on very average saw stands. To me, that's akin to driving a high-performance car with bald tires.

Earlier in my career, I was lucky enough to find a Saw Helper Ultrafence at a trade show. That saw stand was portable, sturdy, and easy to set up, with wide support and an accurate stop system for efficient, repeatable cuts. The best part about it was that once it was attached to the saw, it could be broken down and set up again in a short time with completely repeatable performance. I think I bought six of the company's saw stands over the years but, unfortunately, it went out of business more than a decade ago.

I've purchased several more saw stands over the years, but none have measured up to the standard set by the Saw Helper. So when I discovered the EZ-Wings Pro miter-saw station last year at another trade show and saw that its American-made design was remarkably close to my old favorite, I was eager to see how it measured up.

Setup. Referring to the easy-to-follow set-up video on the EZ-Wings website, I spent about an hour screwing and bolting the miter-saw station together (the necessary fasteners for each step are clearly marked and packaged together). EZ-Wings uses an adjustable base system that attaches through the holes that are already in your particular saw. According to the manufacturer, Red House Tools, the system can be set up to work with just about any existing saw stand.

Since just about everyone I know has several of the "tube" type stands, I decided to set up the miter station to work with a DeWalt saw and one of my DeWalt tube stands. If you want to set it up on a fixed bench in a shop, the system has built-in support legs. I found that starting the install process with the saw on a bench using the legs, then moving it to my saw stand after the wings were attached worked well.

All it takes to break the miter-saw station down is backing off one screw on each side to remove the wings. Because the wings attach to a bracket that remains fastened to the saw, their position is identical each time they are remounted, and the system stays aligned. For transport, all the components can be neatly packed in the equipment bag that comes with the system.

The EZ-Wings Pro miter saw station is compatible with most saw stands **(1)**. The system's support wings attach to a two-piece base, which adjusts to fit your saw **(2)**.

Photos by Gary Striegler

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

Performance. After sliding the stop in, I made some test cuts and was happy to see that the stop had no play in it at all. If I am trying to make a cut within 1/32 inch, the stop can't move. Right now, Red House does not offer a built-in tape measure that works with the stop, but I am told that the company is working on several more measuring/stop options, including a laser measuring device.

At the recent IBS show, I saw the new legs that will be available soon. They are lightweight carbon fiber and completely adjustable, and quickly clip onto the EZ-Wings fence for maximum support.

The EZ-Wings system is well designed and easy to set up. I like that it can be used on a bench in a shop setting or can fit on any stand that I have seen. I'm eager to see options the company will offer for stops and measuring; I think it is by far the best system I have seen since my old favorite disappeared. Prices start at about $850. redhousetools.com

Gary Striegler, a JLC contributing editor, owns Striegler and Associates, in Fayetteville, Ark. (craftsmanbuildersnwa.com), and teaches workshops at the Marc Adams School of Woodworking. Follow him on Instagram at @craftsmanbuilders.


3


4


5

The mounting bracket that attaches the wings to the stand has front-to-back adjustment and another screw to micro-adjust the height to match your saw, plus a couple of bolts with comfortable grips for tightening the bracket after you make final adjustments **(3)**.

Multiple wings can be added to each side for additional support, while L-brackets are used to make the fence-to-wing attachments. The author recommends setting the EZ-Wings fences up about 1/4 inch behind the saw's fence to accommodate material that isn't perfectly straight **(4)**.

Here the author is attaching the miter station to a DeWalt saw stand, using four 1/4-20 x 2 1/2-inch bolts (that is, 1/4-inch-diameter-by-2 1/2-inch-long bolts with 20 threads per inch)—the only bolts not supplied in the EZ-Wings hardware packet—to fasten the assembly to the base. A 6-foot level placed across the top of the saw table and wings while he's adjusting the saw stand brackets helps the author to align the assembly **(5)**.

Toolbox? Step Stool? It's Both

BY JOHN CARROLL

I recently came to the conclusion that my life would be simpler if I put all my cordless drills and drivers, along with their batteries and chargers, in a single toolbox. To do this, I would need a fairly large one, so I went online to see what was available. I was looking for a simple, open tote without partitions or lids, so I typed in the words "tote toolbox."

It turns out that the word "tote" can mean many things. I was inundated with all kinds of tool bags and toolboxes with zippers, lids, compartments, and pockets—exactly the things I didn't want. In the flood of options, however, DeWalt's DWST25090—an unusual combination of a step stool and toolbox—floated by. It caught my eye because the large, open toolbox was just what I was looking for.

The price ($67 at The Home Depot) for DeWalt's storage step stool was about the same as that of many of the toolboxes that turned up in my search. So, I bought the combination mainly for the toolbox and looked at the step stool as a bonus. This combo has worked out very well for me.

At about 25 inches long, 8 inches deep, and 12 inches wide, the toolbox is quite large. Made of dense plastic, it's also pretty stout, rated to handle 66 pounds. The handle folds down and nestles just inside the box; the way it does that is an advantage, which I'll talk about below.

The step stool is about 17 inches high with a 10-by-23-inch top. Rated to support 300 pounds, it's stout and stable along with being handy, especially for interior work. If I step up on it, my eyes are just above the top of a standard 6-foot 8-inch door, and I can easily reach an 8-foot ceiling. In addition to standing on the step stool, I often use it as a small work platform.

The toolbox can be quickly and securely attached to the top of the step stool via two integral clamps mounted to the ends of the stool. With the toolbox thus mounted, I can carry both the fully loaded toolbox and the stool with one hand. Then, if I need to use the stool, I can unclamp the toolbox in a matter of seconds. Alternatively, the legs can be folded up and the step stool clamped to the top of the toolbox to become a lid.

In some circumstances, I leave the toolbox clamped to the stool. Doing this holds the toolbox up, and I can grab the tool I need at a convenient height. Alternatively—here's where being able to fold the handle down inside the box and out of the way pays off—I can put a piece of plywood over the top of the toolbox and have a nice 1-by-2-foot shelf at a convenient 25-inch height. Going even further, I've considered getting a second DeWalt storage step stool. That way, I could set up the pair about 4 feet apart and lay a piece of plywood across them to make a 2-by-4-foot worktable 25 inches high.

Widely available in big box stores and online, DeWalt's DWST25090 step-stool toolbox might seem odd, but it's proven to be an adaptable and useful combination for me. dewalt.com

John Carroll, author of Working Alone*, is a builder who lives and works in Durham, N.C.*

DeWalt's DWST25090 storage step stool consists of a large tool tote and separate step stool that can be clamped together for transport **(1)**. The author uses the stool as a small work platform **(2)**, while the tote stores his cordless tools **(3)**. The stool has a 300-pound load capacity **(4)**.

Photos by Matthew Navey

BY CLAYTON DEKORNE

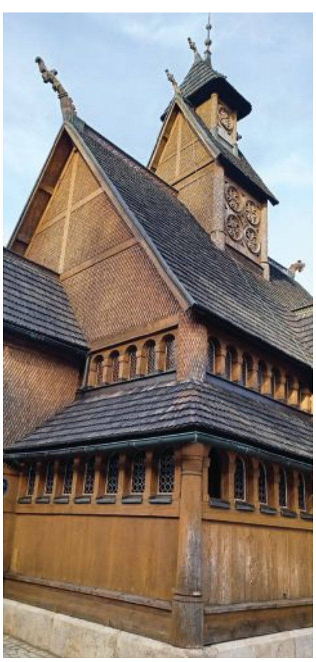
800 Years and Counting

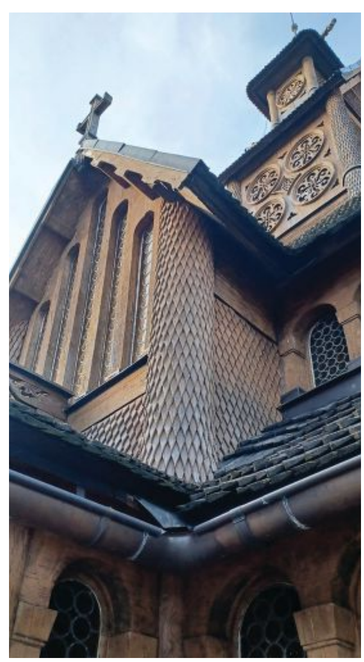
Opposite an ice-cream stand and a pizza shop, on a steep granite-cobbled street that leads into the forests cloaking the Karkonosze mountains that form the Polish-Czech border in Silesia stands an usual wooden church. I was instantly drawn to the "stave" (Norwegian word for "post") structure. Except for a few copper flashings and gutters, a small domed copper roof jutting off one end, and elaborately forged wrought-iron door hinges, the church—which rises 50 feet to the top of its central tower and 35 feet to the ridge of its imposing 16:12-pitch main roof—is entirely wood. As in, no metal fasteners whatsoever. All those wall shingles (which I heard others comparing to dragon scales and the surface of pine cones, both of which were probably intended) and the cascades of wood roof shingles are doweled in place.

The building was originally built in Vang, Norway, around 1200. By 1831, it stood in disrepair and the local parishioners wanted to tear it down and build a new and larger church. Johan Christian Dahl, a prominent Romantic-era landscape painter, campaigned to save the weather-beaten building and, after a number of failed attempts to relocate it, finally managed to interest the king of Prussia in moving it to Berlin. The building was dismantled, packed in crates, and put onboard a ship to sail across the Baltic Sea to present-day Szczecin, Poland. Plans changed again, this time at the urging of a Prussian countess, and the package was floated on barges down the Oder River and carted overland to the mountain-side town of Krummhübel, Prussia, present-day Karpacz, Poland, where the building was erected anew in 1844.

Stave construction seems to be a uniquely Viking technology that evolved from methods the forest-and-fjord dwellers devised for building ships. Essentially, it's a post-and-beam structure formed from all-heart Norway spruce and Scots pine that the builders prepared by lopping off the branches of living trees in early spring so the trees would bleed sap and concentrate resins in the heartwood. Once frost-hardened, the trees were felled in early winter, yielding a pitch-infused, extra-rot-resistant wood. Walls were formed from thick vertical boards that were "fish-joined" (an arrow-and-groove-type edge joint) to each other, and the ends dovetailed into horizontal sills that rested high and dry on gravel beds and granite footings.

Though they had never seen such a building, the local builders, also forest dwellers, were no strangers to building timber structures with the same four essential tools—ax, chisel, auger, and drawknife—that the original builders had used. Using the weatherworn parts as templates, they fashioned most of the building from local woods and kept only the pitch-soaked posts, sills, and trussed rafters, which, to this day, remarkably still give off a scent of tree pitch.





The Kościół Wang, as it is locally known today, is a Norwegian "stave" church dating from around 1200 that was moved in 1842 to Karpacz, Poland. There are no metal fasteners except in the domed copper roof, gutters, and some flashings. Even the wall and roof shingles are doweled in place.

Photos by Clayton DeKorne

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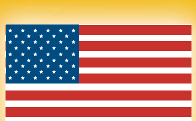

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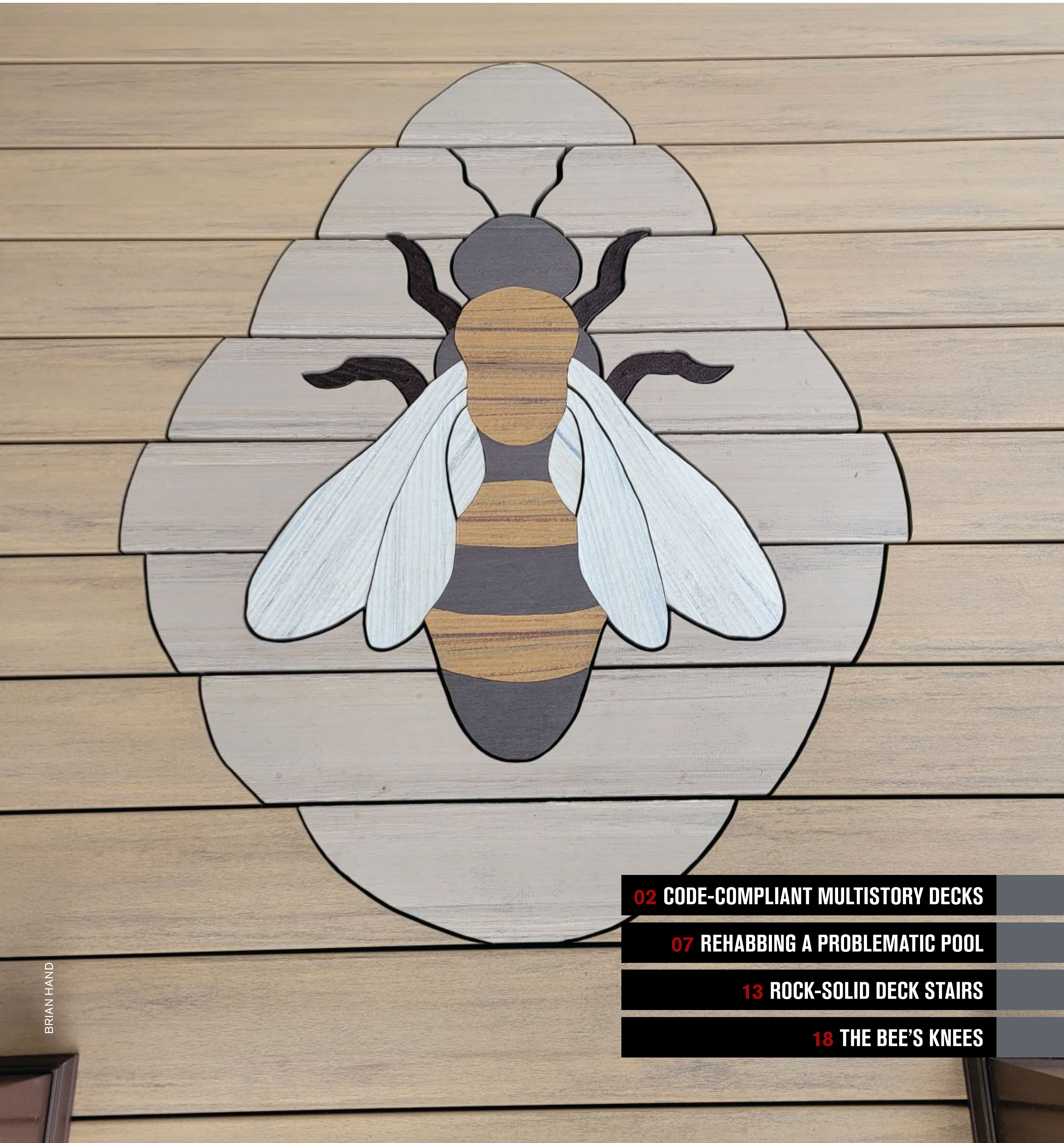

BRIAN HAND

A Code-Compliant Approach to Multistory Deck Construction

by Scott Coffman, P.E.

Residential decks have become increasingly elaborate to include covered wood-framed structures one or more stories in height. Unfortunately, the model building codes have been slow to adopt comprehensive prescriptive deck construction guidelines, with the 2021 International Residential Code (IRC) continuing to limit such guidelines to decks with a single, uncovered level. However, once you understand and can properly apply the tributary-area approach contained within IRC tables, you can use it to size deck footings and select deck columns or posts for covered and multilevel decks.

Understanding Common Errors

One of the main challenges presented by covered and/or multistory deck design is the vertical and lateral-load development of the free-standing posts. You don't want to use platform construction with posts installed at each story, because decks don't have structural wood panels (for example, OSB or plywood) to provide long-term stability, as a typical platform-framed structure would. In addition, the typical nailed connections at post ends are insufficient to resist lateral deck movement and uplift forces (**Figure 1**).

Vertical loads need to be transferred through the floor framing to the footings, and the beam-to-post connection must be sufficient to resist both lateral and vertical uplift forces, a crucial detail that's often overlooked in the construction of multilevel or covered decks. In this article, I'll describe a simplified design and construction approach using continuous posts that will provide lateral stability and ensure a continuous load path from the foundation to the uppermost floor or roof level.

Figure 1. Discontinuous posts don't provide adequate resistance to uplift and lateral forces on a multilevel deck.

Deck Post Sizing

Let's look at a typical two-story covered deck, as shown in **Figure 2**. The roof and floor framing are supported by beams at each level that are connected to the house and three posts across the front. The residential floor live load is 40 pounds per square foot (psf) with a 20-psf roof live load. The deck dimensions are 8 feet by 24 feet with a 1-foot roof overhang, and the maximum vertical distance between the support beams is 9 feet, which is used to determine the post height.

Tributary area. In the illustrations on the facing page, I show the tributary areas at each deck level that are supported by one of the corner posts (at left) and by the center post (at right). When you use the deck post sizing table (Table R507.4) in the 2021 IRC, the tributary areas for each level and the roof, including cantilevers and overhangs, must be added together. On our deck, each corner post supports a tributary area from the truss roof of 65 square feet, which includes the overhangs, and a tributary area of 24 square feet at each floor level. To find the total tributary area supported by each corner post, add the tributary areas for the roof and the two floors: 65 + 24 + 24 = 113 square feet.

Because of the truss roof, the center post supports only the first and second floors. The area on each floor supported by the center post measures 4 feet by 12 feet, so the calculation to find the total tributary area is 48 square feet x 2 = 96 square feet. Because the 113-square-foot tributary area supported by each corner post exceeds the area supported by the center post, I use the corner-post tributary area to size all three posts.

IRC Table R507.4 shows deck post sizes based on load, wood species, tributary area, and maximum post height allowed (**Figure 3**). For the load, I use the larger of the floor live load or ground snow load. From the table, a southern pine 4x6 post would be sufficient to support a 113-square-foot tributary area with a 40-psf live load or ground snow load for the building location and a deck post height less than 9 feet 8 inches. If a square post is preferred for aesthetic reasons, you could use a 6x6. Remember, a one-piece post ensures the load path is continuous to the footing as required by the code.

PHOTOS AND DRAWINGS BY SCOTT COFFMAN, EXCEPT WHERE NOTED

In this example, 20-foot 6x6 corner posts are selected and must be continuous from the top of their concrete footings to the second-floor ceiling. The posts are braced by the intersecting beams at the floor and roof level, resulting in unbraced lengths between levels that are less than the 14-foot maximum table value for 6x6s. (For more on sizing deck posts, see "Better Deck Post Sizing" by Glenn Mathewson, *JLC/PDB*, Mar/22.)

Post footings. The same tributary-area approach used for sizing the deck posts can also be used to size the post footings, this time by referring to 2021 IRC Table R507.3.1. You will need to first identify the soil's load-bearing capacity to then determine the appropriately sized square or circular footing. (For more on sizing footings, see "Better Deck Piers" by Mike Guertin, *PDB*, Feb-Mar/15). For soil with a 2,000-psf load-bearing capacity, a live or ground snow load of 40 psf, and a 120-square-foot tributary area, you would use a 21-inch-square or 23-inch-diameter footing that's 7 inches thick.

Framing. The prescriptive tables in the IRC may be used to select rafters, joists, beams, and decking, but covering those in detail is beyond the scope of this article. However, when you're

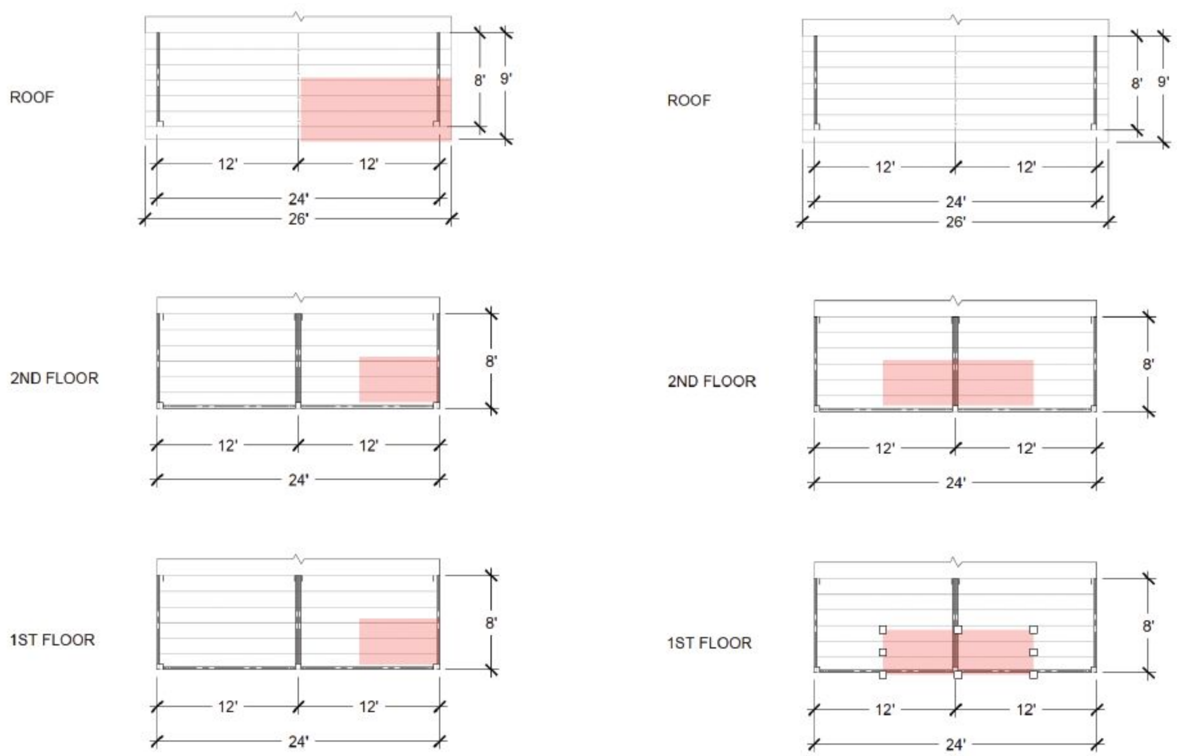

Figure 2. Shaded above, at left, are the tributary areas supported by a corner post of the two-story 8-by-24-foot covered porch shown in the photo (top). The total tributary area supported by each post is 65 sq. ft. (roof) + 24 sq. ft. (second floor) + 24 sq. ft. (first floor) = 113 sq. ft. Similarly, above, at right, the tributary areas supported by the center post are shaded. There are no loads on the center post from the truss roof, while the tributary areas on the first and second floors measure 48 sq. ft. each, for a total tributary area of 96 sq. ft. Tributary areas are used to size the posts and footings.

TABLE R507.4
DECK POST HEIGHT

LOADS (psf)[b]	POST SPECIES[c]	POST SIZE[d]	TRIBUTARY AREA (ft^2)[g, h]							
			20	40	60	80	100	120	140	160
			MAXIMUM DECK POST HEIGHT[a] (feet-inches)							
40 live load	Southern pine	4 × 4	14-0	13-8	11-0	9-5	8-4	7-5	6-9	6-2
		4× 6	14-0	14-0	13-11	12-0	10-8	9-8	8-10	8-2
		6 × 6	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0
		8 × 8	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0
	Douglas fir[e] Hem-fir[e] Spruce-pine-fir[e]	4 × 4	14-0	13-6	10-10	9-3	8-0	7-0	6-2	5-3
		4 × 6	14-0	14-0	13-10	11-10	10-6	9-5	8-7	7-10
		6 × 6	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0
		8 × 8	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0
	Redwood[f] Western cedars[f] Ponderosa pine[f] Red pine[f]	4 × 4	14-0	13-2	10-3	8-1	5-8	NP	NP	NP
		4 × 6	14-0	14-0	13-6	11-4	9-9	8-4	6-9	4-7
		6 × 6	14-0	14-0	14-0	14-0	14-0	14-0	13-7	9-7
		8 × 8	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0

Figure 3. After calculating the tributary area and load, use 2021 IRC Table R507.4 to size posts according to height and wood species. In this example, with a maximum tributary area of 113 square feet and a 40-psf live load, either 4x6 or 6x6 southern pine posts could be used for the porch's corner and center posts.

TABLE R802.11
RAFTER OR TRUSS UPLIFT CONNECTION FORCES FROM WIND (ASD) (POUNDS PER CONNECTION)[a, b, c, d, e, f, g, h]

RAFTER OR TRUSS SPACING	ROOF SPAN (feet)	EXPOSURE B									
		Ultimate Design Wind Speed V_{ULT} (mph)									
		110		115		120		130		140	
		Roof Pitch		Roof Pitch		Roof Pitch		Roof Pitch		Roof Pitch	
		< 5:12	≥ 5:12	< 5:12	≥ 5:12	< 5:12	≥ 5:12	< 5:12	≥ 5:12	< 5:12	≥ 5:12
24″ o.c.	12	96	86	118	106	140	128	190	176	244	226
	18	118	104	148	132	178	162	244	224	314	292
	24	142	124	178	158	216	196	298	274	384	356
	28	158	138	198	176	242	218	334	306	432	400
	32	172	150	218	194	268	240	370	340	480	444
	36	188	164	240	212	292	264	406	372	528	488
	42	212	184	270	240	332	298	460	422	600	556
	48	236	204	302	268	370	332	516	472	672	622

Figure 4. While probably not familiar to most deck builders, 2021 IRC Table R802.11 can be used to determine uplift loads on the deck-post-to-roof-beam connection. As shown in the shaded area, the uplift force for each truss connection is 356 pounds, or 178 pounds per foot along the length of the beam supporting the roof trusses. The total uplift load on the post = 178 x 5 (half the beam span + 1-foot overhang) = 890 pounds.

sizing the roof framing members, it's important to know the ultimate design wind speed and the building exposure category.

Similarly, floor joists and beams may be selected from the Exterior Decks section of the code (R507). Size members for the appropriate live or ground snow load shown in the table. You'll need to calculate the support beam's load to the post to select the correct manufactured-beam-to-post connector.

Deck Post Connections

The connections are the most critical component of multilevel and covered decks and must be designed to resist gravity, uplift, and lateral loads. Roof beams should be connected to the post based on an uplift load that may be determined from IRC Table R802.11 (**Figure 4**).

In our example, the truss roof has a 5:12 slope and 24-foot span, and trusses are spaced 24 inches on-center. The building is located in a 140-mph ultimate-wind-speed zone with an Exposure Category B. According to Table R802.11, the truss-to-beam tie-down connector should be sized to resist 356 pounds. The beam uplift force to the post may be calculated by dividing 356 pounds by the truss spacing (2 feet) to arrive at a load of 178 pounds per foot. The tributary roof length to the post is equal to the 12 inches of the overhang plus half the 8-foot beam span, or 5 feet. The total uplift load to the post end is then 890 pounds (178 pounds x 5 feet). A post cap or notch (with fasteners checked for uplift) as shown in IRC figures R507.5.1(1) and R507.5.1(2) should be used at the topmost post elevation to attach the beam (**Figure 5**).

Each floor beam should be attached with a manufactured connector to a post that's continuous through the floor cavity. The load for connector sizing can be calculated by taking the tributary area at each level multiplied by the sum of the

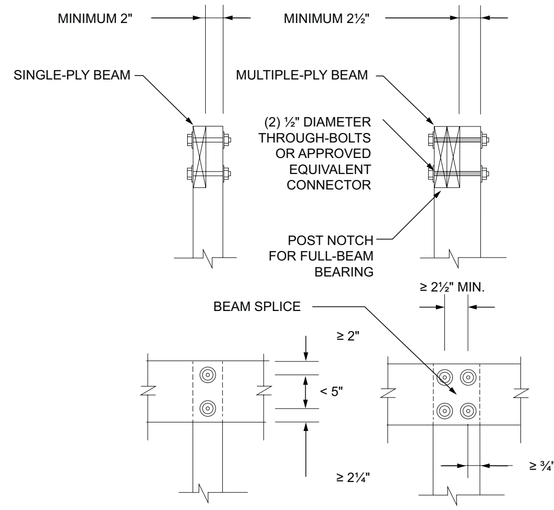

Figure 5. Metal connectors help keep posts and beams aligned at this critical load-path connection but also play an overlooked role in resisting uplift loads (photo, left). The fasteners should be checked per Figure R507.5.1(2) in the 2021 IRC for a covered-deck uplift load (illustration, right).

FIGURE 5: GREG DIBERNARDO

floor live load or ground snow load plus 10 psf (in published tables, code assumes the weight of the deck framing members is 10 psf). In our example, the second-floor center beam has a tributary area of 48 square feet (12 feet x 4 feet). The beam load to the center post is 48 x (40 + 10), or 2,400 pounds. Roof gravity loads are determined in the same manner.

Beams at each level should be connected to the post face with manufactured hardware sized for the calculated beam load to the post (**Figure 6**). The post needs to be wide enough for the attachment, which—depending on the hardware—may require you to increase the size of the post. Steel hardware should have corrosion protection for the environmental conditions anticipated and meet a minimum of G185.

The post should be connected to the footing with a manufactured connector or embedment into the soil or concrete (see IRC Figure R507.3 for prescriptive post-to-foundation details). When choosing a post-base connector, be sure the manufacturer's published gravity and uplift values exceed the calculated roof- and/or floor-beam loads to the post. In our example, the roof-beam loads to the post are 2,100 pounds downward (gravity) and 890 pounds uplift. Additionally, floor-beam loads to the post are 1,200 pounds downward at each level. Therefore, the post-base connection should have published capacities that exceed 4,500 pounds downward (2,100 + 1,200 + 1,200) and 890 pounds uplift.

Finally, remember that to resist lateral loads, a multilevel deck or porch will need to be connected to the building with one of the methods shown in IRC R507.9.2. These tension devices (either two devices with a stress design capacity of not less than 1,500 pounds, or four devices with a 750-pound capacity) are required at the roof and each floor level.

While the IRC may be used to design the deck framing members for a multistory or covered porch following this simplified approach, a licensed engineer or architect can help to optimize the members and connectors. Additionally, design professionals can assist in the selection of engineered posts or in the design of built-up posts when lengths exceed what is readily available for solid-sawn posts. ❖

Scott Coffman, P.E., is a senior engineer with REI Engineers in Westminster, S.C. He provides forensic engineering services based on over 40 years of experience in structural wood design.

Figure 6. When connecting beams to continuous posts, choose metal hardware sized to fit the posts as well as for the loads. Here, the connectors have inward-turning flanges.

Rehabbing a Problematic Pool

by Dave Settlemyer

A new curved deck that steps down to water level is the centerpiece of this pool rehabilitation project, located in Longmont, Colo. The deck is framed with $1^1/_2$-inch-by-$5^1/_2$-inch pressure-treated Pacific Woodtech LVL joists 12 inches on-center, while the bottom step that cantilevers out over the pool is framed with Trex Elevations steel joists.

PHOTOS BY DAVE SETTLEMYER

As a designer and builder of outdoor living spaces, my responsibility transcends aesthetics; it extends to foreseeing potential issues and crafting solutions that resonate with both form and function. One particular project that exemplifies this approach stands out—a new construction build less than a year old, teeming with issues that threatened to overshadow its potential. The original contractor who built the pool and pool deck abandoned the project at its conclusion and at the onset of apparent problems. My company was contacted to see if we could fix them.

During our initial consultation, it was clear that this project was fraught with problems, from elevation discrepancies to improper watershed drainage. Standing water plagued the lawn, fostering mold and causing unsightly dying areas, while the flawed pitch of the poured concrete flat work surrounding the pool directed water runoff into the pool, bringing along debris and soil during heavy rains.

To me, however, the most alarming problem was the compromised transition from the back porch to the concrete walkway leading to the pool deck. Here, an in-ground hot tub was located, and while it was convenient to the house, the spa interrupted drainage, causing a puddle of water to form over a large area. Even worse, in colder months, any standing water would freeze into ice, creating a safety risk for our retired client.

While the client contemplated a complete overhaul, the notion of discarding a newly constructed pool seemed impractical and economically unfeasible. Armed with a background in landscape architecture, I was confident that we could come up with a transformative solution that would address the

Drainage problems plagued the existing pool (A), which the author addressed with a new stone overlay pitched away from the pool, new drain lines, and re-grading (B). The existing spa interrupted travel between the house and the pool (C), and water tended to pool around its base, freezing in winter and creating a safety issue. The author expanded the patio and porch deck to provide better access and corrected the pitch when installing the stone overlay (D).

project's challenges without resorting to drastic measures.

The property's constraints, including setback requirements and unalterable travel paths, necessitated a strategic approach. Instead of starting from scratch, we leveraged the existing layout, maximizing its impact while minimizing excavation and removal efforts. The result was a design that integrated a deck shaped like a half-moon nestled amidst a grove of aspens and Bosnian pines, offering a serene oasis that defied the property's limitations.

Site Work

To correct the drainage issues, we did some grading work in the yard. We also installed additional drainage lines, using water catch basins and underground corrugated piping.

To divert water away from the pool, we added a stone overlay with the proper pitch to the pool deck. By locating thicker stones in the lower areas and thinner stones in the higher areas of the original flat work, we were able to resolve the patio grade without having to rely on an extra-thick mortar bed under the stones.

We also expanded the existing footprint of the pool deck by adding flat work to accommodate curved lines and

Access to the spa was improved by extending the porch with new TimberTech decking installed over sleepers fastened to the concrete and adding wider curved steps on either side of the spa.

seamless transitions across the project. This required excavating all the top soil to an 8-inch subgrade, adding 4 inches of compacted 3/4-inch road base, and pouring new, 4-inch-thick slabs doweled into the existing patio.

The stone overlay expands on the existing concrete and bridges these additions, hiding them from view with the pattern of the random ashlar layout of the stone.

Curved Pool Deck

The new curved pool deck is the central element in our redesign. Supported by strategically located deck piers, the curved deck features a cantilevered step transition down into the pool and required an engineered design.

To execute the plan, we needed to core-drill through the existing concrete patio and carefully excavate to avoid damaging the buried pool utility lines when we were installing new piers. In a couple of cases, we had to adjust the pier locations to avoid those utilities, and we ended up adding a pier to the original plans.

Framing. We used Pacific Woodtech(pwtewp.com) treated LVL engineered lumber to frame the flowing curves of the deck itself, but providing a 30-inch cantilever over the pool edge required the use of steel. Here, we used Trex Elevations steel joists, which were the right dimension to provide the 2-inch drop down below the pool's coping edge (just above the elevation of the automatic pool cover) to provide a proper step down into the pool. Although Elevations has been discontinued by Trex, we were able to source the material through our supplier's discontinued material pile.

To provide solid support for the deck's cantilever, we bolted a 2-by pressure-treated resting plate to the pool apron using 1/2-by-7-inch wedge anchors. The distance of the cantilever support required us to bolt to the existing concrete patio surround. The step depth needed to be 5 feet overall to have a 20-inch cantilever, per engineering. Cutting, welding, and shaping the hard material allowed us to make sure the pool's auto cover would still be able to operate under the stair edge.

The pool deck's design focal point is a symmetrical arrangement of fire features. The linear fire pit, centrally positioned, serves as an inviting gathering spot. A pair of flickering stone fire bowls flank either side of the deck on top of raised stone columns and contrast with the lush backdrop to create a visually striking yet harmonious structure. Together, the fire features extend the space's usability into the cooler evening hours.

The author widened the existing concrete patio around the pool to make room for this curved planter, then installed a natural stone overlay in a random ashlar pattern, using a combination of different thicknesses of stone set in a mortar bed to correct the pitch so that water now drains away from the pool instead of into it.

Similar stone columns and carefully selected black-stained 8x8 western red cedar posts support the 20-foot-dead-span pergola. We used 5 1/8-by-16-inch Alaskan yellow cedar for the beams and red cedar for the rafters.

Material selections. We used TimberTech decking in the company's coastline hue, harmonizing its warm undertones with the TimberTech dark-hickory accents to create a cohesive transition between the deck and adjacent pool area.

For the pool deck's stone overlay, we used three colors of a natural stone imported from India and supplied by Stone Universe (suistone.com). The main colors are ebony (the swirled-color stone) and grey mist (the light gray stone), while the dark gray border stone is called dark slate (see photo, above). To correct the pitch in the existing pool deck (as described earlier), the stone ranged from 1 inch to 2 inches in thickness. In addition to correcting the pitch as we installed the stone, we tried to blend appealing tones in a random pattern encompassed by a solid-color border to mimic the appearance showcased in the deck.

The natural stone veneer that we used for the columns is called "dark horse" by our supplier. It comes from an unnamed Oklahoma bluestone quarry (our supplier renames all of its sourced stone).

Porch and Spa

At the house, we bridged the existing raised concrete patio to the spa with the same TimberTech decking used on the pool deck. We fastened the decking to Deckorators sleepers screwed to the concrete with 1/4-by-4-inch Tapcons. We also built an elegant curved staircase using heat-bent deck boards. This improved accessibility to the built-in spa and echoes the flowing curves of the pool deck.

As day transitions into evening, the space undergoes a subtle transformation, revealing new layers of ambiance and functionality. The meticulously crafted stonework, flickering fire bowls, and black-stained cedar pergola columns enhance the space's aesthetic appeal, fostering unity and harmony. By addressing complex challenges with creativity and expertise, we transformed a problematic space into a harmonious oasis that resonates with beauty, functionality, and enduring appeal. ❖

Dave Settlemyer owns LS Underground in Longmont, Colo.


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PHOTOS BY TIM UHLER

Rock-Solid Deck Stairs

Concrete treads supported by solid 4x12 stringers add up to a sturdy set of no-slip stairs

by Tim Uhler

There's a lot to be said for uncut stringers. For one thing, they are stronger than cut stringers and make it possible to build stairs with longer spans without intermediate supports. And if the tread material is strong enough, a 3- to 4-foot-wide stair will require only two stringers. That's not possible with composite tread stock, of course, and, even with 2x12 treads, the stairs would be limited in width to 36 inches. But by using concrete treads and 4x12 solid stringers, we can build exterior stairs as wide as 48 inches that are strong, visually appealing, long lasting, and less expensive than cut-stringer stairs.

At first glance, front porch stairs may look a little unconventional with uncut stringers and concrete treads, but we've been building them this way for more than 20 years and have found that not only have the ones that we've built performed well over this time, but they also look like they will last decades more with minimal maintenance.

Concrete Treads

We source stock precast concrete treads from Puget Sound Precast (psprecast.com). They're made with 4,000-psi concrete reinforced with a grid of #2, #3, or #4 rebar (depending on the size of the tread) and have four threaded inserts—two at each end—embedded in the bottom for 3/8-inch-diameter bolts. A pair of galvanized L-brackets, which bolt to the inserts and the stringers, are included with each tread to support it.

On this project, we used stock treads with an exposed aggregate finish (a broom finish and custom finishes and colors are also available). The 42-by-12-by-2 1/2-inch treads weigh 105 pounds each; other stock sizes range from 36 to 48 inches in length. The treads we bought cost about $58 each, which included the galvanized brackets, lag screws for fastening the brackets to the stringers, and machine bolts for fastening the treads to the brackets.

Determine Elevations and Rise

As with any set of stairs, we began by establishing the elevations at the concrete landing and the surface of the porch decking using a Stabila LAX600G cross-line laser to measure the total rise,

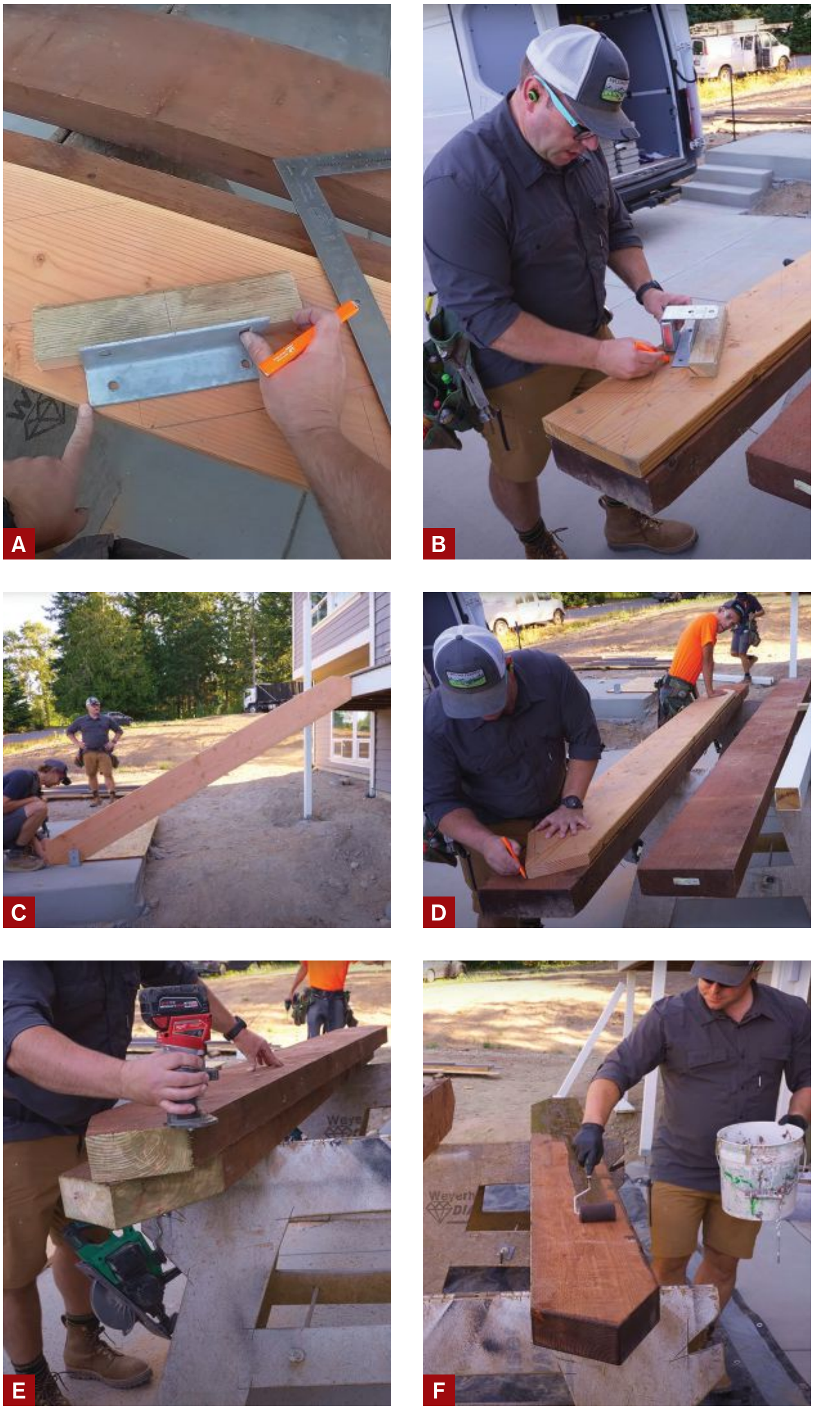

Figure 1. After marking the sawtooth tread-and-riser pattern on a 2x12, the author aligned a mounting bracket and tread block with the bottom edge of the template at each tread location (A), then marked and drilled pilot holes for the mounting screws. At the base, he had to adjust the layout to account for the height of the mounting hardware (B). After checking the fit (C), the author used the template as a pattern to lay out and cut the 4x12 stringers (D), then eased all the edges with a ¼-inch-diameter roundover bit (E) and applied wood preservative on all surfaces with a roller (F).

which in this case was $64\frac{3}{16}$ inches. Because of the open-riser design of these stairs, we needed to limit the riser opening between treads to less than 4 inches to comply with code (see 2021 IRC R311.7.5.1, which says that any riser opening located more than 30 inches above the floor below must not allow the passage of a 4-inch-diameter sphere). Since the treads measure a full $2\frac{1}{2}$ inches thick, our maximum rise height needed to be less than $6\frac{1}{2}$ inches.

Our plan was to use 10 treads, so I divided the total rise ($64\frac{3}{16}$ inches) by 11 (10 treads plus the last riser). This resulted in a rise of $5\frac{3}{16}$ inches, which met our requirement that the rise be less than $6\frac{1}{2}$ inches.

For the stair stringers to be located properly on the landing, the total run needed to be close to 96 inches, or about 8 feet. To keep things simple, I used a run of 10 inches, the minimum required by code, for a total run of 100 inches.

Stringer Layout

Using the same approach I would for laying out a cut stringer, I set up a framing square with a pair of stair gauges for a rise of $5\frac{3}{16}$ inches and a run of 10 inches. But instead of aligning the framing square with the top edge of the stringer, I aligned it against the bottom edge as I stepped off and marked the sawtooth pattern for the treads and risers (the treads can be oriented toward either the bottom or the top edge of a solid stringer without having any impact on its strength; with a cut stringer, a minimum of 5 inches of solid material is required between the bottom edge of the stringer and the corners of the notches).

I marked the layout on a 12-foot-long 2x12 that I could use as a template instead of marking one of the incised 4x12 stringers. This way, I could clearly see my layout marks and easily make corrections without worrying about disfiguring an expensive and heavy 4x12 timber.

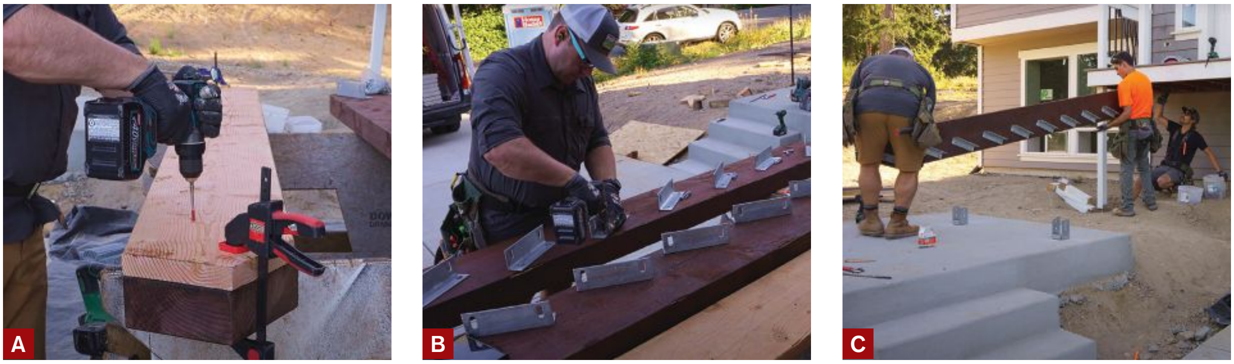

Figure 2. The author clamped the template to each stringer and used it as a guide to drill pilot holes for the mounting brackets (A), which were fastened to the stringers with 3/8-inch-diameter lag screws (B). The stringers bear on brackets bolted to the concrete landing (C) and are fastened to the porch with structural screws driven through a doubled rim joist (D). Here, the author is using an impact driver to tighten one of the bottom tread brackets (E).

Template. After marking the sawtooth tread-and-riser pattern on the template, I extended the horizontal tread lines all the way across the 2x12. Next, I marked the center of one of the steel tread support brackets and the center of a tread block that I made from a 2 1/2-inch-wide offcut from a 2x12 to match the thickness and depth of one of the treads. By aligning the centers of the bracket and the tread block with each other, and then aligning the corner of the bracket with the bottom edge of the stringer template while lining up the top of the tread block with the tread lines, I was able to accurately mark the mounting holes for the brackets onto the template.

Instead of using a pencil to mark the hole locations, I simply positioned one of the 3/8-inch-diameter lag screws in the mounting holes and tapped it with a hammer to make dimples in the surface of the template. This is a fast way to mark holes, and the dimples help prevent the drill bit from wandering off course when you're trying to accurately locate drilled holes. Then I drilled 1/4-inch holes all the way through the template at each marked location.

To complete the template layout, I marked the position of the back edge of the top tread where it will touch the rim of the deck. I added 1/4 inch to this mark to provide for drainage between the tread and the rim, then marked the plumb cut at the top of the stringer. I marked the horizontal cut so that the stringer would fit snugly under the nosing of the porch decking and maintain a consistent 5 3/16-inch riser height from the top tread to the porch decking.

At the bottom, instead of bearing on the concrete landing, the stringers are fastened to Simpson Strong-Tie ABU44Z brackets bolted to the concrete. Here, I had to adjust the horizontal cut across the bottom of the stringer to account for the 1 1/8-inch height of the bracket base.

Solid stringers. After completing the cuts at the top and bottom of the stringer template, we tested the fit to make sure that the layout was correct before transferring the pattern to the 4x12x12 stringer stock. Then I cut two identical stringers using a 10 1/2-inch circular saw capable of completing a cut through 4-by stock in a single pass. When you're working with pressure-treated stock, it's always a good idea to order longer lengths than required so you can avoid the knots and cracks that sometimes are found at the ends of the stock. Using the stringer template overlaid on top of the stringers as a guide, I drilled the holes for the lag screws that we'd use to fasten the brackets to the stringers.

Incised PT Doug fir is a little rough looking, so I used a router to ease all the edges on the stringers with a 1/4-inch-diameter roundover bit to dress them up.

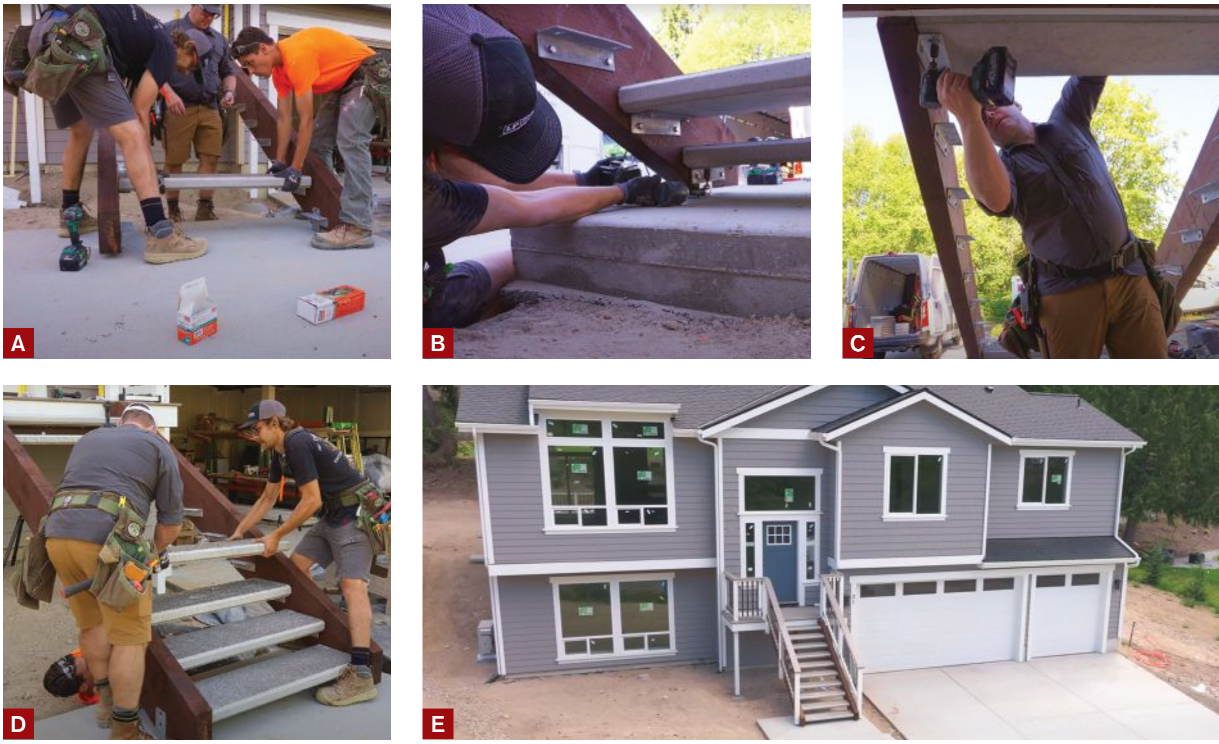

Figure 4. Each concrete tread weighs 105 pounds, making it a good idea to enlist help when placing the treads into position (A). There are threaded inserts cast into the ends of each tread for the supplied galvanized machine bolts that fasten the treads to the brackets (B). After installing the bottom and top treads (C), the crew installed the remaining ones, maintaining a ¼-inch gap between the ends of the treads and the stringers for drainage (D). A Deckorators baluster and rail system was used to complete the stairs (E).

To meet code, all cut edges in PT lumber have to be field-treated with an approved wood preservative anyway, so I rolled a coat of Copper-Green brown wood preservative on all surfaces of the stringers to protect them and to give them a uniform look. After the coating dried, I clamped the template to each stringer and used it as a guide to drill the pilot holes for the mounting brackets.

Installation

When I screwed the brackets to the stringers, I left the bottom brackets a little loose so that they would fit over the legs of the metal bases that we had already bolted to the landing slab. Where the stringers meet the porch, we drove Simpson Strong-Tie SDWS timber screws through the doubled rim joist and into the stringers to make the connection.

Treads. With the treads weighing 105 pounds each, it's a good idea to use two workers to set them in place on top of the brackets. We started with one of the bottom treads, leaving a gap of about 1/4 inch between the ends of the tread and the stringers for drainage. When installing the lowest tread, we needed to use a right-angle impact driver to tighten the bolts that fasten the brackets to the treads.

Next, we bolted the top tread in place, finger-tightening the bolts at first and then adjusting the gaps before completely tightening the bolts with an impact driver so that the stringers remained parallel with each other. As we installed the remaining treads, we repeated the procedure to keep the stringers aligned.

To complete the stairs, we installed a Deckorators square baluster and rail system. We also reinforced the rim joist with another concrete pier and support post centered in the middle of its span to support the substantial weight of the stairway and keep it from moving over time. ❖

Tim Uhler is a lead carpenter for Pioneer Builders in Port Orchard, Wash. He is a contributing editor to JLC *and* Tools of the Trade. *Follow him on Instagram at @awesome framers, subscribe to his YouTube channel, or visit his website: awesomeframers.com.*

A whimsical bee inlay greets visitors to this New Hampshire home (A). To make the inlay, the author transferred the design onto plywood, cut out the individual pieces with a scroll saw, then reassembled the pieces on a piece of plastic so that he could show the design in full scale to his clients (B). Arrows marked on the patterns indicate the grain orientation on each wing. Shown here (C) is the reverse side of the assembled inlay, after the author used the plywood patterns to cut the 36 individual pieces out of decking on a shaper table. Pocket screws join the pieces together. After removing the existing porch decking, the author added PT blocking for the inlay and covered the blocking and tops of the joists with peel-and-stick membrane. Here (D), the new decking has been installed with a cutout to accommodate the inlay. The author face-fastened the assembled bee and the pieces that make up the hive to the blocking (E), then later filled in the holes with Cortex plugs that matched the color of each individual piece.

The Bee's Knees

by Brian Hand

The honeybee inlay shown here was a key part of a recent entry porch makeover for a family of avid beekeepers. To create the double inlay of a bee within a hive, I found an image of a bee online and projected it full-scale onto a piece of paper marked with deck-board spacing. I traced the outline and the body parts and wings, labeled the parts, then cut out the design to transfer it onto a piece of 1/4-inch plywood.

I used a scroll saw to cut the plywood into pattern pieces that I then attached to the decking material. As I did so, I carefully matched each pattern piece to the associated decking color and grain orientation indicated on my original design, then used a shaper table to form the final 36 inlay pieces.

Because I needed to use decking material of different thicknesses to get the colors I wanted, I used pocket screws to keep the face in plane while screwing the body together, then padded out the backs of the thinner pieces with 1/16-inch PVC material. To give the wings a natural look, I not only used the differences of the grain but also created a gap to differentiate the wings. The antennae are simply gaps cut strategically within a few hive pieces. Each individual piece of the hive was rounded on the outer edge to form a stylized image of how many people conceive hives to look. ❖

Brian Hand owns Homes & More by Hand in Manchester, N.H. Follow him on Instagram @homes_by_hand, or find him at Dynamic DeckInlays.com.

PHOTOS BY BRIAN HAND