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On the cover: James Mahony of Dennis, Mass., lays down a sheet of interlocking pebbles on the floor of a walk-in shower. The curbless shower floor slopes down to a linear drain. See the story on page 31. Photo by Roe Osborn.

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DEPARTMENTS

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Q How do I anchor a wood post to old poured-concrete porch steps?

A Don Boivin, a contractor and craftsman from Hyannis, Mass., responds: There are many options for anchoring a post to existing concrete, but the trick for choosing the right anchor is gauging the condition of the concrete. If the concrete is older and unstable, some anchors might be more effective than others. Unfortunately, I know of no good, inexpensive way for a remodeler to test the strength of concrete.

Be aware that by code, guardrails are required when walking surfaces are 30 inches or more above grade, and the posts must be able to resist 200 pounds of lateral pressure. In such cases, it is best to consult an engineer, but even then, it would be difficult to gauge the integrity of the concrete without some method of testing.

Recently, I was able to try several different anchors while installing some posts on a set of old concrete steps. The highest walking surface of these concrete steps was less than 30 inches above grade, so code regulations did not apply.

I could not use surface-mounted post anchors (on the tread surface of the step) because the bolts would have been too close to the edge of the concrete and the width of the steps would have been compromised. Instead, I used the anchors to attach the 4x4 treated posts directly to the sides of the steps, where there was more concrete to bite into.

The first anchors I tried were hefty 1/2-inch-by-6-inch wedge anchors—two for each post. Wedge anchors fit into drilled holes, and tightening a nut on one end of the anchor forces a sleeve on the other end to expand against the sides of the hole, securing the bolt—and the post—in place **(1)**.

I always try to keep fasteners safely away from the nose of the step, which is the weakest point of any step—wood or concrete. An easy way to locate and drill the holes for the anchors is clamping a short piece of 2x4 to the side of the 4x4 post to hold it temporarily at the desired height. After marking on the post where I want the bolts, I drill holes through the posts.

Then I set the post back into place, holding it plumb, and run a masonry bit through the holes in the post to mark the anchor locations in the concrete. Then it's just a matter of drilling the right diameter and depth holes at those locations. Always be sure to clean the dust out of the holes before inserting the anchors.

In this case, I discovered that the concrete was not solid enough for the anchors to tighten in the holes. My next option was anchoring the bolts in epoxy made specifically for concrete. I pushed the epoxy into the holes, bedded the bolts in the mix, and left it to set overnight **(2)**. Epoxy forms a tenacious anchor for the bolts, and it worked for the most part. But I was still not totally satisfied with one of the posts, so I installed an additional hammer-drive anchor **(3)**. Pounding on the center pin of the anchor causes the other end of the anchor to expand and wedge itself against the sides of the hole. For this project, the hammer-drive anchor solved the problem.

Three anchoring options: Epoxy, hammer-drive anchor, and wedge anchor **(1)**. Bolts epoxied into concrete **(2)**. Post attached with epoxied bolts and a hammer-drive anchor **(3)**.

Photos by Don Boivin


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BY CHRIS KLEE

Shiplap Trim Done Right

In the homes we trim, we often add visual interest to the interior by installing 1x6 or 1x8 shiplap siding. Whether used as wainscot in a basement or bathroom renovation, a feature wall for a plain room, a visual offset to a niche space for laundry, a coat rack, or a fireplace, or for an entire room, shiplap is a great alternative to plain drywall, and a profitable upsell.

The most common shiplap styles are tight gap and nickel gap. Technically not shiplap siding, tight gap is S4S 1x6 or 1x8 stock that is butted edge-to-edge, but it is lumped into the same design conversation, so I'll include it here. A tight-gap installation is more commonly used with rustic, rough-sawn, and knotty "barnwood"-style siding, though it also works with smooth, knot-free siding with a rustic style of paint.

Nickel gap, on the other hand, is rabbeted on the top and bottom so each piece overlaps the next, leaving a slight gap (about the width of a nickel) between the boards. Smooth-faced, painted nickel-gap poplar shiplap leaves nice, clean lines and accentuates a room—there's a reason it's popular on TV.

TERMINATIONS

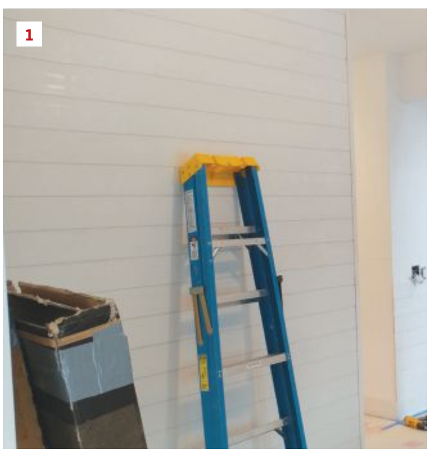
When we're working with shiplap, the starting and stopping points—or terminations—determine how we install it and what tools we reach for to get it done. In a square room with no outside corners, the terminations are pretty basic and the main layout challenge is to avoid visible "slivers" (more on that below). Most of the houses I trim, however, have an open floor plan with few places to end runs.

For example, when there is a run of shiplap down a hallway and the termination point is an outside corner, I like to butt the shiplap into a square stop that I mill from 5/4 stock **(1)**. On paint-grade trim, I sand the cut edges smooth to remove the table saw's swirl marks. For stain-grade work, I like to use maple, alder, and even white oak, cutting a shallow rabbet in the stop to cover the shiplap ends.

A table saw makes quick work of both cuts—rabbet and square. For the rabbet, I usually run one side, flip the 5/4 stock over and adjust the blade, and run the other edge. If there's a lot to run, it probably makes sense to set up a dado blade or even a router table with a straight-cut bit, depending on the scope of work.

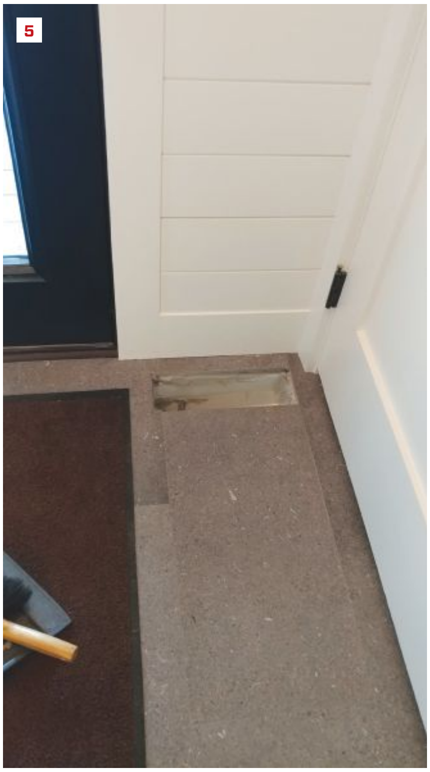
For mid-wall terminations, I like to run my stops square and butt to them, though if I'm worried about expansion and contraction—say, on a beach house—I might considering rabbeting both sides of the stop to cover the ends of the shiplap. For most of the shiplap we install, however, I think the butt joint leaves a cleaner look; I don't like the little holes the rabbet reveals where it covers the nickel gaps.

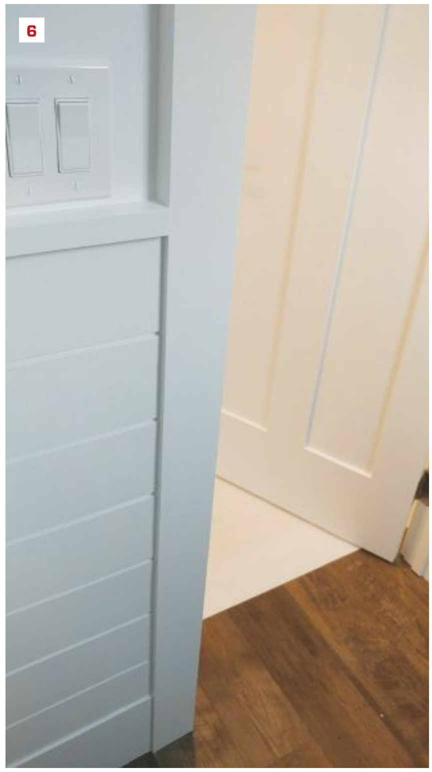
Another way to stop shiplap in the middle of a wall is to cut miter returns, as we did on a fireplace surround we recently completed **(2, 3)**. I cut the short return pieces on the flat with a sliding compound miter saw, then fastened them with glue and a 23-gauge pin nailer. Setting the bevel of the saw to slightly more



Photos by Chris Klee

Figuring out how to terminate runs and make transitions is one of the first things to get a handle on when adding shiplap siding to a room. At outside corners, the author typically butts the shiplap into either square or rabbeted stops **(1)**. To terminate a run of shiplap in the field, the author uses mitered returns cut flat on a sliding compound miter saw to hide end grain **(2, 3)**.





Miters can also be used to wrap outside shiplap corners and make transitions into other rooms **(4)**. Where the shiplap intersects with existing or to-be-installed trim elements, such as base and casings, the author either uses thicker, 5/4 stock for the trim, or packs the trim out so that it's proud of the shiplap **(5)**. When using shiplap as a wainscoting, consider device heights and how the switch plates will intersect with the shiplap or whatever top cap assembly is being used **(6)**.

than 45 degrees (like 46 or 47 degrees) drives the outside of the miters together, resulting in tighter joints.

This detail can also be used when wrapping the shiplap around a corner into another room **(4)**. To make sure there's nothing too irregular about the corner before I start, I check it with an angle finder like a Starrett ProSite protractor, which will tell me exactly how far the corner deviates from 90 degrees.

INTERSECTIONS AND TRANSITIONS

I typically install shiplap over drywall, so it can be tricky to figure out how this element fits with other wall trim, such as base moldings, door and window casings, and crown molding. Is the shiplap thicker than the casing? How do I transition to the base molding? Do I want the shiplap to butt into the base or lap over it?

The answers to these questions will vary based on context. For instance, to accommodate shiplap, it might not be worth tearing out the existing base molding in a renovation; on the other hand, in new construction, it might be worth adding a square stock base. There's no simple rule of thumb, but there are some easy options.

One approach is to apply a base made of thinner stock (typical base moldings measure 7/16 inch thick) over the shiplap, though it will then be necessary to figure out a detail where the base meets the door casing. The best way I've found to create reveals around the base without making it proud of the door casing is to pack out the base so that it protrudes just enough to clear the shiplap and form a shadow line. For example, a 1x6 packed out 1/8 inch is still behind the 5/4 casing but proud of the shiplap, and it blends nicely with the casing. To achieve the pack-out, I use Ram Board or Thermo-Ply to shim it. If your casing allows, you can use lauan plywood, which is around 3/16 inch thick **(5)**.

While I usually replace 1-by trim with 5/4 material to create a reveal where shiplap butts up against existing casing **(6)**, another option is to add a backband to standard 1-by trim. Your lumberyard probably stocks several different backband profiles, but it's not difficult to mill your own from 5/4 stock with a rabbet and some roundovers.

LAYOUT

Once the termination points have been laid out and the type (dado, butt, return) determined, it's a matter of nailing the shiplap to the wall. Almost. First, avoid slivers. You don't want to start running the shiplap and end up with a sliver at the top, or worse, a tapered sliver. So, a little math goes a long way.

I measure the wall height in a few places, measure the shiplap's face coverage plus the reveal, then—using a baluster-layout app called BalusterPro on my phone—divide to see how the pieces land. Depending on the width of the border piece, you can divide it in half—like tile or a suspended ceiling with even pieces on each end—or put the whole border piece on one end. Sometimes, it looks better to have the border piece at the bottom, sometimes at the top. It's personal preference **(7, 8)**.

Once I've figured out the starter-board dimension and ripped it to width, I use a laser to make horizontal reference marks around the room, and I find and mark the studs. Then I level the starter board, which I nail in place tongue side up with an 18-gauge brad nailer (in some cases, it's better to run the starter parallel with the ceiling, if the ceiling is out of level).

I face-nail along the bottom, then along the top through the tongue and into the studs. With nickel-gap shiplap, the nails have to be placed high in the tongue so they aren't visible in the gaps. On tight gap, there's no tongue, so face-nailing is the only option.

While tight-gap siding can be installed from the top down, we usually run it from the bottom up. At the top, we install a trim piece—either crown molding or a flat stop—to close the gap.

V-JOINT SHIPLAP

V-joint, or 45-degree shiplap, is a little trickier. It takes more patience, layout, and time to get it right. We start by measuring some reference lines off the ceiling and square them up using the 3-4-5 method (a laser level can be used instead). Both vertical and horizontal reference lines are needed to create an accurate 45-degree layout on the walls. Once the reference lines are established, I measure back using a framing square to establish the 45-degree angle and install the first piece. As I continue installing the shiplap, I keep checking along the way to make sure both sides of the V descend the wall at the same rate.

A laser is my friend for the V because the vertical line is so important. On a short wall, only a single, centered vertical layout line is required; on a longer wall with multiple V's, the verticals need to be laid out carefully depending on where the V points will be located.

After laying out the verticals and snapping those lines, I lay out and snap a few horizontal lines for reference. It doesn't matter where the horizontals are located as long as the shiplap tips on either side of the verticals are the same distance from the horizontal reference line. As each course is installed, I keep measuring from the line to make sure the layout is staying true.

Chris Klee is a finish carpenter for Bay Area Contracting in Traverse City, Mich.

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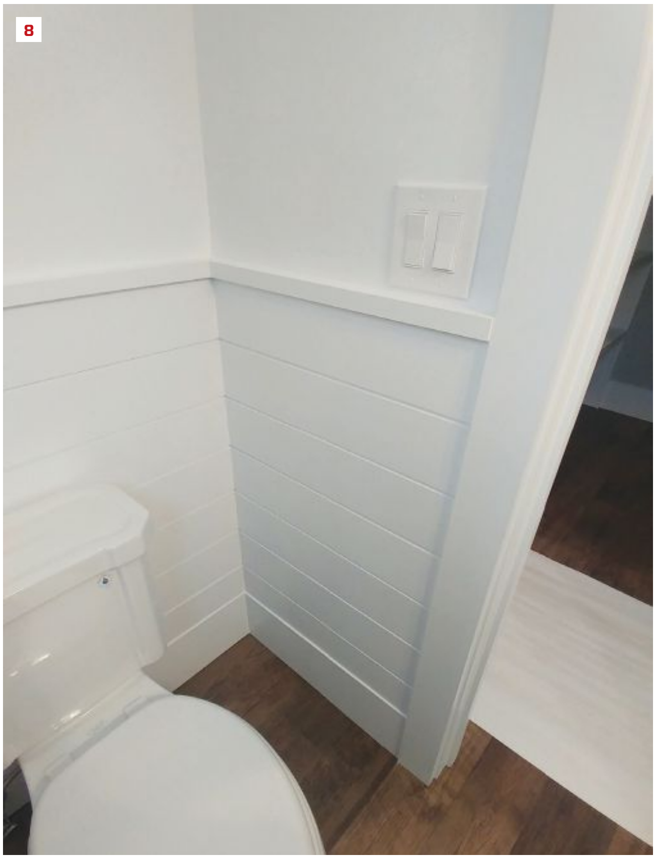


The author plans layout to avoid "slivers," or narrow lengths, at the top or bottom of a horizontal run when installing shiplap within a shelving unit **(7)** or as wainscot **(8)**.

Installing a Composite-Railing Kit

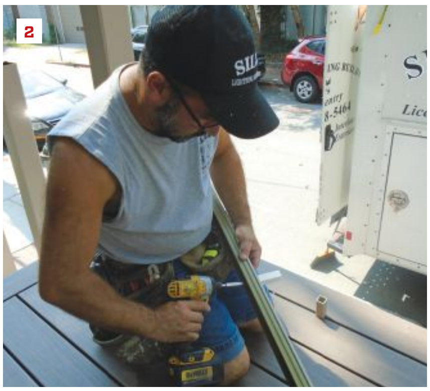
BY EMANUEL SILVA

I've installed a number of different manufactured rail systems, but on this project, my clients selected an RDI Transform composite railing, whose traditional look was a good fit for the character of the house. It has a two-part design that allows it to be installed without any visible mounting brackets or fasteners connecting the balusters to the rails or the rails to the posts. (Every rail system has its own quirks and assembly details, so I'm always careful to save and follow the manufacturer's instructions.)

Strong posts. Because of zoning regulations, the replacement porch occupies the same footprint as the old one. When I reframed it and installed new posts, I used plenty of blocking and metal hardware as required to ensure that the posts were strong enough to meet code. Most rail installation instructions are vague on these details, but the strength of any rail system is dependent on posts that can withstand 200-pound loads (500 pounds with a 2.5 safety factor applied).

In my area, 42-inch rail heights are required for multifamily homes, so I included six 54-inch-long RDI Transform 5x5 PVC post sleeves in my railing order to accommodate the additional post height needed for the taller rails. The sleeves are fitted to the smaller, 4x4 posts with pairs of HDPE spacers—one each at the top and bottom of the post—so there's little opportunity for shimming the sleeves if the posts are out of plumb **(1)**.

One-inch-square hollow blocks are included with Transform rail kits **(2)**. These are cut to length and used as needed (typically one at the center of the rail; for longer rail spans, the manufacturer recommends two) to support the bottom rail and prevent sagging. The actual height of the bottom rail can vary depending on the balustrade design, as long as the top rail meets minimum height requirements and there is less than 4 inches of clearance between the top of the decking and the bottom of the rail.



Each post-sleeve kit comes with a pair of HDPE spacers that lock the sleeve in place over a 4x4 post **(1)**. The rail sections are supported by short, hollow blocks that slip over PVC trim screwed to the beam **(2)**. After fastening the lower beam to the posts through PVC mounting brackets that slide into the ends of the beam **(3)**, the author snaps the slotted bottom rail down over the beam **(4)**. The precut balusters are already fitted with end plugs, which fit into the slots in the bottom rail **(5)**.

Photos: Emanuel Silva

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After verifying that the upper and lower stair posts are plumb, the author clamps them to a straightedge and repeats the procedure with the middle stair post **(6)**. Laying the lower beam across the stair-tread noses is an easy way to find the beam's length and cut angles **(7)**. After making a small cutout in the trim ring for the beam, the author fastens it to the posts **(8)**. He uses an offcut to mark where the handrail intersects the post **(9)** and find the length of the stair balusters **(10)**.

Level rail. The two-piece rail sections consist of beams that are fastened to the posts, and matching rails that snap over the beams, finishing and reinforcing the assembly. For longer rail lengths, up to 8 feet, an optional Resalite stiffener can be inserted into the upper beam before snapping the upper rail in place.

PVC mounting brackets are used to connect the beams to the posts. After cutting the lower beam to length, I aligned the brackets with the ends of the beam and fastened them in place with pairs of screws driven through the sides of the beam. I also screwed a short PVC block to the bottom of the beam. I sized this block to fit inside the 2-inch-long bottom rail support, although I could have omitted the block and simply screwed down through the beam and support into the decking after the beam was installed.

Finally, I slipped the support over the PVC block, set the beam in position, and fastened it to the posts using the mounting screws—three per bracket—that came with the rail kit **(3)**. These screws are beefy, so to avoid damaging the post sleeves, I always predrill the holes whenever installing mounting screws.

The bottom rail and the top beam are slotted to accept the PVC plugs that connect the balusters to the rails, so the baluster layout has to be considered before cutting the beam and rail to length. I just placed the uncut sections against the posts and adjusted their positions until the clearance between the posts and the baluster slots at either end was equal. To allow room for the internal PVC mounting brackets, clearance between the slots and the ends also has to be greater than 1 3/8 inches **(4)**.

After that, it was a quick matter to insert balusters, snap the top beam into place, and fasten the beam to the posts through the mounting brackets. I aligned the plugs in the same direction when I installed the balusters so that they would all lean the same way when I installed the top beam **(5)**.

Stairs. Building inspectors in my area want multifamily units to have graspable stair handrails, with a maximum cross-section dimension of 2.25 inches and a perimeter dimension of between 4 and 6.25 inches. The narrower RDI Emerge stair rail profile doesn't meet these dimensions, but it does have graspable finger holds on both sides of the profile and was approved by my building inspector for this project (your inspector may have a different interpretation).

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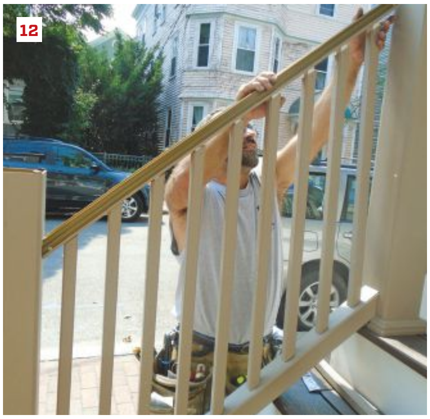
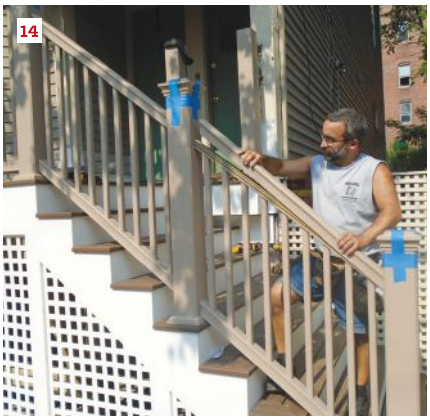




After cutting the bottom rail to length and snapping it over the support beam, the author installs the stair-rail plugs **(11)** and balusters, then snaps the upper beam in place **(12)**. Then he screws the beams to the posts **(13)** and snaps the upper rails into place **(14)**.

To prevent the post caps from being accidentally dislodged, the author glues them to the post sleeves with elastomeric sealant **(15)**. Masking tape holds the post caps in place while the sealant cures **(16)**.

Before I measured or cut anything, I verified that the upper and lower stair posts were plumb, then locked them in position by clamping them to an aluminum straightedge **(6)**. Next, I made sure the intermediate post was plumb, and clamped that in position as well. To determine cut lengths and angles, I simply laid the bottom beam across the noses of the treads and marked where the posts intersected the beam **(7)**.

By code, the triangle created by each tread, riser, and stair rail must be smaller than a 6-inch sphere. To meet that requirement, I drop the bottom stair rail down as low as possible, which sometimes requires cutting the post trim rings to fit around the lower rail. Trim rims are flimsy and subject to damage, so I carefully cut the notch out with a multitool **(8)**.

For a snug and precise fit, I always start with a rail-section offcut to act as a template as I determine the correct cut angle **(9)**. Once I'm satisfied with the angle and the fit, I mark the exact locations of the upper and lower assembled rail sections right on the posts. Even after carefully measuring, I always cut stair rails slightly long and make several more incremental cuts as I sneak up on the final length. Better to spend extra time at the saw than to end up with a railing that's too short.

While upper- and lower-beam assembly for the stair rail is similar to the level-rail installation, the PVC mounting brackets are inserted into the ends of the beams prior to cutting, rather than afterward. A wrap of tape around the brackets ensures a snug fit while the cut is being made. The idea is to remove as little of the plastic on the bracket as possible while giving it the proper rake angle. If the bracket is left square, not enough of the mounting screws engage in the post, which weakens the connection between the rail and the post.

Unlike the balusters for the level sections, the stair-rail balusters had to be cut to fit so that the handrail height was between 34 inches and 38 inches above the tread nosings, as required by code **(10)**. To make sure the balusters were all the same length, I set up a stop block on my chop-saw table. The plug design allowed them to rotate slightly within the slots in the lower rail and upper beam to accommodate different stair pitches **(11, 12, 13)**.

Finishing up. Once I'd fitted the balusters and screwed the upper stair beams to the posts, I snapped the handrails in place **(14)**. The post caps also snapped on, over the post sleeves, but for good measure, I put a small drop of Geocel Pro Flex elastomeric sealant at each inside corner prior to installation to make sure they didn't pop off if they were bumped. I taped the caps down with masking tape while the sealant cured overnight **(15, 16)**.

Emanuel Silva owns Silva Lightning Builders, a remodeling company in North Andover, Mass. A version of this article appeared in Professional Deck Builder *(May/June 2016).*

THE SPEC LINE
WHAT THE JOB DEMANDS.

TOP 10 EXTERIOR DOOR INSTALLATION KILLERS

Your truck is a rolling arsenal of installation firepower … except when it isn't

What's your top frustration with hanging exterior doors?

Goodness knows there's plenty to choose from, so we gathered a Top 10 list. What's No. 1 on your hit parade? Which one(s) did we leave out? See if any of these ring a familiar bell:

1. **Running short of flashing tape.** You probably carry plenty of tape in the truck. But when you're caught short of this must-have exterior door installation material, you better figure a trip to the store. No one needs to tell you how disruptive that is during the workday.
2. **Running short of spray foam.** "Why is it always cold around the door?" Why risk questions like that on callbacks over a drafty door frame? Spray foam is about as handy and effective as it gets.
3. **Running short of sealant.** Another tough one to fake or improvise if you run short.
4. **Running short of shims.** Can you ever have too many shims?
5. **Wrong sealant.** Yes, you can improvise with any-old sealant. But you may risk callback issues over incompatibility issues with the tape or paint.
6. **No rigid sill pan.** Flashing tape makes a poor substitute for a rigid sill pan. The key word is "rigid"—only a rigid sill pan slopes water away from areas vulnerable to rot.
7. **No rigid sill pans available.** Unfortunately, not every building products supplier keeps them in stock.
8. **Too much to worry about.** Keeping track of all these parts and pieces from project to project is another needless headache.
9. **Door dealer without installation materials.** Sell a door without the materials to install it? Some door dealers do. That could mean more wasted time gathering materials.
10. **Bad weather delay.** Some sealants, spray foams, or flash tapes aren't cold- or wet-weather friendly. Why face an installation delay waiting on better weather?

Even if you routinely restock your truck each night, it's inevitable you'll run short of installation material on occasion. The good news is, there's a handy way to avoid trips to the building material supplier, compatibility issues, falling behind your competition, or installing out of compliance with the latest International Residential Code standards (IRC 2018 703.4.1.1).

Just ask your building products supplier to include an exterior door installation kit with each single, double, or sliding patio door order. The kit is instant peace of mind and offers you a leg up on every competitor that doesn't offer this value-added plus.

Learn more about DAP Products Quick Kit for exterior door installation at **http://www.dapquickkit.com/**.

BY IAN SCHWANDT

Building a Worker-Centered Crew

Part 1: Foundations

Our industry excels at filling physical voids: Foundation holes, wall cavities, joist and rafter bays, and empty cabinets are among the many voids we jump at to fill. But over the last decade, this industry has failed in its attempt to fill another important void: young workers. Lead carpenters, like myself, need to be at the center of the solution. By definition, a lead carpenter sits at the crossroads of production and business, putting us in the exact right spot to influence how new workers are nurtured in a company.

In a series of articles, I will explore ways of developing a "worker-centered crew," an idea that was inspired by David Gerstel's concept of an "employee-centered company" and has grown out of my work with production and business systems throughout my 15-year career as a lead carpenter. In this first article, I'll share how my job came about and what I've learned about running jobs, training young workers, and building a crew. The goal of this exploration is to serve others who need to bring apprentices into the trades and who understand that helping them reach their full potential benefits not only the apprentices but also the company.

THE FOUNDATION ON WHICH EVERY JOB IS BUILT

"I run the job" is typically the answer a site superintendent, foreman carpenter, or lead carpenter will give when asked what they do. Depending on who you work for, and where, there is often little difference between the duties performed by the tradespeople holding these titles. I have held all three, and the differences have come down to whether or not my required dress fits the task of the day—am I swinging a sledgehammer when wearing khakis and dress shoes or holding client meetings covered in mud and dust?—and the amount of "neck down" work expected of me along with the "neck up" demands of running the job.

Regardless of job title and footwear, when a tradesperson is given the task of running a job, it generally comes with a triangle of obligations. This triangle consists of our immediate supervisor (often the owner of the company who assumes the financial risk to employ us); the client for whom we are building the project; and labor—both our crews and our subs. Without the men and women who work under our direction, we cannot fulfill our obligations to the company owner and the client. Labor is the foundation on which the job is built, and our ability to meet the needs of our employers and our clients is directly tied to how well we meet the needs of those who work under us.

Recently, my crews have tended to be on the younger, inexperienced end of the spectrum. Their needs are different from those of the grizzled, old carpenter who enjoys pointing out his superior knowledge and telling you how much more relaxing his life is now that he is no longer running work, taking evening phone calls, or attending Saturday meetings with clients. For up-and-coming tradespeople, the focus is on motivating and training, and for me, this challenge led me to start by reflecting on how I got to where I am today.

FOUNDATION FOR A CAREER

My favorite part of being a tradesman is working with different tradespeople and seeing how they perform their work. We all do things differently and bearing witness to this forms the foundation for a young tradesperson's career. "When you drive home, think about the new things you learned today" is as good advice for me today as it was on the day I first heard it. But the more I think about the lessons learned through the experience of being a lead carpenter, the more I see how those I worked under orchestrated my opportunities for learning.

> For lead carpenters, the ability to meet the needs of our employers and our clients is tied directly to how well we meet the needs of those who work under us.

Just as two carpenters will have two methods for hanging doors or cutting rafters, two lead carpenters will have different approaches to running work. And all carpenters will have different approaches to working with those with less experience. Though the method by which a door is hung or a roof is framed is unlikely to show in the finish product, the future skill set of any young tradesperson will clearly reflect the lead carpenter's approach to running work. This sets a high bar for how we as lead carpenters nurture new hires.

Two years into my carpentry apprenticeship—with three years of general construction laboring as a foundation—my boss, Dan, asked me what I felt I had learned and could do competently. Like most young tradesmen in their early 20s, I way overshot my answer. It was early in the roaring 2000s and we were building panelized homes and apartment buildings in the Milwaukee area as fast as farmland could be turned into building lots. I thought after five years of working in a boom market and having two years of apprenticeship school under my belt that I could figure my way through any trim detail or kitchen problem that Dan could throw at me.

A month or two passed while I was allowed to work largely unsupervised except for a daily check-in by the subdivision site foreman and a Thursday visit from Dan to drop off my check and maybe a box of 2-inch finish nails or the like. I enjoyed the freedom of working alone, but I could see that the subdivision was nearly complete and before long, there wouldn't be another house to trim. On a Monday morning in December, I met Dan at a condo complex our framers had put up over the summer. When Dan got out of his black Chevy 3500 van, I immediately saw that he was carrying a Nextel two-way radio clipped to a file folder.

Every site foreman at the company always carried their Nextel and the job file folder. Dan handed me the one I saw him holding and walked me around the site explaining that I would be running the interior trim work at this site—due to the holidays approaching, it would start off slow, but by the end of winter, I would have a crew of my coworkers working under my direction. That was obviously a big turning point in my career—one I want to underscore because it marked the moment I went from being a participant to being committed to my career. Dan got it. Employers, and those who nurture employees on an employer's behalf, need to recognize that it's in these moments that a career is made. If we are going to hire, train, and grow committed employees, we need to be open to making these moments possible for individuals.

What Dan (and many others I worked under during my apprenticeship) created was a forum for action that provided the opportunity for a young tradesperson to hone both "neck up" and "neck down" skills and put those skills to the test. Not all companies I've worked for, however, provided this forum; only those with strong business systems and fluid communication between office and field proved to have the essential ingredients. Our having a long view on workers' needs is also vital to their ability to prosper, and by extension, for the company to thrive as well. Our commitment to providing opportunity for young crews serves as the foundation on which to build a worker-centered crew. In the next article, I'll delve into the framework needed for those new workers to thrive while they are still green and not yet committed to the trades.

Ian Schwandt is a lead carpenter from central Wisconsin with experience leading commercial and residential projects in the Midwest and Northeast.

BY MATT BOWERS

Window Positioning in a Fat Wall

Whenever you build a superinsulated house, you encounter a dilemma. Where do you set your windows in those fat walls—flush to the outside of the wall, flush to the inside of the wall, or somewhere in between? As a Passive House consultant in upstate New York, I have had to analyze this decision from several different perspectives. I've learned that if energy efficiency is the goal, positioning the window in the center of the wall (to be more precise, in the center of the wall's R-value profile) turns out to give the best-performing result.

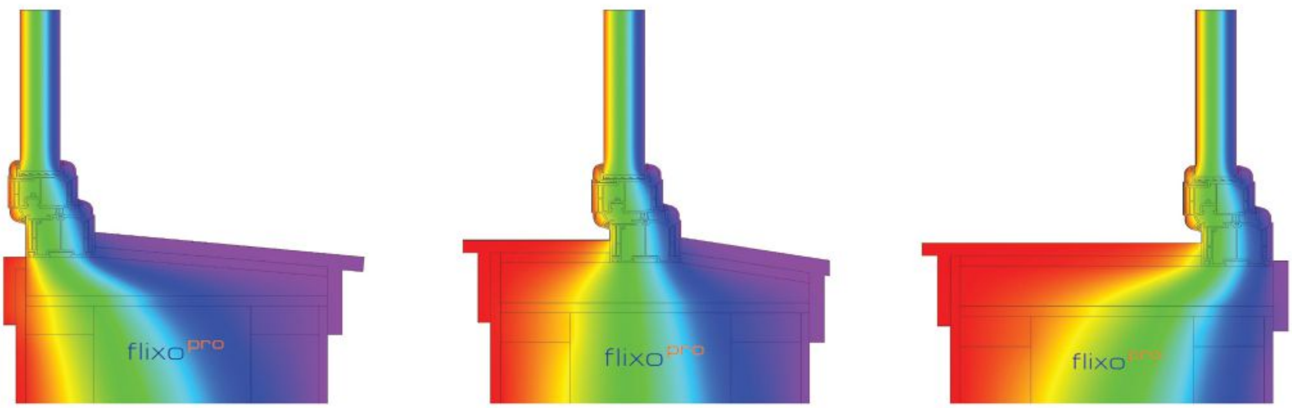
To predict the thermal performance of a window, I analyze the window as part of the wall assembly using Flixo, a versatile and powerful thermal-bridge-analysis application. Flixo can output a variety of reports, as well as diagrams and illustrations such as the ones shown below. (Learn more about Flixo at certiphiers.com/flixo.)

Here, I used Flixo to create a two-dimensional drawing of the window in its rough opening, set the design indoor and outdoor temperatures, and assign each shape a thermal conductivity. Flixo then output the "psi value" (Ψ-value) for the juncture between the window and the opening. The psi value is a correction factor between the window and the wall assembly accounting for the thermal discontinuity of different materials as well as framing effects.

Using Flixo, I can take a fine-grained look at the window. I model the frame U-value (rate of heat loss), the glazing U-value, the installation psi value, and the psi value at the joint between the glazing and the frame (which is called the spacer). With those four values, I can get a much more accurate overall window U-value than is possible from a standard National Fenestration Rating Council (NFRC) window label. I then input that value into the Passive House Planning Package (PHPP) to see the contribution of the windows, as installed, to the overall heating or cooling demand of the building.

The rainbow drawings shown below are the output from Flixo for three different window installation configurations. One window is placed all the way to the inside of the insulated window buck, one is centered in the wall, and one is placed all the way to the outside. As you can see from the rainbow patterns, the heat flow and temperature gradients in the walls are different.

I analyzed this problem for a new construction project, a 2,559-square-foot house built to Passive House



These images, generated by the software application Flixo, are a graphic representation of heat flow through the complex interface between a window and its framed opening. Warm is indicated by red, cold by purple, and the other colors represent temperatures in between. The flow through and around the centered window most effectively retains heat in the building.

A mockup of the author's window installation shows the insulated window buck and the window's location near the wall's center of mass.

levels of efficiency. To find the values in the table below, I input the psi values from Flixo into the PHPP. You can see that the difference in the window position carries through to the annual heating demand for the entire house. In this example, keeping the windows in the center is the only option that allows me to meet the Passive House criterion for heating demand, 4.75 kBtu per square foot per year. Setting the window to the outside was worse, and setting it to the inside was the worst of all. The difference in the numbers might be noise in conventional code-compliant houses with a peak heating demand of 60,000 Btu/hr or so. But in advanced energy-efficient projects, these are make-or-break decisions.

In a high-performance house, there are a number of reasons to think carefully about window placement. Energy consumption, which we've just discussed, is only one consideration. Probably more important is the question of condensation potential and durability. Cold spots in a wall system are vulnerable to condensation; by keeping the window and its surrounding framing warmer, we minimize the risk of condensation. Hand in hand with that concern is the issue of comfort. By eliminating a cold spot in the wall, we avoid a source of discomfort.

We also need to consider aesthetics and think about how the house will look from the street. If the wall is a foot or more thick, you (and your clients) may not want the windows pushed all the way to the inside. Along with this concern, there's the "tunnel vision" effect that may be created when a window is installed all the way to the inside or all the way to the outside.

In addition to those factors, we have to be mindful of the extent of shading that's going to occur on the glass in the various window positions. When the window is installed all the way to the outside, the window buck isn't going to shade the glass much. But when it's installed all the way to the inside, now you have substantial shading on that window—which could be either good or bad, depending on the project.

Assuming you've decided to optimize the window's thermal performance, exactly where in the wall you position the window depends heavily on the characteristics of the particular window. With the Klearwall windows I modeled for this example, the center of R-value of the wall turned out to be the best spot. But if, for example, you have a wood window with an inch of foam or a half-inch of foam on the outside of it with aluminum cladding, that window might need to go in a slightly different location in the wall to be optimized. In any case, that optimal position can be analyzed using a program like Flixo. Or you can ask your window vendor; some vendors are able and willing to do the calculations for you.

Matt Bowers is president of Rochester Passive House Consulting in Rochester, N.Y., and an accredited Passive House Certifier.

WINDOW POSITION	HEAT LOAD (BTU/HR)	ANNUAL HEAT DEMAND (KBTU/SF/YR)	ANNUAL HEAT DEMAND (KBTU/YR)	WINDOW U-VALUE (BTU/HR-FT2-F)	WINDOW R-VALUE (HR-FT2-F/BTU)	COMFORT CRITERIA	CONDENSATION POTENTIAL
Outside	10,615	4.78	12,232	0.139	7.19	Not Met	Yes Below -2°F Outside
Middle	10,423	4.56	11,669	0.133	7.52	Met	No
Inside	10,722	4.83	12,360	0.142	7.04	Not Met	Yes Below 3°F Outside

The author's analysis of the position of a high-performance window in a superinsulated wall established that location in the center of the wall yielded the best performance, maximizing the insulation value and removing a condensation risk.

Photo by Matt Bowers

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Tiling a Walk-In Shower

Old and new materials and methods combine for an attractive, accessible, and watertight shower

BY TOM MEEHAN

A few years ago, I wrote an article about making a traditional mud pan for a leak-proof shower ("Preventing Leaks in Tiled Showers," Oct/16), and I still often use those methods. The project in that article was a simple stall shower with a curb. Recently, I was asked to tile a larger, curbless shower with a linear drain. This complex project was a perfect showcase for many important tiling techniques. The introduction here gives a quick overview of them, and the photos on the subsequent pages show the basics. Online (at jlconline.com), I'll cover each topic individually in much greater detail.

Dropped floor. Unlike in the project mentioned above, the waterproofing system in this one allowed us to install the wallboard before waterproofing the shower floor. Instead of installing a curb for the shower, the builder dropped the shower floor framing 3 inches, making it easier to create a drainage slope with an even transition from the bathroom floor. No shower curb also meant that the shower could be wheelchair accessible for age-in-place clients.

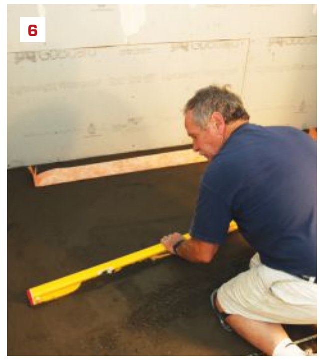
Mud base. After covering the subfloor with 30-pound felt paper and galvanized wire lath, I created a sloped floor with the same dry-pack mortar I used in the previous project. I had dry-fit the drain earlier, so I knew how much to slope the mud layer. I packed the mortar with a wooden float trowel and used two levels to screed the mortar in two directions.

Linear drain. Another difference for this shower was the linear drain along the back wall. I put the drain in during the mud-base installation, making sure to set it at the proper slope. From there, I finished packing and screeding the rest of the mud layer over to and around the threshold of the shower.

Floor heat. After letting the mud cure overnight, I installed Ditra membrane for a warm floor, the same system I describe in the

Photos by Roe Osborn

The author adjusts the height of the linear drain so that the floor will slope properly **(1)**. To allow for a flush transition from the bathroom floor into the shower, the shower subfloor had been dropped 3 inches. The author then puts down a layer of 30-pound felt paper and attaches galvanized wire lath over the paper with galvanized roofing nails **(2)**.



The author begins installing the dry-pack mortar bed with trowels at the back of the shower, screeding it in two directions with long levels **(3)**. He digs out a shallow trench for the drain, butters the back of the drain with unmodified thinset **(4)**, and glues the drain into place, with a rubber coupling added for flexibility **(5)**. He finishes up by packing and screeding the rest of the mud layer **(6)**.

article "Tiling a Three Season Porch" (May/19). The heated floor extended from the shower into the rest of the bathroom. We put the bathroom-floor heat and shower heat on separate lines; that way, if one area has a problem, the other can continue to provide heat.

Waterproofing membrane. The next layer was the waterproofing membrane. We opted for Schluter's Kerdi membrane, which is installed with unmodified thinset. The drain (also made by Schluter) comes with membrane that is integrated into the membrane on the rest of the floor. I lapped the membrane up the walls and onto the waterproof wallboard and installed specially made pieces to seal the inside and outside corners.

Shower seat. Modern, lightweight materials make it easy to build durable, waterproof structures, such as seats and shelves, in a shower. For this shower, we created a built-in seat that extended along the wall opposite the faucets.

Wall tile layout. The tile for the walls was white subway tile. Tile layout should always be based on the most visual aspect of the shower, which in this case was an awning window. We centered the layout on the window and set the level of the courses so there would be a full tile at the back of the shower seat. The layout for adjacent walls was taken directly from the back wall, and a story pole was instrumental in determining the side-to-side layout.

Wall tile installation. Once the layout was completed, the tile installation went quickly. The crew staggered tiles between courses and used plastic wedges to set the horizontal grout lines. All straight cutting was done with a score-and-snap cutter, and cutouts for the faucets were done with a wet saw.

We tiled the back wall first, using a long level as a ledger to support the first course. For the adjacent walls, we set the ledger below the first course on the back wall and worked up from there. When we'd finished the walls from the ledgers up, we removed the ledgers and the wedges and filled in the spaces down to the floor.

Pebble floor. The client chose pebbles for the shower floor. The random look of the pebble sheets meant that a precise layout was not necessary. The sheets fit into one another quite neatly, and we cut small pieces from the pebbles to fill in along the wall and drain.

Grout and out. The final step was grouting the tile. This step was fairly routine, with unsanded grout used for the smaller lines between the wall tiles, and sanded grout used between the pebbles on the floor tile. After allowing the grout to sit for a few days, I applied a sealer to the shower floor.

Tom Meehan, co-author of Working with Tile*, is a second-generation tile installer who lives and works in Harwich, Mass.*

The first membrane layer for the heated floor is bedded in unmodified mortar. The author then installs the wire for the heat **(7)**. Over the heating layer, the author beds the waterproofing membrane in unmodified thinset, beginning with the membrane around the drain **(8)**. Pieces of membrane lap over the drain membrane and up the walls **(9)**, with special pieces for the inside corners **(10)**. Layers overlap by at least 2 inches **(11)**. The installation required special outside corners, as well **(12)**.

Final prepwork before tiling the shower included constructing a built-in seat. Here, a crew member applies waterproofing membrane to the edges of the seat **(13)**. The seat face will be tiled, but the horizontal surface will be covered by a slab. As a final waterproofing measure, he runs membrane a couple of feet up the corners of the shower **(14)**.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Wall layout begins at the most visible wall, starting with a vertical line drawn at the center of the window. Using a story board, the author then measures over from the line to check where the tiles will fall with the window trim **(15)**. To ensure a full tile over the shower seat, a crew member draws a level line from the back of the seat **(16)**. Measuring down from that line with the story board, the crew member sets the height of the ledger (a long level) for setting the first course **(17)**.


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After spreading unmodified thinset on the wall with a $^{3}/_{8}$-inch notched trowel, a crew member begins the subway-tile installation with a grout line centered on the vertical layout line drawn earlier **(18)**. Tiny plastic wedges set the width of the horizontal grout lines and support the tiles for subsequent courses. All of the straight cuts were made with a snap cutter, including the angled cuts where the wall meets the seat **(19)**. Every few courses, the work is checked with a level to verify the tile is straight and level **(20)**.

To lay out the adjacent wall, a crew member levels over from the bottom course on the first wall **(21)**, then checks the side-to-side layout with the story pole **(22)**. Metal edging was used to finish the outer edge of the tile **(23)** to prepare for a glass-block partition that will butt into the edging. For cuts around faucet stubs, the worker traces the cutout on the tile with a felt pen **(24)**, and then cuts out the shape with a wet saw **(25)**. The story pole was used to ensure the face of the seat will have a full tile at the top **(26)**.

Pebble floor tile comes in sheets that the crew member sets into the thinset mortar **(27)** and then presses flat **(28)**. He precuts several different-size pieces of stone on a wet saw **(29)**, then fills in empty places in the layout **(30)**. At the back of the shower, the narrow strip of tile must be pitched properly to the drain **(31)** to complete the installation **(32)**.


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The last tiling detail to finish was a niche below the window **(33)**. The author spreads unsanded grout for the wall tile in the usual fashion, making diagonal strokes with a grout trowel to ensure that the joints are filled completely **(34)**. Next, he strikes the horizontal joints with the rounded barrel end of a marking pen to pack the joint and to remove the excess grout **(35)**. Then he wipes the wall with a damp sponge **(36)**. After letting the grout set for a few minutes, he wipes the wall with paper towels to absorb more of the moisture from the grout **(37)**. He then gives the wall a final wipe with a terry-cloth towel to remove the haze from the grout and leave the tile shining **(38)**.


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Low-Slope Roofing Details That Work

Positive slope and easy drainage are keys to success

BY DOUG HORGAN

Photos by Doug Horgan; Illustrations by Tim Healey

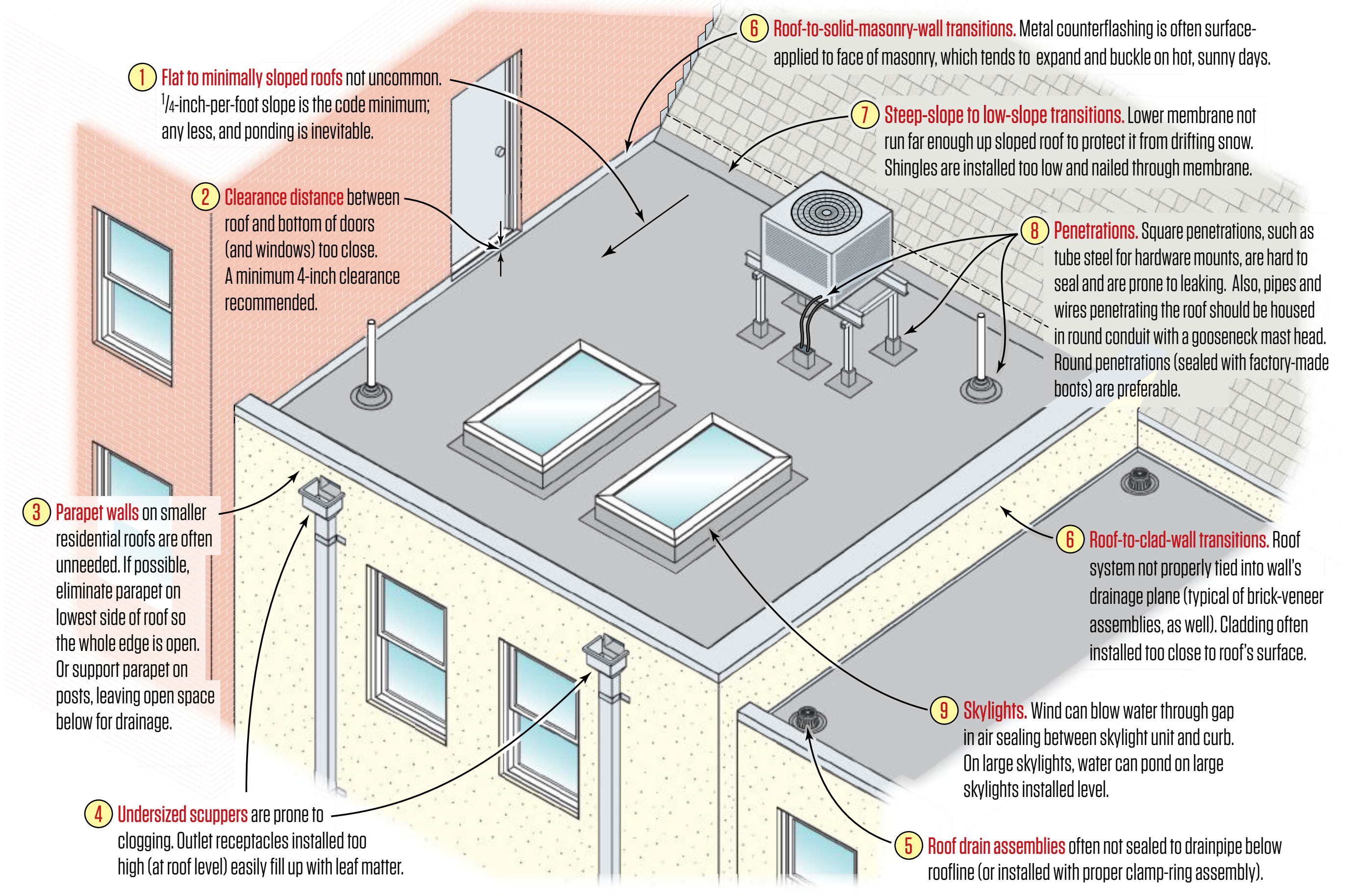
Low slope ("flat") roofs are challenging to build, and fail more often—and more disastrously—than steep roofs. Most have no redundancy: A tiny leak goes right into the house. A lot of stored water can build up, so a leak can be a very big problem instead of a little stain on a ceiling. The seams have to be watertight, so the work must be done perfectly. High turnover in the trade means inexperienced crew members.

For all these reasons, we've had the chance to learn a lot about what can go wrong with low-slope roofs. Some of these lessons have been learned on our own projects, although most were learned by repairing other contractors' roofs. I'd like to share those trouble spots and explain what we do to prevent the problems we've seen.

By "low slope" roofing, we mean any roof that is pitched at less than 4 inches of rise in 12 inches of run, or 4/12 pitch. Regular asphalt shingles and standard skylights will work at pitches of 4/12 or greater, but at lower pitches, you have to use different materials. That includes soldered metal roofing or synthetic membranes. Metal roofs, even fully soldered systems, have drawbacks for low-slope applications. So in this story, I'm going to focus on details for membrane roofing, and in particular, TPO (thermoplastic polyolefin) membranes.

I've written on this topic for *JLC* before (see: "Low Slope Roofing: Troubleshooting in Advance," Jan/16; "Draining Low-Slope Roofs," Oct/15; and "Steep-Slope to Low-Slope Transitions," Apr/14). Those stories focused on troubleshooting roof failures; in this story, I'll

Low-Slope Roofing — Common Trouble Spots



TYPICAL TROUBLE SPOTS

Membrane roofing materials are flexible, tough, and durable. Short of a tree branch dropping through them, they can stand up to conditions on a roof. Trouble can occur, however, at joints, seams, penetrations, and intersections. The illustration above shows areas where careful attention is important.

1. Roof Slope. Dead-level or backward-sloping roofs are prone to ponding. Be careful to maintain a slope of at least 1/4 inch per foot.

2. Threshold Clearance. 8 inches of clearance above the roof is recommended for door and window sills. Where that's not possible, shoot for at least 4 inches (the minimum for good working room).

3. Parapets. Most residential roofs don't actually require parapets. If possible, eliminate the parapet at least on the lowest roof edge to allow water to flow easily off the roof.

4. Scuppers. Compounding the parapet-wall issue, scuppers are often too small and too few to allow good drainage. Size scuppers at least 8 inches high and 12 inches wide. Mount receptors (conductors) low on the wall.

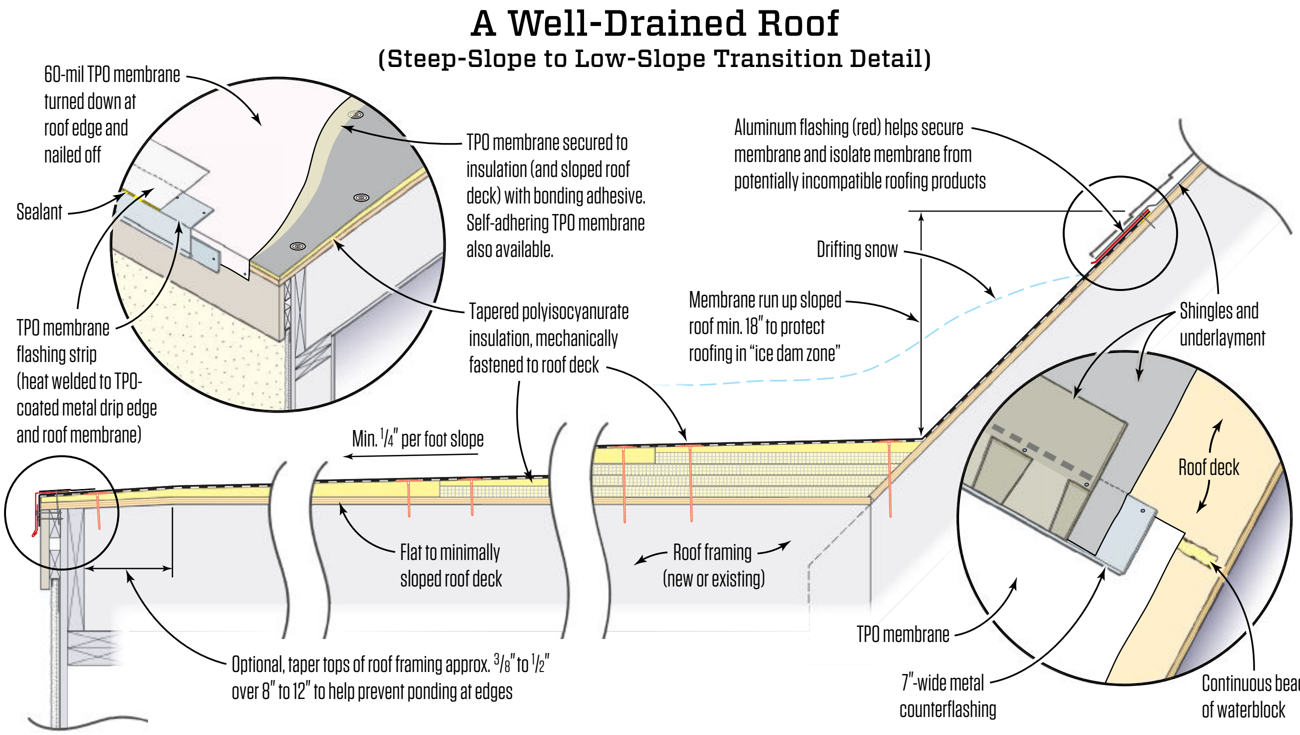
5. Roof Drains. A poor seal between the drain and the roofing is a typical cause of serious leaks. Use a clamp-ring drain to prevent this.

6. Roof-to-Wall Transitions. Roofing must be properly tied into abutting walls.

7. Steep-Slope to Low-Slope Transitions. Lower flat-roof membrane may not run far enough up the slope to protect against drifting snow and ice. Allow at least 18 to 24 inches of rise for the membrane.

8. Penetrations. Use factory-made boots and seal carefully.

9. Skylights. Skylights may leak from wind-blown rain or ponding water. Slope skylights and seal against air penetration.



A "slope kit" consisting of tapered foam sheets adds slope to a dead-flat roof. A wide-open roof edge is preferable to scuppers because it is less likely to clog. Tapering the rafters at the edge of the roof helps counter the buildup of layers at the edge. Extending the membrane up the adjoining steep roof protects against drifting snow and ice buildup.

focus on solutions that avoid those failures in the first place.

When we encounter trouble on any membrane roof, the problems are always related to joints, edges, and penetrations. Let's take a look at the details that work in those situations.

SLOPE

Roofing-association manuals, as well as the code book, specify a minimum slope of 1/4 inch per foot for low-slope roofing. One cool trick is to use a "slope kit," consisting of sheets of foam that are tapered to provide the necessary slope. You can order the foam in different slopes. If, for instance, you wanted to add 1/4 inch per foot to a dead-flat roof, you would get foam that ranges from 1/2 inch thick to 1 1/2 inches thick over 4 feet. You'd start at the bottom edge with a 1/2-inch-to-1 1/2-inch piece, and then at the up-slope side, place a sheet of 1-inch flat foam and layer another piece of the tapered foam on top of it. You would continue on in a similar fashion up the roof to the high point.

ROOF EDGES

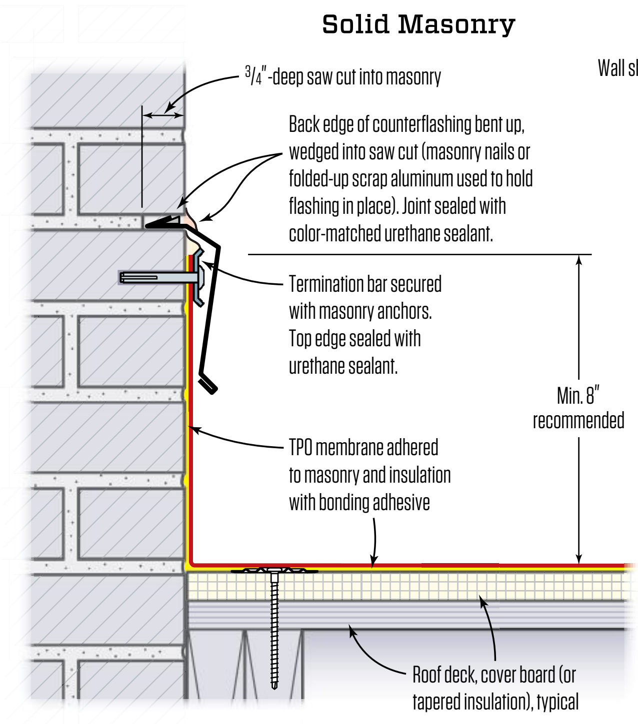
When it comes to drainage, open roof edges are preferable to roof drains or scuppers in a parapet wall. Roof drains and scuppers are both prone to clogging and they involve complicated detailing that is hard to do right. Most houses in our area don't actually need parapets: The main purpose of a parapet is to keep wind from sucking the membrane off the roof of a large building, and in our location, the wind forces don't make this necessary for residences.

At roof edges, multiple layers of material sometimes create a raised edge or a backward slope. To avoid this, we recommend tapering the framing at the roof edge to add a little slope pitching toward the outside. Just cutting a taper of 3/8 inch to nothing over 8 inches, or 1/2 inch to nothing over a foot, is enough to keep all those outside layers below the level of the main roof.

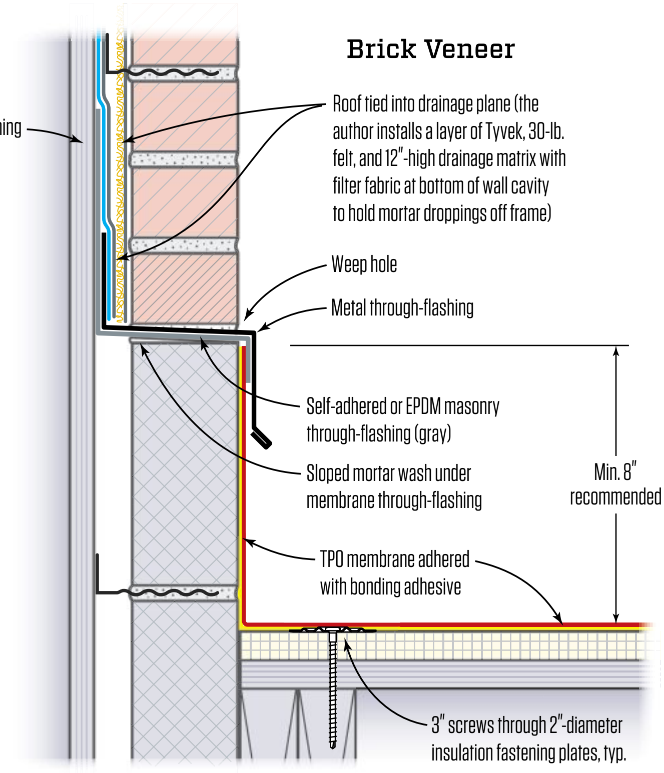
Metal drip edge at the roof edge is difficult to seal against water intrusion. The metal expands and contracts and puts a stress on any sealant you may apply at lap joints. To effectively waterproof this area, we like to follow a detail supplied by manufacturers that calls for running the membrane all the way to the roof edge and down over the fascia. Then we apply the drip edge on top of the membrane, and seal in the top of the metal with another strip of roofing.

As an alternative in locations prone to sliding snow and ice, you could implement a similar method: Attach a strip of roofing to the edge first, apply drip edge over this edge strip, and then apply the main roof membrane on top of this. This isn't necessary in our D.C. area, but it could be a better alternative in a colder climate.

Roof-to-Wall Details



For solid masonry, the author recommends running the membrane 8 inches up the wall. The membrane is secured at the top with a termination bar and counterflashed.



Masonry veneer requires a through-flashing that ties into the weather-resistive barrier behind the masonry.

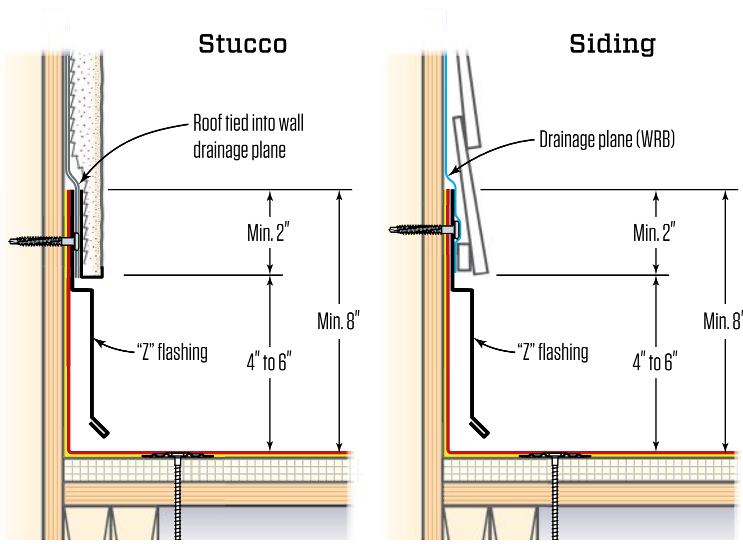
WALL CONNECTIONS

According to the roofing-association manuals, roofing should lap up the wall at least 8 inches at roof-to-wall intersections. In practice, we've had good results with a 4-inch lap, but any lower than that is taking a risk.

When we attach to solid masonry, we generally use a termination bar—a strong piece of metal that we fasten into the wall, that clamps the roofing to the wall. We seal the top of that with sealant, and then we add another flashing over top of it which is set into a 3/4-inch kerf cut into the masonry—deep enough to keep the metal from working itself out of the kerf with expansion and contraction as it heats up or cools off.

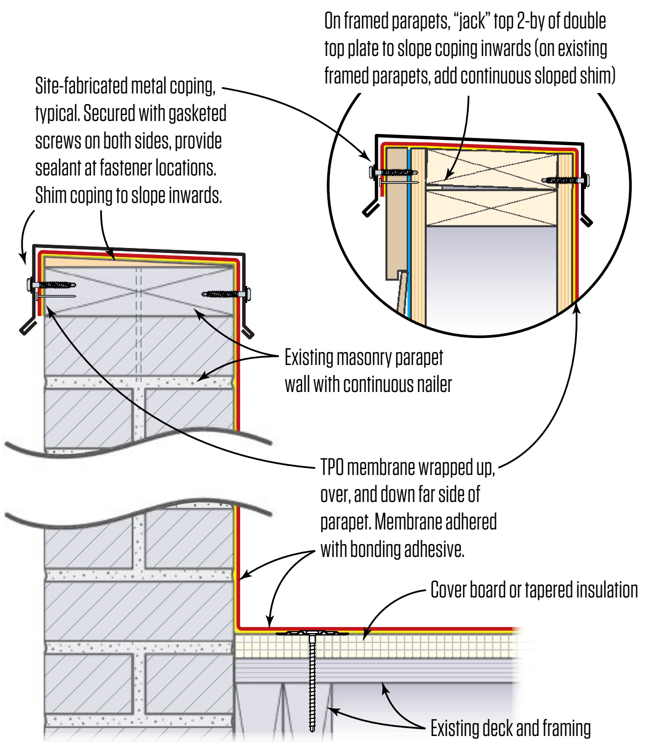
With brick veneer, you can't just kerf into the wall and embed a flashing in this way. Instead, you have to install a through-flashing into the wall that goes all the way back to the wall and ties into the drainage plane.

Under siding, it's enough to run the roofing up the wall and apply flashing over the roofing. Be sure to allow enough clearance between the siding and the roof to allow for reworking the roof in the future.

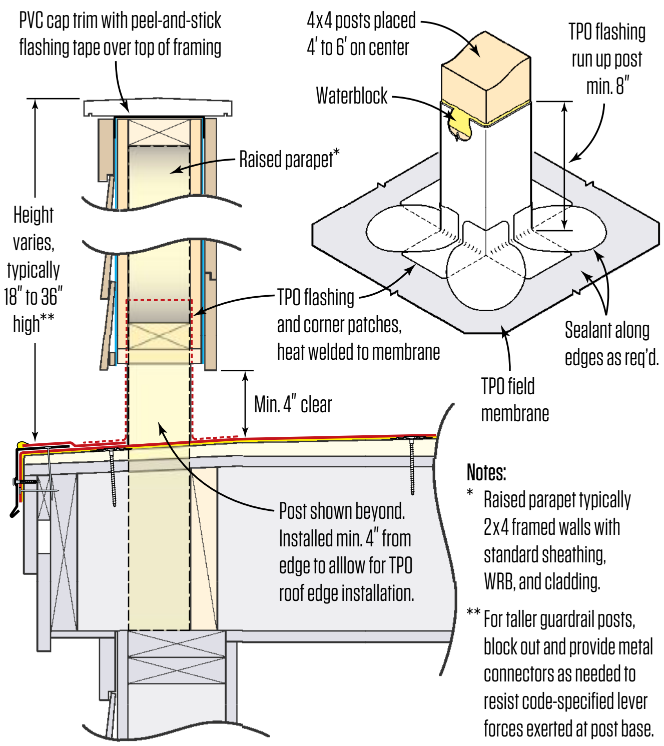


To tie the roofing into stucco or lap siding, the author recommends a "Z" flashing that laps under the weather-resistive barrier.

Parapet Details

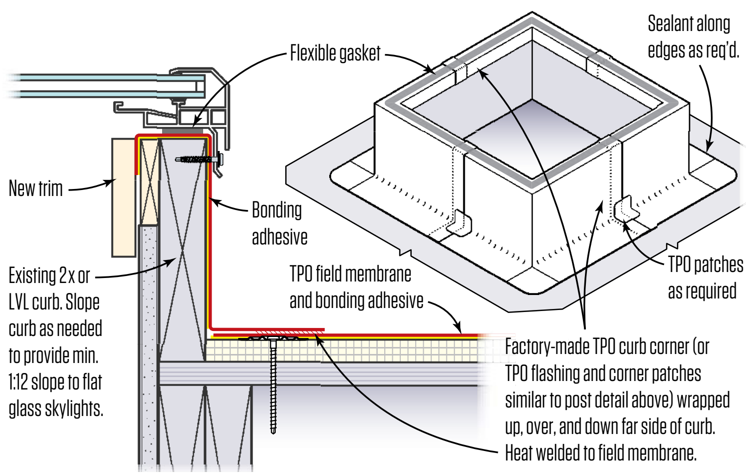


Raised Parapet at Draining Edge



When roofing wraps up and over the top of a parapet wall, waterproofing the coping or trim is less critical. For optimum drainage at the roof's lowest edge, the author prefers a parapet raised on posts as shown above, with the post base wrapped in membrane. The tops of parapets should be shimmed for slope to prevent standing water from collecting.

Sealing Skylights



Preformed skylight curb corners help with wrapping membrane up and into the skylight curb. Skylights should be gasketed to block the intrusion of wind-blown water.

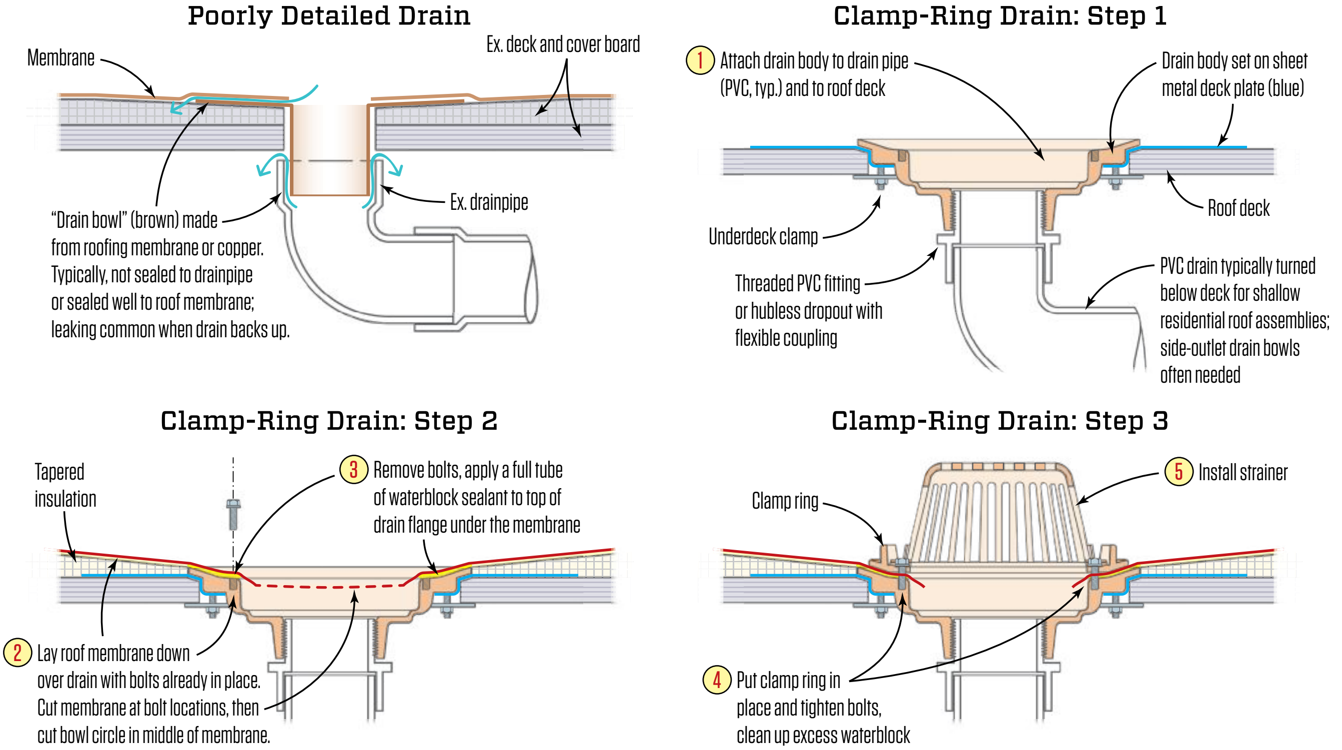
PARAPETS AND SKYLIGHT CURBS

Parapet walls and skylight curbs are similar elements that receive very similar treatment. The pieces of metal on top of parapet walls are not sufficient to keep water out of the assembly, because they develop leaks at the joints due to expansion and contraction. So it's important to run the roof membrane up the parapet, over it, and down onto the other side, and then cap that with the metal.

In an ideal world, you would even slope the top of the parapet a little bit so that water that makes it onto the membrane will run off instead of pooling. Once the membrane is wrapped over the parapet, the metal piece is essentially decorative.

Skylights are a similar situation. The membrane roofing should lap up onto the skylight curb and over it. The curb should be pitched to the outside for drainage. Air-sealing between the skylight unit and the curb is an often-neglected detail that we try to pay attention to, because if there's a gap and the wind is blowing the wrong way, it will suck water right through it.

Roof Drains



Common flaws in roof drain detailing allow leaks between the membrane and the drain body, and leaks between the drain body and the drainpipe. To avoid this scenario, the author recommends using a clamp-type drain that locks the membrane into the drain body. Watertight pipe connections are also crucial for preventing water from leaking into the building.

ROOF DRAINS AND SCUPPERS

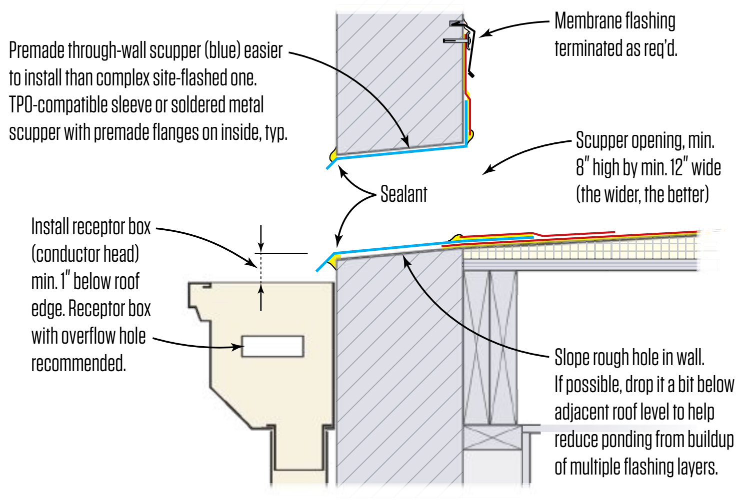
I'm not a fan of roof drains: They're high maintenance, they tend to clog, and there are many ways to do them wrong. I've seen a lot of leaky roof drains. Typically, what happens is that the pipes clog, and if you don't have a perfect seal between the drainpipe and the roofing, the water will back up, overflow the pipe, and run into the house.

Clamp-ring drains are designed to seal the membrane to the top of the drain body. If the pipe backs up, water can't get into the house, and it runs off the roof through the overflow. These are the only acceptable drains on roofs, but whenever there's a choice, I would prefer an open roof edge to any kind of roof drain.

I feel the same way about scuppers as I do about roof drains: They're tricky to detail, and the smaller they are, the more prone they are to clogging with leaves and debris. I have seen 4-inch-tall openings clog; we now recommend 8 inches for scupper opening height and at least 12 inches for width (the wider, the better).

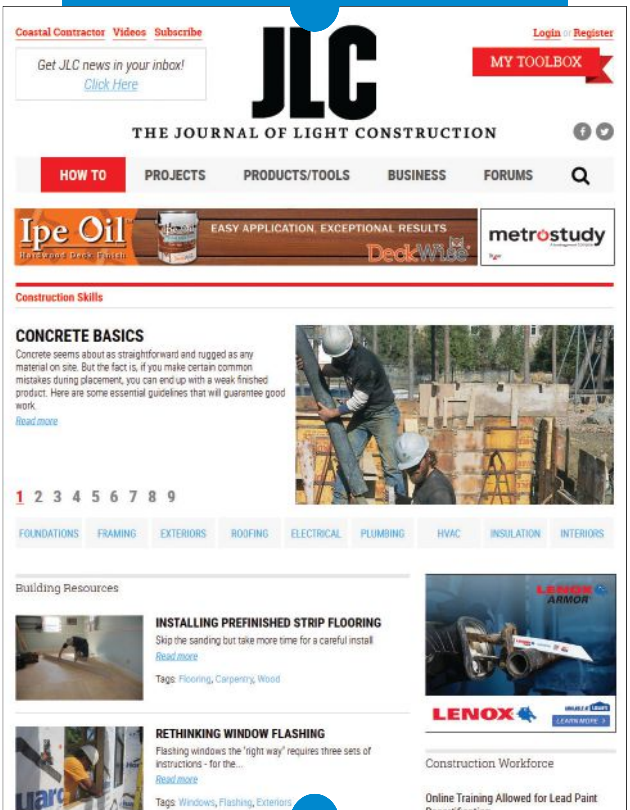
Doug Horgan is vice president for best practices at Bowa.

Scupper Detail



Drain receptors (conductors) are best positioned an inch or more below the scupper outlet so that clogs won't create leaks into the wall or ponding on the roof. Scuppers should be pitched to the outside.

JLC



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FOUNDATIONS

Pinning to Ledge

Rebar and epoxy provide the grip on a sloping coastal site

BY TED CUSHMAN

Photos by Ted Cushman

On the rocky shores of Maine, building a house often requires adapting the foundation to a difficult site. This fall, *JLC* is following the construction of a small accessory building sited on a boulder-strewn ledge slope on the back shore of Peaks Island, just outside the Portland, Maine, harbor. In this story, we'll show how the crew from Thompson Johnson Woodworks anchored the building's foundation to the rocky outcropping.

To make matters more complicated, the building had to be engineered to withstand coastal winds. That meant shear walls on the main floor, with loads that had to be transferred down to the foundation and into the earth. Engineer Andrew Jackson specified the structural system, and it was up to lead carpenter Mark Pollard and his crew to execute the plan.

The site was inaccessible to ready-mix trucks, so designer Rachel Conly came up with a system of short stem-wall piers that could be built with concrete mixed by the bag and placed with five-gallon pails. The challenge for the crew was laying out the piers on the sloped site, forming up the piers, anchoring reinforcing steel to the ground, placing the concrete, and framing the short engineered walls required to bring the structure up to the first-floor level.

A local excavation company stripped off the thin layer of topsoil and removed loose stone and boulders. When that job was done, the site under the building's footprint dropped off sharply from a high

Crew members Finn Bradenday and Jackman Wood screw batter boards to trees at the low end of the sloped site **(1)**. Lead carpenter Mark Pollard takes a measurement along a string line **(2)**. Bradenday removes rock using a wet saw **(3)** and a rotary hammer **(4)** at a pier location.

point on the uphill corner to a low point on the diagonally opposite downhill corner. The crew set up batter boards and strung lines to identify the building's perimeter and to locate interior piers.

The challenge began with the batter boards. With no topsoil for driving typical wood stakes, the crew had to drill into the stone and drive predrilled steel grade stakes, then fasten the grade stakes to 2x4 posts for the batter boards. On the downhill side, where the posts would have to be well above head height, the crew came up with the ingenious workaround of screwing the batter boards to conveniently located trees. They set the elevations of the batter boards using a Bosch rotary laser, but they squared off their string lines using the old-school method of establishing a 3-4-5 triangle.

Despite the makeshift layout method, the string lines were remarkably accurate: Cross-taping the rectangular string setup showed that the square was precise within 1/16 inch. To locate the piers, the crew measured out along the strung lines and marked locations with a Sharpie marker, then tied more strings at the marked locations with weights on the ends to form plumb lines, checking their layout with a 6-foot level where possible. They marked locations for their piers directly onto the stone using Sharpie markers.

As luck would have it, some of the piers fell out at locations with a sharp irregularity in the rocky contour. The ocean side of the building was an outdoor deck, and the piers for the deck could be moved a few feet from side to side in order to find more suitable ground for the footing. But for the main building, layout was constrained by the requirements of the structural system. So where the stone contours were too rough, the crew had to remove stone to create a more nearly level footing base and to reach sound rock. This they accomplished using a Husqvarna masonry wet-saw and a Bosch rotary hammer (a tedious and time-consuming process).

To secure the piers to the earth, Wood drills holes in the rock **(5)**. A shop-fabricated blow-out tool **(6)** is used to clean rock dust out of the holes **(7)**. Using tubes of epoxy with a mixing nozzle and a caulking gun **(8)**, Wood squeezes epoxy into the drilled and cleaned hole **(9)**, then pounds rebar into the hole **(10)**.

Pollard scribes a form board to the irregular rock using a compass **(11)**, then cuts the outline with a jigsaw **(12)**. He assembles the form using screws **(13)**.

Next, the crew set about building forms, using 1x12 pine boards. They screwed together boxes of pine in the required dimensions, then used short rips of pine to make legs for the upper box. With the form's top outline defined, but while they still had room to access the ground, they drilled into the rock with a rotary hammer, blew out the holes with compressed air, injected epoxy into the holes, and drove 1/2-inch rebar into the stone at the locations and spacing specified by the engineer. This would anchor the piers against sliding and uplift in response to wind forces.

The crew scribed pieces of 1x12 to match the irregular rock surface, cut the pieces with a jigsaw, fine-tuned the curves using an angle grinder, and placed the form boards in contact with the stone. Preparing the grade, driving the rebar pins into the rock, and piecing together all the stem-wall forms took several days of labor.

Now it was time to place concrete. The crew had about a hundred bags of concrete on hand and two electric mortar mixers. With both mortar mixers going, they mixed small, two-bag batches using a measured amount of water, dumped the concrete into five-gallon pails, carried the pails over the rough surface to the forms, and dumped the concrete into the forms.

The crew consolidated the concrete by rodding and tamping it with a short board, and by vibrating the outside of the forms using a reciprocating saw with a site-fabricated wooden extension. They struck off the concrete level with the form tops using a straight piece of board. When the concrete was set but still workable, they finished the top surface using an edger and a finishing trowel. Two days later, they stripped the forms.

Now the crew had to prepare for floor framing. Some of the piers were at full height and would need only a simple sill. But others were short of the floor and would need stem walls of various heights to bring the structure up to the first-floor frame level. In any case, the crew had to start by installing 4x6 treated wood sills on all the piers.

The crew fills forms with site-mixed bagged concrete, one bucketful at a time **(14)**. Pollard vibrates a form using a recip saw **(15)** to consolidate the concrete. He strikes off the concrete level with the top of a form **(16)**. After the concrete has set sufficiently, Wood tools the edge of a pier **(17)** and trowels the top **(18)**. After forms are stripped, the piers stand ready for framing stem walls **(19)**.







Wood applies capillary-break membrane to the underside of a 4x6 PT sill **(20)**. He drills a hole for an anchor bolt **(21)**. Holding a piece of sill in place, Bradenday and Wood start the hole for an anchor bolt **(22)**. Wood continues to drill to a depth of 7 inches **(23)**. Bradenday epoxies anchor bolts in place **(24)**. Wood sets a sill plate down over the anchor bolts **(25)**. Bradenday tightens a nut onto a bolt **(26)**.

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Pollard installs the top plate on a stem wall **(27)**, then bolts a hold-down into place **(28)**. He drills a hole in the top plate for the hold-down's threaded rod **(29)**. Bradenday nails off the sheathing on a stem wall at 2 inches on-center, as specified by the engineer **(30)**.

After cutting the 4x6 lumber to length, the crew set about applying Henry Blueskin WB25 waterproofing membrane to what would be the underside of the sills, in order to create a capillary break. The membrane would not adhere to the treated wood unless the wood was first primed with Henry Spray Prep.

Once the membrane was applied, the crew drilled holes for anchor bolts in the sill material. This required careful layout in some cases. In places, the locations of a double-LVL floor beam and doubled dimensional joists had to be worked around. Also, some of the hold-downs for the one-story building's shear walls needed to be anchored into the same piers as the anchor bolts, in specific locations.

After the sill plates were drilled, the crew set the sills in place on the piers and used the holes in the sills as guides for drilling into the concrete. They drilled 7 inches deep into the concrete, blew out the holes with compressed air, and epoxied threaded rod into place for the sill anchors. Once the epoxy had set (which took only a few minutes), the crew set the sills down over the threaded rod and applied nuts to secure the sills in place.

Now it was time to build stem walls. Crew leader Mark Pollard determined the stud length for each wall by setting up the rotary laser again and measuring from the sill up to the laser beam. He cut stud and plate packages for each wall and brought the lumber to each of the piers. Then the crew framed the stem walls.

At the top of several of the stem walls, hold-downs were required by the structural plan. The carpenters installed these hold-downs as they went, and drilled down through the top plates of the walls to accommodate the threaded rod that would complete the hold-down assembly. Then the crew applied $^1/_2$-inch plywood to the inside face of each wall as specified in the structural plan, nailing the plywood at 2 inches on-center at the perimeter and 6 inches on-center in the field.

Ted Cushman is a senior editor at JLC.

BY SYMONE GARVETT

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1. Stylish Stair Risers
Ornamental Moulding & Millwork's reversible risers are available in two styles: a shiplap and beaded planking version, and an oak and primed smooth version. The primed sides of either version can easily be painted, and the oak version can be finished to match existing décor. Each riser is $3/8$ inch thick and measures 42 inches by 7 $1/2$ inches but can be cut to size. Pricing ranges between $12 and $14. ornamental.com

2. Small-Appliance Suite
Whirlpool has added new products to its suite of appliances designed for use in small spaces such as apartments. The new 4.3-cubic-foot front-load washer and 7.4-cubic-foot electric dryer, both Energy Star–certified, can be installed in a 33-inch-deep closet. The suite also includes a 24-inch bottom-freezer refrigerator, a 24-inch electric ceramic glass cooktop, an 18-inch dishwasher with stainless steel tub, a microwave, and wall oven. Pricing ranges from $500 to $1,000. whirlpoolpro.com

3. Hurricane-Resistant Window
Deceuninck North America has launched its new 164 Series Hurricane Impact Resistant Window System. Windows are designed for new construction, replacement, or light-commercial applications and are available in single-hung, single-slider, or picture-window configurations. Frame options include prepunched fin, masonry clip, and Florida flange. The impact system is made to meet coastal building code requirements up to and including ASTM E 1886/1996, Wind Zone 3, with an AAMA rating of up to DP50. Contact a local distributor for pricing. deceuninckna.com

4. All-in-One Paint
SuperPaint Interior Acrylic Latex, Sherwin-Williams' newest paint formulation, is labeled as a paint and primer in one. The manufacturer says it offers a uniform appearance, strong washability and durability, and enhanced hide for faster, easier color changes. The product is available in flat, satin, velvet, and semi-gloss sheens and may be used on previously painted, bare or primed wallboard, and wood, as well as primed plaster, masonry, and metal. Pricing for a gallon starts around $59. sherwin-williams.com

5. Smart Deadbolt Lock

Schlage's new smart lock, the Schlage Encode Smart WiFi Deadbolt, integrates with Brilliant's Smart Home Control to allow users to lock and unlock their doors either directly from any wall-mounted Brilliant Control or using voice commands. When paired with the Schlage app, owners can grant access to family with customized access codes and know when the lock has been accessed. The deadbolt features built-in WiFi, providing easy installation and making additional gateways unnecessary. Pricing starts at $250. schlage.com

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6. Mini Barn-Door Hardware

Doug Mockett & Co. has introduced a double-sliding-barn-door hardware kit sized for use with a pair of small furniture doors up to 17 inches wide. The SDH4-90 set may be used to convert any existing swing door into a barn door. The manufacturer recommends the hardware for use with bar or buffet cabinets, entertainment centers, mantle displays, vanities, or storage spaces. It is currently available in a black finish and includes a 60-inch top rail, four sliding brackets, and two cabinet door handles. Pricing starts at $112 per set. mockett.com

7. Cable Stabilizer for Stairs

The newest addition to Atlantis Rail Systems' product collection is a more affordable cable stabilizer option for stair railings with cable infill. Designed to be field-cut to size and surface-mounted using the supplied wood screws, the Aluminum Stair Stabilizer is sold as a kit with all hardware and fasteners needed for installation. The product is made from aluminum, preslotted for use with Atlantis cable rail systems, and powder coated in black, white, bronze, or silver metallic. We found it online for about $38. atlantisrail.com

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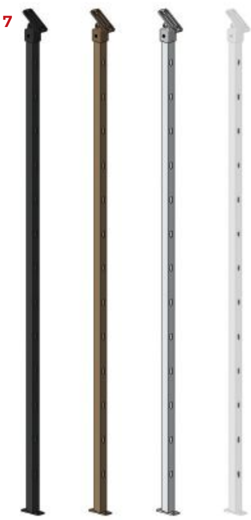

8. Convenient Dimmer Control

The Lutron Aurora Smart Bulb Dimmer is a wireless, battery-powered local control knob for the Philips Hue smart lighting system. The dimmer easily installs over existing toggle-style switches. The mounting base "locks" the existing switch in the on (up) position, and the round knob dimmer snaps over the base. The Aurora controls like a standard dimming switch, allowing users to touch the dimmer to turn the lights on or off, or turn the knob to brighten or dim the lights. Pricing starts around $40. lutron.com

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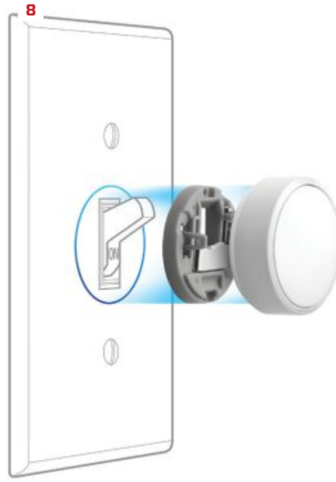

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9. Sound-Dampening Connector
ClarkDietrich's Sound Clip (CDSC) fastens gypsum wallboard to framing members in various wall and floor-ceiling assemblies, while providing acoustical separation. When used in conjunction with 18mil (25 ga.) $\frac{7}{8}$-inch-deep drywall furring channel, the clip functions as a decoupler, permitting the attachment of gypsum board to the framing members without any contact between the two components. According to the manufacturer, the system will reduce the amount of airborne sound filtering from room to room. Contact a local distributor for pricing. clarkdietrich.com

10. Efficient Heat Pumps
Mitsubishi Electric Trane HVAC US has expanded its M-Series with a new line of MSZ/MUZ-WR Model 16 SEER Heat Pumps, including indoor units, outdoor units, and controllers for residential and light-commercial use. The heat pumps are available in 9, 12, 18, and 24 kBtu/h capacity ratings. Each unit achieves an 8.0-to-11.0 energy-efficiency ratio and an 8.5 heating season performance factor. The indoor units operate as low as 22 dB(A), and the outdoor units as quietly as 46 dB(A). Contact a local distributor for pricing. mitsubishicomfort.com

11. Matte-Black Drains
Water-drain manufacturer Infinity Drain now offers a matte-black finish across its collection of drainage products. The popular color is available for several designs in the company's linear-drain-grate styles, including wedge wire, tile insert frame, and slotted, and in its center-drain styles, including tile drain, Moor, and weave. To prevent corrosion and abrasion, says the manufacturer, the finish is achieved through an e-coating paint process that incorporates nano-ceramic technology. Pricing for linear drains starts at $370 and for center drains, at $145. infinitydrain.com

12. Snap-to-Fit Window Trim
Alside has added new trim solutions for its Mezzo series of full-frame replacement vinyl windows. Designed to save time, labor, and materials, the Trimworks Decorative Accents are available in three profiles: brickmold, in $1\frac{1}{2}$-inch or $\frac{3}{4}$-inch sizes; $3\frac{1}{2}$-inch flat casing, available four-sided or with a bullnose sill; and flush mount, for masonry openings. Alside's SwiftLock technology allows the trims to snap-to-fit. All are available in three extruded vinyl colors and 10 painted colors. Contact a local distributor for pricing. alside.com

Cordless Concrete Mixer

BY JOHN CARROLL

Recently, I gave DeWalt's DCD130 60V Max cordless mixer/drill a tough workout while building a brick stairway, the kind of job that involves mixing up a lot of concrete and mortar. While it doesn't replace my favorite mixing tool (the Collomix Xo 4), I found it to be a stout cordless drill that can be used for drilling holes and driving screws in addition to mixing up mud for a variety of jobs. Powered by a 60-volt battery, it's geared low and runs at the right speed for mixing. If the bit binds up, the drill will stop turning thanks to its E-Clutch, a nice safety feature for a tool with this much torque.

DeWalt says that the tool can mix up to nineteen premixed 4.5-gallon buckets of drywall mud, seventeen 5-gallon buckets of tile mortar, or nine 5-gallon buckets of concrete on a single charge, a claim that my testing confirmed. I was able to mix eleven 80-pound bags of concrete on a single charge. I also was able to mix mud for an entire day of somewhat slow brick masonry work, recharging the battery once at lunchtime.

At first, the keyed chuck was a source of frustration because the mixing paddle frequently came loose as I mixed mud. My theory is that forcing the paddle through the dry mixture as I mixed it with water while moving the paddle up and down to reach the bottom of the tub applied too much stress. So I tried to be careful about how much mud I mixed up at once, and with how I combined the materials. Instead of adding water to a dry mix, I measured the water and poured most of it in the bucket at the beginning, then mixed in half the sand and all the dry masonry cement to make a soupy slurry. Finally, I put in the balance of the sand, which seemed to produce a good, workable mix without straining the machine. I also cranked the chuck as tight as I possibly could (using both hands) to make sure the mixing paddle stayed put, and that annoying problem was put to rest.

The DCD130 won't keep a masonry crew in mud or mix up more than a dozen bags of concrete, and it doesn't have enough power to mix up drypack for a tile floor. It will, however, supply all the mud a small drywall or tile crew needs, and if you also do plumbing or electrical work, it will power hole saws and self-feed bits through lumber with ease. Price is $350 (kit); $220 (bare tool). dewalt.com

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

Photo: John Carroll

The DeWalt DCD130 60V Max mixer/drill is a high-torque, low-speed tool capable of churning out nine 5-gallon buckets of concrete on a single charge. Equipped with an electronic clutch to protect wrists and hands in case of bind-up, the tool can also be used for drilling big holes in framing for drain and vent pipe or for driving large-diameter structural screws.

Finely-Evolved 'Whiskey Stick'

BY MARK CLEMENT

I adore the term 'whiskey stick' and the association it has with guys hand-nailing the houses that we, with our modern power tools and need for speed, now envy the craftsmanship of. (I'm told that the term refers to the clear vials in old spirit levels that were filled with colored alcohol to keep them from freezing.) But we probably wouldn't want their old, easy-to-knock-out-of-true levels.

Enter the dialed-in and detailed-looking new Kapro 905 Condor series of contractor box levels. Like the rest of the spirit levels in the Kapro lineup, the Condor line has the kinds of features that I look for—and rarely find—in a level.

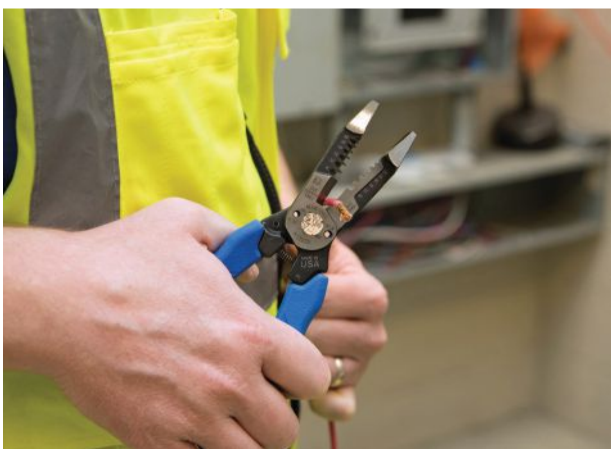
Obviously, I want the level to stay true, and this box level is fitted with solid-acrylic shockproof vertical and horizontal vials that look like they meet industry standards for this class of level. The company says that its horizontal Optivision Red vial is easier to read accurately than the standard vials on other levels, thanks to its highly visible red bubble edges, high contrast ratio between the bubble and vial liquid, and tilted angle, which offers a direct line of sight.

The company's Plumb Site Dual-View vertical vials provide both a front view of the actual vial and a unique reflected view that the company says provides a true plumb reading without parallax error. This is a welcome feature, as I know I've misread vials before when looking at them from an angle. Kapro claims that the vials are accurate to 0.5mm per meter, or 0.0005 inches per inch.

Another feature I look for in a spirit level is the ability to use the edge of the level to mark into a corner, say, for laying out shelves in a linen closet (I've never understood the value of an inset end-stop). Kapro's shock-absorbing bi-material end caps and built-in bridge at the horizontal vial provide a continuous marking edge all the way to the end of the level. And the beams have crisp, square edges, rather than beveled ones, which keeps my pencil from straying off course. Perhaps best of all, I found the non-magnetic 72-inch version of the Condor for less than $60 on Amazon (24-inch and 48-inch magnetic and non-magnetic versions are also available). kapro.com

Mark Clement is a JLC *contributing editor.*

Kapro's 905 Condor box levels have easy-to-read vertical and horizontal vials and shock-absorbing end caps.



Klein-Kurve wire strippers have comfy handles, shear-cutting knives for cutting wire and cable, and a large, knurled plier head for pulling and twisting wire.

Feature-Rich Wire Strippers

The Klein-Kurve heavy-duty wire stripper from Klein Tools features shear-cutting knives that the company says make it easier to cut copper wire and all sizes of larger type NM sheathed cable. The manufacturer says the tool is made from a proprietary U.S.-made steel blend that is four times stronger than that used for traditional Klein wire strippers, with a hot-riveted joint to prevent wobble and separation of the blades over time.

The tool has six stripping holes for use on 8 to 18 AWG solid wire and 10 to 20 AWG stranded wire, a large, knurled plier head to pull and twist wire, a wire looping hole, and holes for shearing 6-32 and 8-32 screws. The spring-loaded Klein-Kurve comfort grip handles have textured grips for reduced hand fatigue and integrated hang holes for easy all-day carrying. They're forged and heavy-duty, the company says, so they'll be hard to break. Just don't cut the hot with them.

They cost about $30. kleintools.com —*M.C.*

Biodegradable Work Gloves

BY STEVE MAXWELL

I'd been searching for biodegradable work gloves and finally found some that I really like. Made for people who do dirty jobs outside, Green Monkey 4-mil nitrile gloves are thin enough to let you grip well, but thick enough to stand up to abrasion. In addition to being among the nicest disposable gloves I've used, they're designed to biodegrade in 10 years in landfills, compared with the 200 years it takes ordinary disposable gloves to disappear. That's an environmental benefit that you can play up with your clients, and because they're made of hypo-allergenic nitrile, not latex, they don't present an allergy risk. A box of 100 gloves costs $20 on Amazon; buy size XXL if you want to be able to remove the gloves and reuse them without turning them inside out. watsongloves.com

Steve Maxwell has been building decks and more on Manitoulin Island, Canada, since 1985. He's the technical editor of Canadian Contractor*.*

Green Monkey's 4-mil hypo-allergenic nitrile work gloves are tough enough for the jobsite but are engineered to biodegrade in less than 10 years after they've been disposed of in a landfill.

Trim Demo Bar

The Dalluge 24-inch trim demo bar is one of those tools that just feels right. I saw it at the National Hardware Show in May, and it seemed well-designed for all types of activity—from demo to shimming to levering to pulling fasteners to scraping and wedging.

The tool—called Da Bar—is nice and light and has a chrome finish. While the website clearly states that the tool is "forged and tempered for strength," I had to stick a magnet to it to confirm it was steel rather than titanium like other Dalluge items.

The bar has both flat and claw-type prying surfaces that are 2 1/4 inches wide, extra width that I'm sure will be easier on drywall than a typical bar when removing trim; I still wouldn't try to pry the trim too far from a stud, though. The nail-puller slot looks like it'd be great for prying broken screws out on a deck re-skin.

The bar's length provides decent reach and leverage without the tool being too long to manage. While Vaughan told me it was a good tool for removing deck boards, it is made with three pieces rather than from a single forged piece. Just how that construction will affect its durability remains to be seen.

According to the website, vaughanmfg.com, the tool was created in Japan to Dalluge standards. It costs $35. *—M.C.*

Inspired by Japanese carpentry tools, Dalluge's forged and tempered 24-inch Da Bar 4420 has a pair of 2 1/4-inch-wide prying surfaces.

Photo, top right: Steve Maxwell

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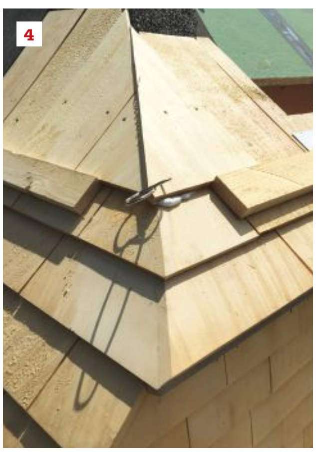
BY DAVE HOLBROOK



Shingling in Slo-Mo

Two years ago, on a previous Cregg Sweeney Artisan Builders job, I swore I was shingling my final roof … until Cregg dangled this project, which was too cool to pass up. There was nothing ordinary about this decidedly architectural, oceanfront house, to be clad entirely in Alaskan yellow cedar shingles.

Cedar wall and roof shingles are typically installed with a standard 5-inch (or so) exposure, with window, door, fascia, and corner trim providing ready boundaries that allow the work to be completed in sections, and relatively quickly. In this case, however, the architects dispensed with all exterior trim, calling for every course to be continuous, from wall across roof and back again on the far side, with woven corners, rakes, and hips. Built-in gutters replaced roof overhangs. In addition, wall courses were called out at a mere $2\frac{1}{2}$-inch exposure **(1)**. Well, easier drawn than done. At $2\frac{1}{2}$ inches, each course overlays portions of six prior courses, constituting an unusually thick buildup. Stacked this deep, the pileup grew concave, requiring us to press each shingle hard into position while nailing. Otherwise, the nailer would often blow the brittle shingle apart.

Another peculiar requirement was to make sure the eaves line was equal to the plane of the interior ceiling, calling for beveled shingle butts and precise layout **(2)**.

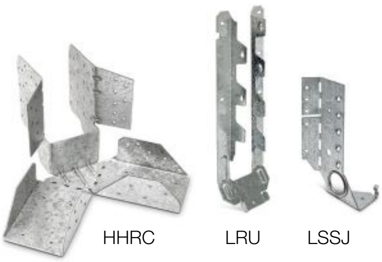
To ensure that the wall courses wrapped end-to-end true around the house, we relied on laser lines, targeting a story pole with a common reference line. Transitioning to the roof slope, the courses widened geometrically, to between $3\frac{3}{4}$ and 4 inches. However, since each roof course "inherited" and continued its adjacent wall course, no section of roof could advance beyond the highest completed wall section, so all areas had to come up in unison **(3)**. Wall corners and roof hips were woven **(4)**, using white Gorilla glue (it's waterproof and foams less and cures faster than the original formula), Collins clamps, and near-invisible stainless-steel pin-nails for reinforcement.

We used white or yellow chalk lines for every course, and, to avoid leaving nail holes when tacking up a guide strip, we hung it from thin aluminum flashing tabs, tacked with stainless staples above the exposure line. After a course is completed, the strip is driven downward, tearing the tabs free from the staples. It's a neat trick.

There was simply nothing fast about the job; space here doesn't allow inclusion of all the complications we encountered. I'd liken it to something between weaving a monster basket and installing scales on a really big fish. It's taken more than three months from base to ridge, covering about 60 square in all, with a crew of six to eight talented carpenters. Would any of us care to do it again? Well, I think this was my last roof, and one to remember.

Dave Holbrook is a freelance carpenter in Orleans, Mass., and a JLC *contributing editor.*

Photos: Dave Holbrook



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