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On the cover: The crew from Davenport and Lord, a foundation and piling company in Marmora, N.J., augers in a piling for a pier-and-grade-beam foundation in Cape May, N.J. Photo by Nate Eldon. See the story on page 29.

FEATURES

DEPARTMENTS

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BY MYRON FERGUSON

Drywall Hanging 101

Most carpenters and residential contractors will be asked to hang drywall at some point in their careers. Those who tackle the task with no experience and a "how hard can it be?" attitude are going to come away frustrated. Hanging drywall is not rocket science, but there are quite a few tips and tricks that can make the process go more quickly and efficiently.

Types of drywall. Drywall is essentially a sandwich with a layer of gypsum between a paper face finish side and a paper backing. The most common type of drywall is a standard 1/2-inch board. Fire-resistant (Type X or Type C) drywall, which is 5/8 inch thick, is often required on ceilings. You can also get a wide range of other types of drywall, including water-resistant; abuse-, mold-, and impact-resistant; sound-absorbing; formaldehyde-absorbing; paperless; and foil-backed.

In addition to carrying various types of drywall, supply yards carry a variety of lengths, but the sizes available can depend on what region of the country you live and work in. Where I live in upstate New York, I can easily get 8-, 9-, 10-, 12-, 14-, and 16-foot lengths in 48-inch widths, and I can even get 12-footers that are 54 inches wide **(1)**.

Fasteners. I recommend bugle-head drywall screws to fasten drywall. Use coarse-threaded screws for wood framing. Screws only need to penetrate wood a minimum of 5/8 inch, so for 1/2-inch-thick drywall, 1 1/4-inch screws work best. For steel studs, I use 1 1/4-inch self-drilling drywall screws.

Drywall cutting tools. Most drywall cutting is done with the "score-and-snap" method, using a utility knife for the scoring, but a drywall utility saw is necessary for making cuts where you need to notch the material or make more than one cut in a sheet to remove a section **(2)**. A drywall router can also be handy for cutting out electrical boxes, but that tool does come with a learning curve.

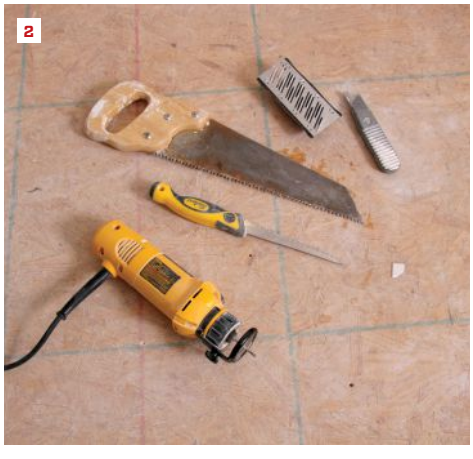
Crosscuts. For making cuts across a sheet using the "score-and-snap" method, a drywall T-square is a must. When setting the blade of a T-square at your measurement, get in the habit of holding the bottom of the blade with your foot to keep it from moving as you score the sheet with your utility knife **(3)**.

To cut a sheet to length, place the T-square on the measurement mark and score the paper face with a sharp utility knife **(4)**. Then snap away from the side you scored and run the knife down the opposite side **(5)**.

Don't try to be too precise with your measurements and cuts—doing so is a mistake that carpenters routinely make. Drywall should never be cut for a tight fit. Sometimes you can get a tight fit to work, but most often, the edge of the sheet will break or blow out as you try to push it into place.

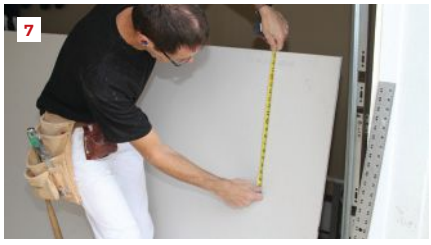
Typically, the ceiling panels are installed first, and the wall panels are butted to the edges. This gives you a lot of tolerance with fitting ceiling panels. Any slight gaps at these corner intersections will be covered by the abutting panel or by taping and finishing **(6)**. I usually aim for 1/4 to 1/2 inch shorter than the actual measurement.

Place the cut end, not the factory edge, of the sheet in the corner. If the wall is longer than the sheets you have, hang



Photos by Linda Ferguson

Drywall comes in many different lengths and widths **(1)**. Common tools for working with drywall are routers, drywall saws, and utility knives **(2)**, as well as drywall T-squares that help guide crosscuts **(3)**.



To cut a sheet of drywall to length, set the T-square at the measurement and score along it with a sharp utility knife **(4)**. Hold the square in place with one foot. Snap the piece back and cut through from the opposite side **(5)**. Don't cut too precisely—small gaps in corners are covered in the taping process **(6)**. Score a rip by pulling the utility knife and the bottom of your measuring tape along the sheet **(7)**. Snap the sheet back and score from the other side to remove the rip **(8)**.

the full-length sheet first. Cut the sheet for the rest of the length and install it with factory edges of the two sheets mating (more on that later). If you absolutely have to mate a factory edge with a cut edge, allow about 1/8 inch to compensate for any irregularities in the cut.

Rip cuts. For cuts along the length of a sheet (rip cuts), I use a tape measure and utility knife. I pinch the tape between my thumb and forefinger at the measurement I need to remove, and then let my finger ride along the top of the sheet while I score the sheet with a razor knife held against the hook of the tape **(7)**. The trick here is keeping the tape perpendicular to the top edge for a straight score.

When I've scored the entire length, I snap away from the cut as with the end cut. But this time, gravity is working against you and wants to rip away the part you scored. Have another crew member help hold the sheet while you cut the score from the back **(8)**. With practice, you can do this by yourself.

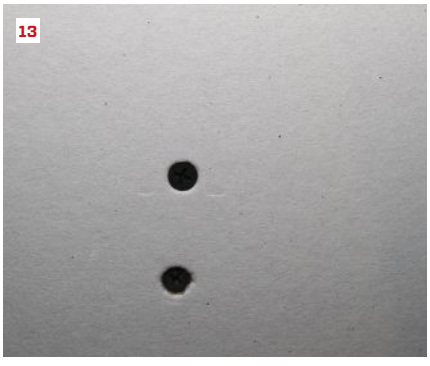
Don't be overly concerned if the cut is not perfectly straight. Remember a tight fit is not necessary. For beginners, snapping a chalk line might be easier than trying to use the tape-measure-and-knife method. And you can always use a drywall rasp after the cut to clean up the edge if you need a better fit **(9)**.

Top panel first. When hanging drywall, always put the ceiling panels in first. That way, the edges of the ceiling panels are supported by the wall panels. Here, we are focusing on walls, so let's assume that the ceiling drywall is already in place. In residential construction, the walls are usually hung horizontally because there is less waste compared with a vertical installation.

The top panel should always go in first. If necessary, cut the board to length. Next, set it on the floor directly below where it will be installed and mark the stud locations along the top edge **(10)**. Lift it into place with a helper **(11)**. Once the top edge is pushed up tight to the ceiling, drive a couple of fasteners at one end to tack the board in place. Then fasten the field, working toward the opposite end.

The main concern for the drywall finisher is a quality finish, and this starts with having to tape as few seams as possible. Starting with a full-width sheet means just a single horizontal seam on the walls for most rooms.

Bottom panel. After fastening the top sheet in place, cut the bottom one to length. With many of the houses I work on, I can use a full sheet on both the top and bottom and still have some leftover height to maneuver the sheet into place. If there isn't enough room for a full-width sheet on the bottom, rip off enough to allow a 1-inch gap along the floor. Always put ripped edges along the floor and put the tapered factory edges along the seam.



A drywall rasp can clean up a rough edge **(9)**. Mark stud locations before lifting the sheet **(10)**. You can cut out for windows before lifting, but it's quicker to first lift **(11)** and fasten the sheet in place and then cut around the frames with a router. A drywall foot lift snugs the bottom sheet against the top sheet before fastening **(12)**. The top screw is driven properly, but the bottom screw has broken the paper around the screw head **(13)**. The author attaches a splicer to land a butt seam between studs **(14)**.

To snug the bottom sheet against the top, use a drywall foot lift **(12)**. A pry bar will also work but typically requires a scrap piece of drywall or wood as a fulcrum to give it enough lift.

Fastener depth. The tip of a drywall screw gun is designed to drive fasteners to the proper depth. Don't force it. The top of each screw should be about 1/32 inch below the panel surface. If the screw breaks the face paper, then it is too deep. If a screw is too deep, I drive an additional screw about 1/2 inch away **(13)**.

To fasten walls, I drive screws every 16 inches along each stud 16 inches on-center. If there are intermediate studs closer together, I often skip them. I try to keep the bottom course of screws close to the floor so the baseboard will cover them, and close to window and door rough openings so that the casing will cover them.

Openings. If I have to work around a window on the wall, I tack the full sheet in place and cut the opening by following the outside of the frame with a drywall router. For doors, I install a full sheet across the opening. After cutting up both side jambs with a drywall saw, I score the sheet from the back along the header. I snap the sheet away from the score cut, and then follow the cut line on the finish side with a utility knife and snap to remove the piece over the opening.

Butt seams. I always try to cover the length of a wall with a full sheet if possible. If a butt seam is needed, it's fine to have the seam land above or below a window as long as the seam is at least 7 inches from the corner of the opening. Never place a seam in line with the edge of a window or door—it is a sure recipe for a future crack.

When I do have to splice in a piece on a long wall, I end the sheet between studs and use a RockSplicer (Wilco Drywall Tools) to join the butted seam. (Trim-Tex ButtBoards also work.) I hang the first sheet and slide the splicer behind the end of the sheet, fastening the end of the drywall sheet to the splicer **(14)**. When the second sheet attaches to the RockSplicer, its slightly raised edges cause the drywall to bend in slightly. The spliced seam is very stable, and the depression created by the RockSplicer makes the seam easy to hide with tape and compound.

Myron Ferguson is a drywall and home performance contractor in Galway, N.Y., and a presenter at JLC Live.

For a more detailed discussion on installing cedar shingles, go to **jlconline.com/training-the-trades/drywall-hanging**.

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Q Does the code in all parts of the country require tempered glass for a window seat?

A Glenn Mathewson, code educator and consultant from Colorado (buildingcode college.com), responds: Code questions like this can be tricky because the answer can vary with individual jurisdictions. While the International Code Council (ICC) does publish a standard for residential construction, it's still up to each individual AHJ (authority having jurisdiction) to choose what model code to reference and whether to amend it. Whenever you have any doubt about a local code issue, the foolproof solution is to talk to your local authorities.

According to the 2018 International Residential Code (IRC), the easy answer to this question is "no." Code does not require tempered glass for a window seat, but that doesn't mean that tempered glass in this situation isn't a good idea. Code standards are often mistakenly thought of as the best standards, even though building code requirements are actually the "minimum standard." Meeting the code could be A-plus work, but it could also be D-minus, a mere passing grade and probably not something to brag about.

As far as the IRC is concerned, tempered glass, or "safety glazing," is required in areas identified as "hazardous locations." What these locations have in common is the existence of a hazard while occupants are on their feet. A few examples of hazardous locations are bathroom floors, stairs, ramps, and areas where glass is too close to the floor. All of the locations where safety glazing is required reference "walking surfaces," "standing surfaces," or "the floor." A window seat is meant for sitting—and there is little probable hazard in that stationary activity.

It's always possible to come up with "what if" scenarios in which someone, perhaps a child, could run across the seat or stand on it, but the code minimum standard is not meant to protect us from every bad idea we can imagine. Building codes are intended to protect us from probable hazards, not possible ones.

As responsible contractors, though, we can do better than D-minus. For ourselves and for our clients, we can look beyond what the government authority requires and consider what's best for the occupants of the home at the time. Are there children? Do the clients already have safety concerns? Is there a high fall hazard outside the window? Is the seat going to get daily use as a seat for a breakfast nook or dining table, or is it going to be more of a decorative element? Should you even build a seat where the back is a window? And what about the fall hazard when the window is opened? These are just some of the questions to consider when deciding a client's expected and affordable grade of safety.

While you weigh all the various issues around your client's safety, consider that replacing or reglazing a window with tempered glass isn't the only way to achieve the benefits of safety glazing. For situations that require safety glazing, the IRC details two standards. These standards can be met by applying various proprietary films on existing windows, somewhat like applying tint on your car windows. While typically marketed for security purposes, these products often meet the standards for safety glazing—CPSC 16, CFR 1201, or ANSI Z97.1—and might be a less expensive way to achieve peace of mind for your clients.

Tempered-glass etching. This etching (shown several times its actual size) on the corner of a glass panel indicates that the glass is tempered. Tempered glass is stronger than conventional plate glass and is used in situations where stronger glass is required, such as for windows at the bottom of a staircase or in a bathroom where a wet floor can be a walking hazard.

Photo by Glenn Mathewson

Q Which is better for attaching sidewall shingles, nails or staples?

A Chris Yerkes, a cedar-shingle installer certified by the Cedar Shake and Shingle Bureau (CSSB), and owner of Cedarworks, in Brewster, Mass., responds: When I started in the sidewall-shingling business, I was taught the old-school hand-nail method for attaching shingles. Now I’m the ripe old age of 47—and I was probably one of the last to be taught this bygone method.

In my experience, staples have much better holding power than nails. They are an accepted fastener by shingle manufacturers such as SBC and Maibec. When properly installed, a staple grabs and holds more material than the small-head nail could ever hope to.

The installation manual for the CSSB says that staples for attaching sidewall shingles must be stainless steel. Much of the work I do is on Cape Cod within 15 miles of saltwater, so I use Type 316 stainless steel. (Type 316 is a higher grade than Type 304, which is acceptable in many other locations.) The staples should also have a minimum crown width of 7/16 inch and should be long enough to penetrate the sheathing 3/4 inch (or all the way through). The same fastener-location guidelines should be followed for staples as for nails: 2 inches above the butt line and 3/4 inch in from each edge.

Pneumatic guns are used to drive staples, and it is important to keep the air pressure adjusted so that the staples are driven to the correct depth. As with nails, overdriven staples break the surface of the shingle, which weakens their holding power. Proper stapling also means keeping the staple crowns horizontal (or level). The farther off horizontal the staple is driven, the closer together the staple points are and the less wood is captured between the points. An experienced installer always keeps the staple gun as close to vertical as possible, so the crown is as close to horizontal as possible.

That said, staples aren’t a good option for face-nailing. For areas such as on the courses directly below a window or in other places where the fastener will be exposed, there is no substitute for the look of good old-fashioned nails.

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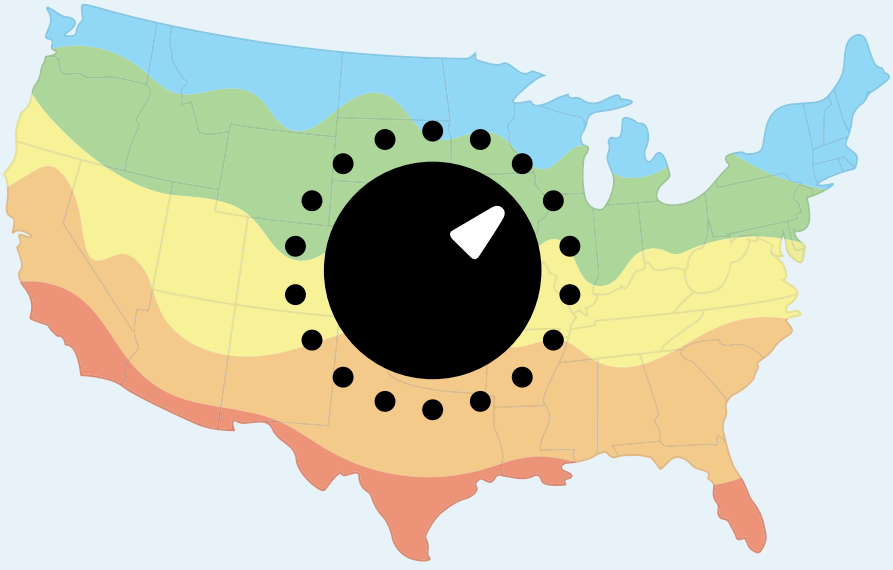

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The OSB-sheathed double stud wall had limited drying in the outward direction, and in this cold climate, posed a risk of condensation **(1)**. Some of the external wall cavities were cluttered with wiring, meaning that a careful (and inspectable) insulation job was critical to performance **(2)**. The author chose to use netting to contain the blown insulation, and then apply Majrex directional vapor control membrane as a control layer for air transport and diffusion of vapor, allowing the building to dry to the interior if needed **(3)**.

Photos by Tim Healey/JLC

On Site With Majrex

BY JIM BRADLEY

Good building science is important for every house in any climate—and homes with double stud walls and cathedral roofs in a cold climate are certainly no exception. And if you must do one thing, it's this: Make sure the wall and roof assemblies have the ability to dry.

As a construction manager for a custom homebuilder in northern Vermont, I take responsibility for the implementation of energy-efficiency details, as well as the critical building-science details. A large custom home we're currently wrapping up on the shore of Lake Champlain is a worthwhile example.

The double stud walls, sheathed with Zip System OSB panels, are 13 inches thick, and the unvented low-slope roof is framed with 18-inch-deep wood I-joists. Wall and roof cavities are both insulated with dense-blown cellulose. The roof also has another 1 to 4 inches of polyiso under the TPO membrane roofing.

In this example, where outward drying is constrained (especially for the roof), we've chosen to set up reliable drying to the interior. To do this, we installed Majrex directional vapor barrier membrane on the walls and ceilings, with the directional drying face pointed toward the interior.

THE DIRECTIONAL VAPOR CONTROL LAYER

For this application, we needed a variable vapor control material that permits good inward drying in summer, but slows the outward vapor drive in winter. Either Intello (from ProClima) or Majrex (from Siga) will perform in this way, as will MemBrain (from CertainTeed). For this project, we chose Majrex.

Carefully installed, Majrex controls vapor diffusion as well as air transport of moisture, but it's only as good as the installation details. With any moisture-control strategy, it's critical to control both air transport and diffusion of vapor, and to avoid discontinuities in the materials. The good vapor control achieved by this fabric could be compromised if we allowed air-driven moisture to bypass the control membrane. So we covered every inch of the interior, and we were careful to tape-seal around every outlet, every light fixture, and every penetration of any kind, as well as along the floor and the ceiling.

THE ENERGY CHALLENGE

This house is high performance, but only moderately so. The clients in this case didn't place an especially high priority on energy efficiency or power bills; they were more concerned with comfort and appearance. Large expanses of glass, for example, make the most of this home's exceptional water views (see "Installing Lift-and-Slide Doors," Apr/18); but all that glazing is a challenge for the space conditioning system.

Even so, our advisors at Efficiency Vermont, the state's energy-efficiency utility, are confident that the home's mini-split heat pumps can do the job. However, the owners wanted to be sure their floors wouldn't be cold underfoot, so we have also installed radiant-floor-heat tubing under the main floor's concrete slab, as well as beneath the bedroom floors. Highly insulated wall and roof assemblies were key to helping this custom package perform effectively.

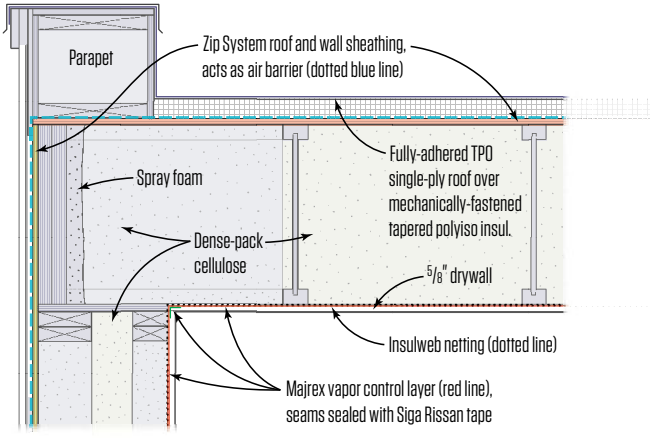
COLLABORATING WITH THE TRADES

In theory, you could use a membrane such as Majrex to contain your dense-blown cellulose insulation. In practice, that's not a great idea. Too many times, we have tried to dense-blow against a membrane in this class, and then when we come back later to inspect, the insulation has settled. The membrane seals so well that the blowing machine's air can't get out of the cavity, so the insulation stays fluffed up and doesn't pack densely enough. The manufacturers suggest cutting escape holes for air in the membrane, but that complicates the taping job. So instead, we used open netting to contain the insulation. That way, we would get a good install job and the ability to inspect easily. The added cost was negligible.

The insulation crew was fine with this, of course. But we had trouble later with the drywall crew. The first drywallers we hired had never worked on a house with this vapor-control detail, and when they arrived to hang drywall, they realized they couldn't use their usual methods. We had carefully sealed all the outlets and other penetrations, and they wouldn't be able to hang their sheets and then buzz out all the openings with a RotoZip—that would break all our well-crafted air seals. After a heated discussion at their van, that crew drove away without doing the job, and we had to find another contractor. Interestingly, the new drywallers we found were able to give us some practical tips about how to complete our air seals without interfering with their work. That's the future of high-performance construction: collaboration among the trades.

Jim Bradley is a project developer and manager with Hayward Design-Build in South Burlington, Vt.

Directional Vapor Control Layer



The airtight outer skin of this building didn't allow good drying for the dense-blown, thick wall and roof cavities (illustration, top). The crew stapled up directional vapor barrier material after the cavities were blown with insulation **(4)**, taking care to seal all the seams at wall-to-ceiling intersections **(5)**, as well as around fixtures and wall penetrations **(6)**.

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PRO THE HOME DEPOT

Concealed Gutters for a Modern Lake Home

BY JOE GRAINDA

My company recently built a large, high-end house with a modern design on a North Carolina reservoir. One of the most prominent features of this home was a wide overhang whose projections varied from just under 3 feet to more than 7 feet in some sections (around 4 feet was the typical overhang for most sections of the multiplane roof).

As a design element, the wide overhang provided ample shade and helped keep rainwater away from the structure, but it presented two challenges. First, to manage roof runoff, the owner (a successful concrete contractor who is very aware of water and site drainage issues) wanted gutters to collect the runoff from the vast and complex roof and deposit it far from the home's foundation. With wide overhangs, however, conventional downspouts on the exterior of the house were out of the question.

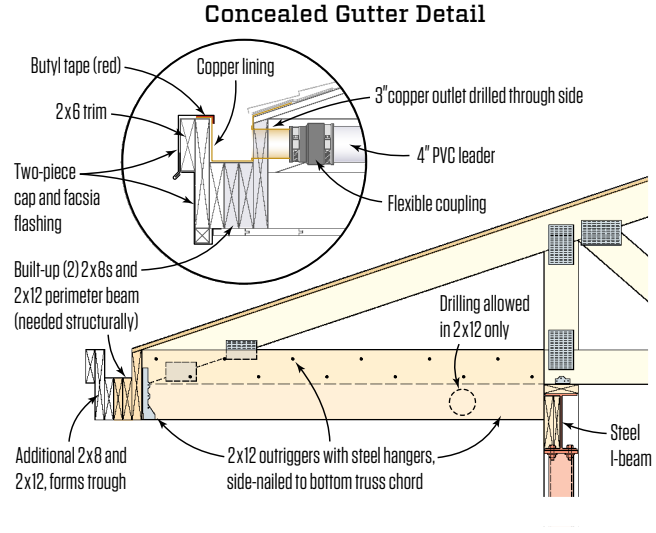
Second, in the wind zone for this North Carolina site, wide overhangs present an extreme uplift condition. To overcome these intense forces, the engineer specified some substantial structural elements to strengthen the roof. By cleverly integrating a unique system of concealed gutters with these structural roof elements, our team was able to successfully manage both challenges.

STRUCTURAL ELEMENTS

We framed the roof with trusses, but in order to handle the reaction forces at the fascia end of these trusses, the engineer specified a perimeter beam to tie the ends of the trusses together. We built up this structural component from a 2x12 and two 2x8s sandwiched together. This perimeter structure was secured to 2x12 outriggers with steel hangers and side-nailed to the overhang portion of each truss. The outriggers braced the perimeter beam back to a continuous steel I-beam that tied the tops of the exterior walls together (see illustration, right).

DRAINAGE COMPONENTS

To form the gutter trough, we added another 2x8, followed by two 2x12s, to the perimeter beam. While these framing members were not strictly needed for the structure, they didn't hurt and they provided an easy means to create a channel that we could line with copper to create an integral gutter around the perimeter. In a few cases, the channel beams were placed high



The engineer required three 2-bys for a perimeter beam; the outer members complete the gutter channel **(1, 2)**. Multiple 3-inch drainage outlets Y together and step up to 4-inch runs through the soffit area **(3)**. Vertical drains were routed through several concrete chimneys. Note the rubber sleeves connecting the PVC to the copper outlets at the gutter, and the transition to cast iron where drains run near living space **(4)**.

Photos by Granda Builders; illustration by Tim Healey

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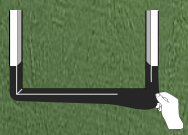

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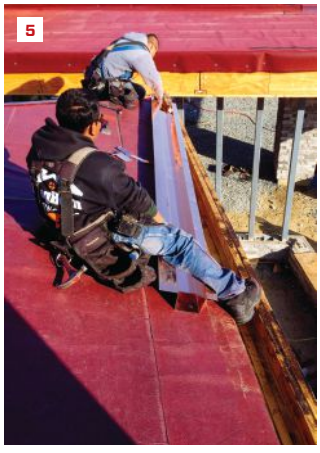
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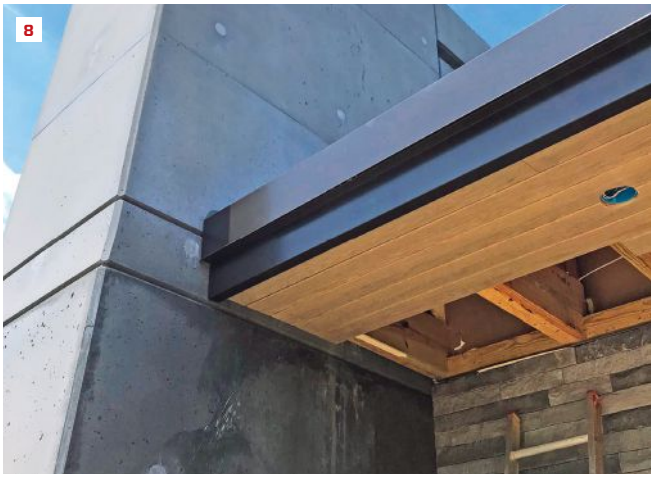
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Long runs for the copper liner were bent off site **(5)**, while the end caps **(6)**, corners, and outlets were fabricated on site, and secured with both rivets and solder **(7)**. The roof was dried-in early; the tape was temporary until the roof could be installed. A two-piece fascia cap and T&G soffits **(8)** finish off the installation. The entire gutter system is completely concealed.

enough on the roof that we could drill drainage outlets in the bottom of the channel. But in most cases, we had to drill through the side. The engineer allowed us to drill through the beam, but we had to limit the hole diameter to 3 inches.

To handle the sheer volume of water we expected from seasonal Carolina storms, we ganged multiple outlets, and enlarged to 4-inch pipe inside the eaves structure to reduce the number of leaders. To accommodate differential movement between the copper outlets and the PVC drains, we connected our drains to the gutter using rubber sleeves.

The PVC drains ran through the soffit area, turning to run parallel to the exterior walls. The engineer allowed us to drill through the 2x12 outriggers, as well, but not through the truss chords. While we didn't have a lot of room, we were able to pitch the drainage pipes to achieve the required 1/8 per foot (1%) slope needed for 3- and 4-inch pipe.

To drain out of the eaves area, we ran the PVC to numerous chimneys placed along the exterior walls. We core-drilled through the formed concrete chimneys to run our verticals inside to the foundation level. In areas where the vertical drains ran near living space, we transitioned to cast iron to limit noise. We then transitioned back to PVC below floor level where the drains joined to exit alongside the foundation perimeter drains to daylight, far from the house.

FINISH DETAILS

We pre-bent the long copper troughs off site and site-bent the end caps and outlets, mechanically joining the copper with rivets before soldering watertight seams. All this work was done after the roof had been dried in, so after installing the copper liner, we taped along the edge of the copper as a temporary measure until the roofing could be installed.

To finish off the fascia, we installed a two-piece aluminum fascia cap. The first piece nailed to the outer 2x12, and was counter-flashed by a second piece that locks in with cleats, so there were no visible fasteners from the ground. This second piece overlaps the copper liner but is separated with butyl tape so the two metals do not have a chance to galvanically react.

Once the project had been completed, you wouldn't know there were any gutters and downspouts on this roof. Yet this summer, a number of torrential thunderstorms have already passed through, and the system handily carried all the runoff away with no detectable spillover.

Joe Grainda is the president and founder of Grainda Builders, a luxury homebuilder based in Cornelius, N.C.

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BY DAVID GERSTEL

Nail Your Labor Productivity Numbers

Note: This article is the third of a four-article series adapted for JLC *by David Gerstel from his new book,* Nail Your Numbers: A Path to Skilled Estimating and Bidding.

Estimating labor costs for an in-house crew is the most severe challenge facing estimators. That's not surprising, because labor cost is the most difficult number to get right in cost forecasts for many types of production. In manufacturing, actual labor cost often varies from the projected "ideal" cost of labor by 100%. By the time bathroom breaks, overly long pauses for lunch, chattiness, absenteeism, turnover, equipment breakdown, and the impact of hazards on the factory floor have been figured in, labor hours actually spent to produce a given item may bear no resemblance to the hours projected in a manager's quiet office.

In construction, the factors eroding labor productivity are even more varied than on the floor of a manufacturing plant. Among the most impactful:

- **Weather.** Heat can sap workers' energy, cold requires cumbersome clothing, and rain or snow will turn worksites into muddy bogs or treacherous obstacle courses.
- **Distractions.** Sometimes, designers or clients hover around the worksite distracting tradespeople. I once had a client who stopped my lead carpenter several times hourly with suspicious questions. I told the client that if he wanted his job well done, he should knock it off. He did, switching to equally distracting lavish compliments several times an hour.
- **Injury.** It can knock a crew lead out of commission for an extended period, throwing a job schedule out of whack and lowering productivity.

Given all the pitfalls, how do we best take on the challenge of estimating labor costs for a new project? Before I give you my idea, let me mention two approaches about which I am dubious. The first is the use of cost catalogues—whether in digital form or as paper books with their hundreds of pages of tables of material and labor costs. The problems with the catalogues begin with their admonishment that you must not just pluck a number from a book, but have to run the number through a gauntlet of modifications to adjust it to your particular circumstance. The problems end with the announcement that after you have forked over your money for the catalogue and done all the work of retailoring the numbers, you alone are responsible for the validity of the costs you have come up with. The publishers disclaim responsibility—though they will eagerly take credit for your success if you happen to get your estimate right.

> He did not try to dignify his process with fancy language. Before I could characterize it, he described his estimator's use of job cost records with dismay. "We just shuffle around, going back and forth between half a dozen of them," he said. "You can really go down the rabbit hole."

The second dubious approach is reliance on "job cost records." Such records do have value for tracking costs on projects while they are under construction. And for estimating, they are more useful than the catalogues; they are at least records of your own cost experience rather than the fictional average of a multitude of other builders' costs like those offered in the catalogues.

Even so, for the purpose of estimating the labor costs—as opposed to monitoring a project—job-cost records are of marginal value for three primary reasons:

- **Don't record productivity.** Job-cost records may record only the dollar costs of phases of work, not productivity—the hours of labor spent on the work. And because wages and the related burdens (like unemployment insurance) fluctuate, the dollar cost of labor done in, say 2014, is likely to be useless a few years later, or even sooner, for estimating costs for a new project.
- **Units not practical.** Job-cost records typically report figures for assemblies that are too large to be useful for precise estimating. For example, costs will be monitored for the framing of a project in entirety—from setting the mudsill through sheathing the roof. But for estimating for future projects, you need cost figures for more finite units, such as wall frames; wall sheathing; floor joists; subfloor; rafters; installing new windows in existing walls; replacing an

existing wall with a beam and posts; and the like. Knowing the labor hours for framing a whole project will not get you much past guesstimating the cost of framing another project that is not identical in all respects.

- **Mismatched to the project.** Job-cost records are not easily accessible. How do you use them for estimating? You shuffle through old records hoping to find one for a project that at least vaguely resembles the one you are now estimating. "Hmm," you say to yourself. "The framing for this addition we did for the Westbrook family in 2016 looks like it's about the same scope of work as this new one for the Durants. Wait! No, the Durant's is maybe 20% smaller. Okay. We'll figure Durant will use 80% as much labor as Westbrook did. Or maybe we should go with 75%. No, that feels too tight. Let's go with 85% of the labor we needed at Westbrook. That feels safer."

When I was interviewing builders as part of the research for my new book, one builder took offense when I asked, "So you are saying that you sort of shuffle through your job cost records to project costs for your crew's work on a new project?" He preferred to think of his process as a "primitive yet effective iterative procedure" in which he went back and forth between records for old jobs and the estimate for his new one until he had a figure he hoped was about right. Later, I interviewed one of his prime competitors who, as it turned out, uses a similar "iterative" process. But he did not try to dignify it with fancy language. Before I could characterize the process, he described it with dismay. "We just shuffle around in the job-cost records, going back and forth between half a dozen of them," he said. "You can really go down the rabbit hole."

There is a much better alternative for estimating labor productivity: It is described in a five-word phrase, which we will break down word-by-word. Here's the phrase: *Narrative Historical Labor Productivity Records.* In my new book, there are eighteen samples of such records. One is shown here, at right.

The records are *narratives* because they tell the whole story of the installation—in the case of the illustrated sample, that is the story of installing a new foundation in place of an old one. Every story involves characters, place, and time. As you can see in the record, the story of the foundation involved four primary characters—the crew members Frank, Daniel, Smitty, and Kevin—and also a capable engineer and good clients. It took place on a sunny, dry, flat site during the spring. And it used 534 hours of labor—or 3 hours per linear foot.

The records are *historical* because they report actual events. In other words, the hours per unit productivity figure is nonfiction. It's the real deal. It is not the sort of fictional average you encounter in cost catalogues.

The records are about *labor productivity* because you get a labor productivity number, a cost per unit of work—in this case, the 3 hours of work per foot of new foundation—on the bottom line. That unit cost is useful! It's what you are after. Here it is figured for 175 feet of foundation. But if a future project includes 142 feet of foundation replacement to be built by a similarly capable crew under similar conditions, you can apply the unit cost and estimate that the new work will take 426 hours (142 x 3 = 426).

And the records are *records*, because they are not mere memories but are written down.

In summary, what we have here are *narrative historical labor productivity records*. For short, you can think of them as "labor productivity records" or just "labor records." When I first began keeping my labor records, I wrote them out by hand on a pre-printed form. Now I word process them, print them out, and organize them in a three-ring binder. I find it very efficient to just flip through the pages in the binder, coming to records for items in the same order—the natural order of construction from foundation through finish—as they occur in my estimating spreadsheet. But you might prefer to keep

DAVID GERSTEL / BUILDER
Labor Productivity Record #7

ITEM OR ASSEMBLY: Foundation Replacement
Included: Layout, trim trench, set rebar & ABs, install concrete, strip & clean, backfill, remove extra soil.
NIC: Shoring, Remove (E) foundation & excavate.

QUANTITY & DEGREE OF DIFFICULTY of ITEM: 175 l.f. 18" x 18" footing. 12" x 16" stem. Tough work. Low crawl space. Crew on knees much of time.

PROJECT: Replacement foundation for two-story 1908 house. College Ave.
TIME OF CONSTRUCTION: Spring
CLIENT: Schneider – Delightful. Kids named dolls after crew!
DESIGNER: Pe (engineer). Really good drawings. Responsive.

ACCESS: Low crawl space. Flat lot right on quiet street with parking.
WEATHER: Sunny. Dry.
OTHER FACTORS: Crew morale high due to weather and clients.

CREW CAPABILITY:
Lead: Frank P. – Highly experienced and efficient.
Journeyman: Daniel M -- Good -- 3 yrs. w/Frank.
Apprentice: Smitty – A bull. Worked for Frank on several earlier jobs.
Laborer: Kevin, steady worker from labor pool.

HOURS PER CREW PERSON:
Lead: 162 hrs.
Journeymen: 146 hrs.
Apprentice: 146 hrs
Laborer: 80
TOTAL HOURS: 534

HOURS PER UNIT: 3 hrs/l.f.

Sample labor productivity record. Think of a productivity record as a narrative telling the story of an installation, in this case of a foundation replacement. Like any good story, it includes characters, time, and place—the crew that did the work, the time it took them to complete the work, and the site where they performed the work. Crucially, the record boils time down to a unit cost, which in this case is hours per linear foot, that can be used in future estimates.

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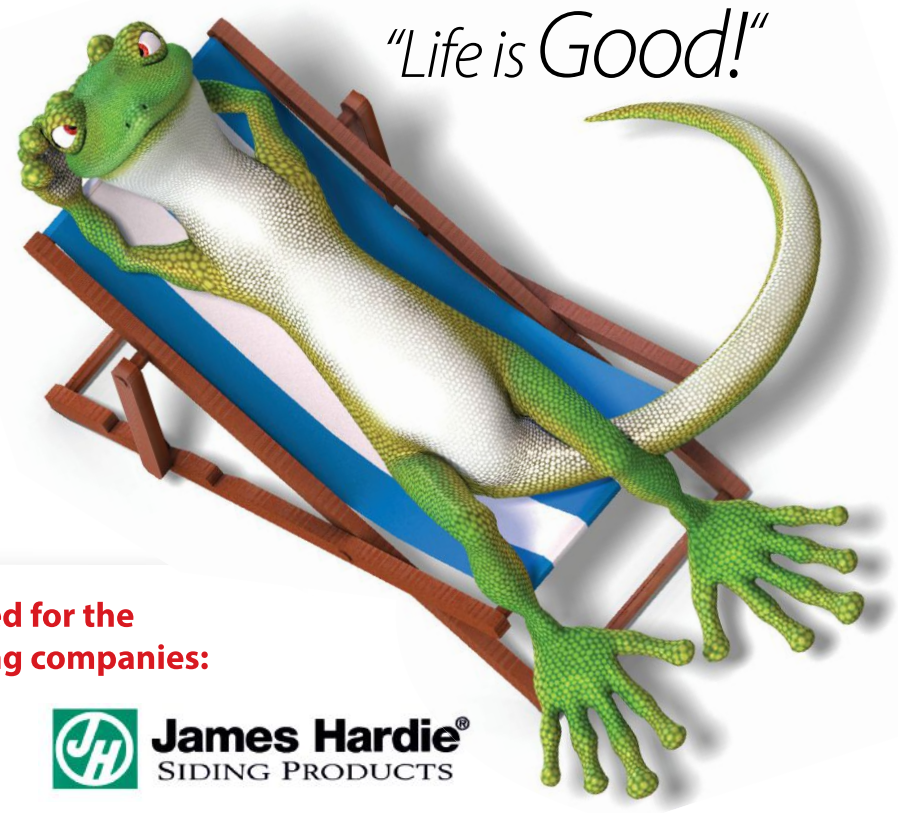

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the records in a computer folder, in turn divided into subfolders, one for each division of work in your estimates. You can then open subfolders for the relevant divisions and click open the needed records for items and assemblies as you work your way through your estimate. Whether they are in a binder or in computer folders, after building many estimates with use of your productivity records, you will hardly need to refer to them. You will have them memorized. You will move fast, yet produce accurate estimates.

There is one hurdle every builder has to clear in order to create reliable labor productivity records: That is getting crew leads to produce the reliable time cards from which those reliable records can be created. Doing so is a challenge in and of itself. It is one I address in *Nail Your Numbers* and that, perhaps, I can discuss in a future article.

Once you have mastered time-card production, accumulating a basic set of records is a task that can be accomplished with a couple of hours of work a week over a year or so. From six or eight remodel projects, you can gather a varied collection of records by compiling half a dozen from each project. From construction of a single house, you can build basic records useful for all future house estimates. You should, however, go beyond building basic records for three reasons. First, as new materials come into use, you will want records of your crew's productivity for installation of those materials. Second, you will want to create records for unusual items and assemblies, like framing an eyebrow dormer. And third, because your crew will probably evolve—even if you run the kind of company where employees are treated with respect and fairly paid so that turnover is very low—you will want to add records for your newer crew formations.

You will find it valuable to accumulate records for differently sized units of work—from small items to complicated assemblies, from installation of a header in an existing wall to standing a wall frame with all work from layout through plumbing and lining and sheathing included. You might even want records for yet more extensive assemblies, say a wall assembly with not only framing but also windows, insulation, WRBs and flashing, rainscreens, and cladding all included.

Whatever your choice, you will want to bear down especially on developing records for what I call the "slipperies," the greased pigs of estimating, those items that frequently elude estimators and escape inclusion in bids altogether. Blocking is one such slippery. It's easy to dismiss it as minor miscellaneous stuff and skip over it entirely in an estimate. But one veteran estimator I interviewed for *Nail Your Numbers* bore down on the cost of blocking. She discovered that it consumed as much as 4% of total framing costs on complex new homes! That amounts to a substantial portion of the potential profit associated with the framing.

Of course, creation of thorough and accurate estimates involves much more than nailing your labor costs via reliable labor productivity records. You need, among other things, a comprehensive spreadsheet and checklist. You need a process for producing accurate takeoffs. You need another for gathering reliable supplier quotes. And you must have a system for obtaining comprehensive sub quotes so that you do not end up holding the bag for overlooked items. That system is the very subject I will take up in my next article.

Here I would like to conclude by requesting that if you have not already done so, please start building your file of narrative historical labor productivity records as soon as possible. They are the essential stepping stones out of the quagmire of estimating via cost catalogues and job-cost records. No one should spend their career in that swamp or have the experience of the builder whose project manager told me, with dismay, "he still misses framing costs by 50%."

That builder is a friend of mine. I respect him because he relates to his crew with great respect for their abilities and looks after their needs as well as his own; and because, as a result, his crews produce excellent work and his clients adore him. But it's taken my friend decades to realize that he needs to develop a file of labor productivity records, that it won't do to flounder around in job-cost records and mis-estimate his costs by such wide margins any longer. There is really no need to delay for so long. Any builder who has not already done so can start building labor records today, or tomorrow at the latest.

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

Estimating with your labor productivity records organized in computer files enables you to more easily include photos of the project with each record. Using two computer screens, one for your productivity records and the other for your spreadsheet, allows you to move more efficiently from spreadsheet to records and back.


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A Pier-and-Beam Foundation, the Jersey Way

Concrete, rebar, and 84 driven piles create solid support

BY NATHANIEL ELDON

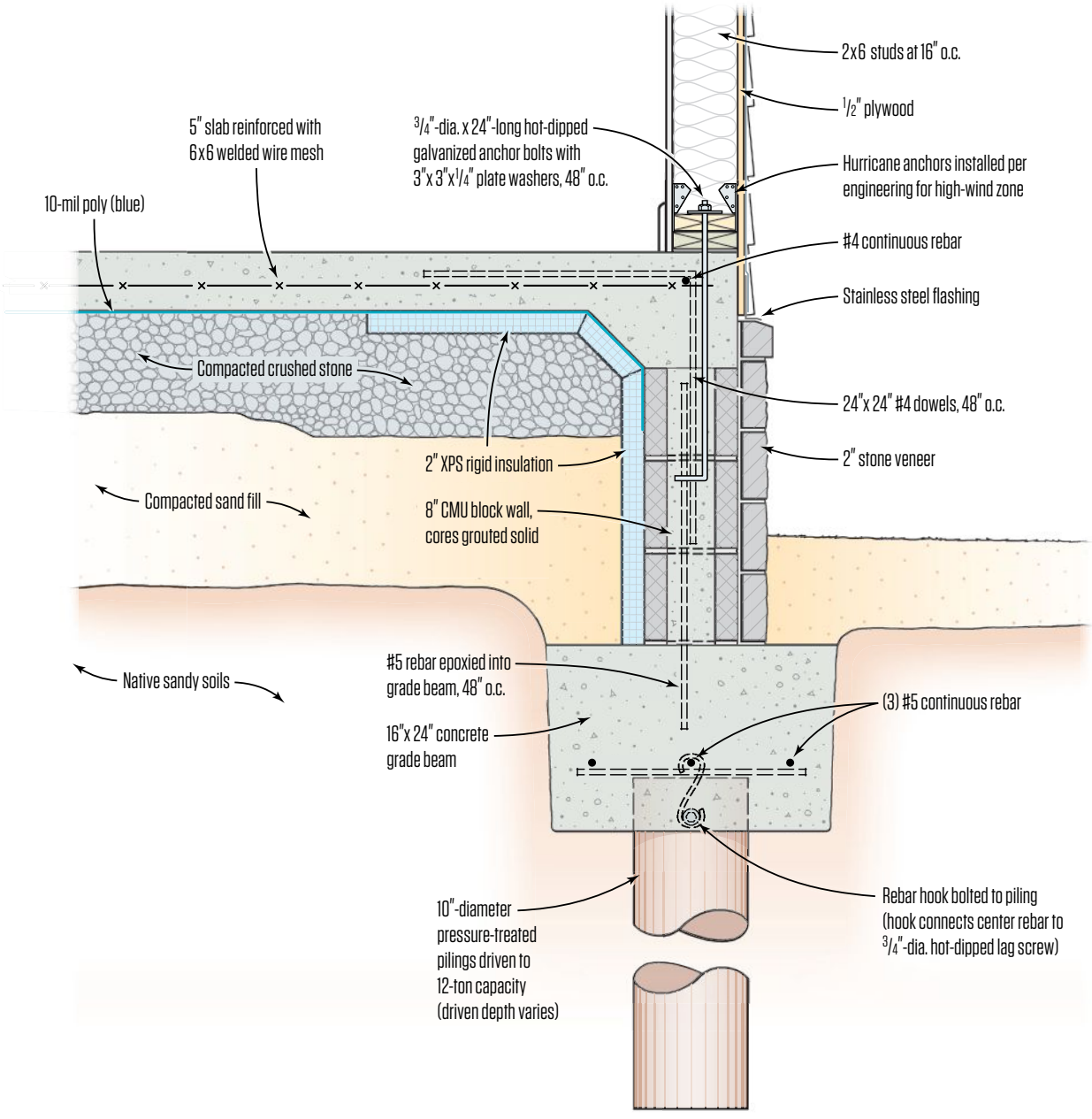
Most of the houses that my company builds are on the barrier islands of southern New Jersey, and most of those homes sit on grade-beams or footings supported by wood pilings or piers. These foundations are used in different configurations in many parts of the country to support buildings where soil conditions may be suspect. Here on the coast, the soil is typically sandy and low-lying. Coastal storms in these areas bring tidal surges and breaking waves that can wash away the sandy soil in a blink. Pier-and-beam foundations (see illustration, next page) ensure that buildings are properly supported and anchored on building lots that are just a few feet above sea level.

These foundations work by distributing the weight of the building to piers (in this case, treated wooden pilings) that are driven into the ground to a specified distance to achieve proper bearing capacity. Reinforced concrete grade beams span between the piers to carry the building's structure. While this specialized type of foundation might not be necessary in most areas of the country, a look at the construction process can offer a valuable glimpse into some the challenges that face a contractor who builds on the coast.

For this project, the base flood elevation for the building lot was 8 feet above sea level, and the planned elevation of the first-floor slab was 11 feet above sea level. Plans called for short CMU walls

Photos by Nathaniel Eldon

Piling-and-Grade-Beam Foundation



A piling-and-grade-beam foundation starts with pilings—in this case, 10-inch-diameter treated logs—driven into the sandy New Jersey coastal soil until each pile reaches a minimum bearing capacity (12 tons for this foundation). The soil is then excavated in a trench along each line of pilings to a prescribed width and depth. Rebar is added on top of the pilings and attached with hooks that bolt to the pilings. The trench becomes the form for the concrete grade beam. A short concrete block foundation sits on top of the grade beam; after the block foundation is filled with soil and that soil is compacted, a slab is poured over the concrete block as an alternative to conventional floor framing and a crawlspace. In a high-wind zone, like the New Jersey coast, all layers including the wall framing have to be tied together with engineered connections.

Illustration by Tim Healey

Piles in the ground. Before pilings are driven, an engineer lays out the positions of each one **(1)**. A dump truck delivers the pilings **(2)**, the length and diameter of which are based on the soil requirements. A long auger digs a hole at each location **(3)**. A crew member fastens a loop of chain around each piling **(4)**, and the crane lifts the piling and swings it to the hole. The crew member then guides the piling into the hole **(5)** and levels the ground around the piling with a shovel.

on top of the grade beams with a concrete slab on top of the walls for the first floor of the house. (Because of strict height restrictions, we chose a slab for this project to eliminate the thickness of the first-floor framing).

SETTING THE PILINGS

After we demolished an existing house on the property and cleared and rough-graded the building site, we were ready to lay out and auger in the pilings. Support for this house consisted of a total of 84 wood pilings. The engineer had set a stake at each piling location **(1)**. Once the holes for the pilings had been augered and the piles set, the engineer would return to witness and certify that the piles were driven to their proper bearing depth.

The foundation-piling contractor, Charlie Lord, has been driving piles on this island with his father (now retired) and his uncle, Dave Lord, for a long time, and they have a good understanding of the idiosyncrasies of the area's soil. Armed with this knowledge, they ordered 12-foot piles with 10-inch-diameter butts. When augered and driven in, this size piling would provide the 12-ton bearing capacity for each piling specified on the engineering plan.

There is an art to setting and driving piles, and the crew of three worked quickly and efficiently. They dropped their equipment at the site mid-morning on a Tuesday—they had already finished a smaller, "warm-up" job of 30 or so piles earlier that morning. Then they left to pick up the 84 pilings (two dump-truck loads) at a local yard **(2)** and returned to the site to begin installing piles just after noon.

Augering. Using a piling rig with a mounted auger, Charlie started drilling the pile locations in the southeast corner of the lot **(3)**. The auger cut holes about 10 feet deep in the sandy soil. This depth would leave the pilings about 2 feet out of the ground before being

Pounding the pilings. When all the pilings are in their holes, the crew attaches a sled with a 1-ton driving hammer to the crane. The crane positions the sled over each piling and a crew member marks 6-inch increments on the sled to monitor how deep the piling travels with each hit **(6)**. The crane raises the hammer and drops it on the piling **(7)**, while the engineer (slightly out of the photo) witnesses and records each piling.

driven. After drilling each hole, he pulled the auger out, spun the shaft to remove the soil, and quickly moved to the next location.

Placing piles. While Charlie dug the first hole, a third crew member rigged a chain around the end of a piling **(4)**. The chain attached to the boom of a crane operated by Dave. As the auger finished digging, the crane lifted and swung the piling over to the hole that had just been dug. The crew member on the ground helped guide the piling into the hole **(5)** and removed the chain from the top of the pile. Then he dashed over to rig up the next piling.

This hectic sequence continued for the next two hours until all 84 pilings were sitting in their holes. The engineer was scheduled to be at the site at 2 p.m. to certify the pilings. Standard practice is for the engineer to witness every pile being driven to capacity. He then produces a log noting the location, length, and bearing capacity of each piling.

DRIVING PILES

With all 84 pilings augered into their holes, the crew set up the driving hammer and sled on the crane. The hammer is a 1-ton block of steel that travels along grooves in the sled. The sled hangs from the boom of the crane. When the sled is in position over a pile, the crane's winch lifts the hammer and then releases it to drive the pile into the ground. Before the hammering begins, a crew member marks 6-inch increments from the bottom of the sled **(6)**. These marks let the engineer witnessing the pile driving determine when the piles have been driven deep enough to reach their bearing capacity.

The bearing capacity of the pilings is determined by a mathematical equation based on the piling length (in this case 12 feet), the butt diameter (10 inches for these piles), the drop distance of the hammer (a dozen feet), and the hammer's weight (1 ton). With these

Digging for the grade beam. A mini-excavator roughs out the trenches, digging between the pilings **(8)**. The crew follows, evening out the floor of the trench with shovels to prep for the concrete **(9)**. The crew keeps the depth of the trenches consistent using a laser level. As the trenches are finished, one crew member cuts the pilings 4 to 6 inches above the floor of the trench with a chain saw **(10)**.

parameters, once the hammer has hit a piling five consecutive times with the piling traveling less than 1 foot total distance, the 12-ton bearing capacity has been achieved for that piling.

With the first couple of hits, the piling moves a lot—sometimes a foot or more. By the third or fourth hit, the piling is moving only an inch or two each time. The hammer continues to hit the piling until it moves less than a foot in five shots **(7)**. Most of the pilings for this project took seven or eight hits total to achieve bearing capacity.

Pile driving was similar to augering the piles in that this same piling crew of three worked quickly. After achieving bearing capacity with one piling, they swung the hammer and sled to the next one, with the engineer checking off the pilings as they went. Occasionally, a piling achieved bearing capacity while still sticking out of grade a bit. To keep these taller pilings from getting in the way, they sawed off the piling to just above grade level.

Conversely, sometimes a pile required more than eight or nine hits before it provided enough resistance to verify the bearing capacity. In those cases, the crew had to dig out around the pile that went below grade level before it was set to the right depth. In the end, the crew was able to drive all 84 piles with the hammer in just over an hour. By the end of the afternoon, the piling crew was loading up their equipment and heading home for the day.

DIGGING OUT THE GRADE BEAM

A few days later, the foundation crew came to excavate for the grade beam. They started by digging a trench along each line of piles. This trench became the form for the beam. Layout for the grade beam was simple: It followed the layout of the pilings. Precision was not critical at this point as long as a minimum depth and

Grade beam reinforcement. The crew installs #5 rebar to reinforce the grade beam. The first pieces are short lengths of rebar that rest on each piling **(11)**. Next, three lengths of rebar sit atop the short pieces **(12)**. Where two or more lengths are needed for a straight run, the pieces overlap and are tied together. At intersections, the rebar from one trench sits on top of the other and they are tied together **(13)**. Finally, the crew bolts S-hooks to each piling to anchor the rebar **(14)**.

width of the concrete grade beam were maintained. Plans called for the beam to be 24 inches wide and 16 inches deep.

There was a pile at every corner of the building, so the easiest strategy was to find the corners and dig between them. The crew used a mini-excavator to do the bulk of the digging between piles **(8)**. Other crew members then followed, hand shoveling beside the piles while leveling the floor and squaring the walls of the trench **(9)**.

Once the crew had a good start on the trench, a couple of crew members broke off and started cutting the piles with a chain saw 4 to 6 inches above the floor of the trench **(10)**. (The bottom of the trench would also be the base of the grade beam).

REINFORCING THE GRADE BEAM

Once the excavation was finished and the piles cut to the proper height, the crew could begin placing reinforcement steel. First, they placed a piece of rebar (about 18 inches long) on top of each pile, oriented perpendicular to the length of the grade beam **(11)**. These short pieces of rebar supported a three-bar assembly of #5 rebar that served as the primary reinforcement for the grade beam.

The crew placed three lengths of rebar equally spaced about 8 inches apart on top of the short, perpendicular pieces **(12)**. They tied the lengths of rebar to the short crosspieces to secure them in position at every piling. At corners and intersections of perpendicular trenches, the rebar overlapped to tie the two directions together **(13)**.

The crew then secured the rebar grid to the pilings. For this project, the contractor used S-hooks made from prebent #3 rebar. The top of these hooks went over the center bar. A lag bolt and washer through the lower portion of the hook held it fast to the piling **(14)**. As a last step, the crew drove grade stakes into the top of each piling, using a laser to set the height **(15)**. These stakes

Bring on the concrete. To set the level for the top of the grade beam, the crew drives a rebar stake into the top of each piling, setting the depth with a laser **(15)**. A concrete truck places mix for each beam while the crew moves the mix around quickly to avoid cold joints in the grade beams **(16)**. After letting the beams cure, the masons build short foundation walls **(17)**. Lengths of rebar are drilled and epoxied to tie the block to the grade beams, and the concrete block is then fully grouted.

helped to keep the top of the grade beam level during the pour.

ADD THE CONCRETE

After an inspection of the rebar grid, we ordered concrete and poured the beam. The crew worked as quickly as possible to prevent any cold joints from forming during the pour **(16)**. On this job, the engineer specified a 4,000 p.s.i. mix for the pour.

After letting the grade beam cure for a few days, the engineer came back to the site to lay out the corners of the foundation. Building on postage-stamp lots such as this one, with strict zoning requirements—not atypical for the projects we do—requires pinpoint accuracy. The 2-foot-wide concrete surface of the beam allowed plenty of room to precisely align the foundation walls consisting of three courses of block.

To tie the block to the grade beam, the masons drilled and epoxied lengths of rebar into the grade beam every 4 feet as they set the block **(17)**. Waiting until after the pour allowed them to place the rebar where it would not interfere with block. The masons fully grouted the block to ensure maximum strength.

When the walls were finished, we placed 2-inch XPS insulation along the inside of the wall before backfilling and compacting the soil inside the walls. All the plumbing stubs also had to be located and placed. We added a layer of 2-inch XPS insulation on top of the compacted soil, followed by a layer of 10-mil poly to act as a vapor barrier. A 6-inch slab formed and poured on top of the block was the final layer for a rock-solid foundation to this house within earshot of the crashing waves on the shore.

Nathaniel Eldon owns Eldon Builders (eldonbuilders.com), a custom home-building and remodeling company in Cape May, N.J.

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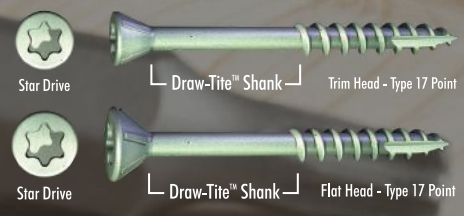

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BUILDING TOUGH

Lifting Slab-On-Grade Homes

Structure meets style in Houston's flood zones

BY TED CUSHMAN

When Hurricane Harvey drenched coastal Texas with more than 60 inches of rain in the summer of 2017, tens of thousands of homes were inundated by floodwater. As of the summer of 2018, thousands of those homes remain unrepaired. But some houses in the flood zone escaped the damage suffered by their neighbors because they had already been lifted above the flood level. And in the year since the storm passed, hundreds more homes have been lifted to safe elevations.

At the heart of that story is a custom design-build firm called Arkitektura Development, headed by architect and contractor Phillip Contreras. Arkitektura specializes in lifting homes in low-lying Texas flood zones. Unlike most house lifters, Arkitektura also brings architecture skill to the task of reconstructing the homes' ground levels in a way that blends with the style of the original home, and Contreras strives to fit each newly lifted house into the visual context of the surrounding neighborhood. This spring, *JLC* visited Houston's flood-prone Meyerland neighborhood and met with Contreras on site to learn about his company's work.

NEIGHBORHOOD SCALE

The leafy street where we met with Phillip Contreras is like many other flooded neighborhoods in the Houston metro area: scraped

Photos by Ted Cushman

Tunneling along the footings. Here, Arkitektura's tunnel crew has excavated tunnels along all the grade-beam footings. Solid blocks with center pins have been placed under the footings at close intervals and driven into the clay soil with hydraulic jacks to the point of refusal. Now, the house is ready for lifting.

lots and unrepaired homes sit side by side with bulky new rebuilds and with older houses that have been either lifted or repaired where they sit.

On these blocks, Arkitektura's work is hard to miss. "We have three projects on this street," said Contreras, "two on the next street, four on the next street, and then as we spread out, they are just everywhere."

The Meyerland area flooded twice in the years just before Harvey, though floodwaters were not as deep as during Harvey's extreme rains. Because of the earlier floods, Arkitektura was already active in Meyerland. While the whole area was still underwater, a news crew boated down the flooded streets filming the devastation. Here and there, Arkitektura's work stood proud in the form of high-and-dry houses—often sitting just inches above the unprecedented floodwaters.

The TV segment was a great commercial for Arkitektura, Contreras said. But it begs the question: How high is high enough? In Meyerland, the rules are changing, Contreras explained: "Currently, if a house has been substantially damaged, they have to bring it up to the current code, which is the 100-year Base Flood Elevation plus one foot. But in September or October, there's a new rule coming out based on the 500-year floodplain elevation, plus 2 feet. So where it used to be like 3 to 5 feet above grade in this area, now we're going to be lifting 5 to 8 feet." Under the new rules, most of the homes Contreras lifted in the past would now be too low.

Is the new requirement right? "I have no idea," said Contreras. "Because it just seems like the flooding is not stopping. It's getting worse. But they've never had a Harvey. They've never had a hurricane come and sit over this area for three, four, five days and just dump water on it like that."

Lift and support. The house above has been lifted with a unified jacking system to its new elevation. Existing grade beams **(3)** for the original slab are exposed and are supported by stacks of 6-inch-by-6-inch solid-core block with center stacking pins. Large spans between the grade beams are temporarily supported by cribbing **(4)**, and the crew is excavating for a new slab **(5)**.

Some of Arkitektura's current jobs are funded by FEMA awards related to the two earlier flood events, and some are privately financed. None of his current work is paid for by insurance from Harvey claims, Contreras told us: "The grants from Harvey probably won't happen for another two or three years." So some homeowners are repairing their homes on grade where they sit, and hoping to elevate later, when funds become available.

Often, Contreras says, he'll contract to lift a house when the building is fully gutted. But by the time he comes back to do the work, the homeowner has restored the building finishes already. "I say, oh my gosh, let's get this up as soon as possible," said Contreras. "This area has flooded several times already, and it's a lot of work and expense to finish them out, only to get flooded again."

But Contreras doesn't have to damage any existing interior work in the process of lifting a building—not even the floors. "Some foundation companies punch holes in the floors trying to find the grade beams," he said, "and it's like Swiss cheese in there by the time they're done. But we don't break through floors like that; we tunnel under from the sides."

TUNNELING UNDER

Much like other homes in the Houston area, existing homes in Meyerland are built with structural-grade-beam-and-slab foundations. Because of the area's soft, unreliable active clay soils, the grade beams usually bear on deep piers driven down to a depth below the "active zone." At these lower levels (12 feet below grade is typical), the soils are less exposed to changing weather and thus more stable. Typically, piers have "under-reams" at this lower zone of sound soil—bell-shaped thickened sections, formed directly in the soil using a special auger.

New underpinnings. Supporting the heavy slab foundation and its house requires beefy new structure beneath the house. Here, a worker builds a rebar cage **(6)** for a 16-inch-by-16-inch main support column. The rebar cage will be set into holes drilled into the newly poured grade beam **(7, 8)**. At lower right **(9)**, the crew member readies the heavy 16-inch-square block for constructing the column. Once the blocks are stacked and mortared in place, the pier will be fully grouted to create a solid masonry column.

To lift the house, Contreras's team starts by digging tunnels by hand beneath the house, to locate the grade beams. The beams are commonly found underneath bearing partition walls in the home above the slab, which provides a clue for the digging crew. Next, the team places solid-core concrete block with center alignment pins at intervals of 4 to 6 feet underneath the structural grade beams, along every grade beam within the home's footprint as well as all around the perimeter. Using hydraulic jacks and stacking block atop block as they go, the crew drives the columns into the soil "to refusal"—at which point any further jacking would begin to lift the slab.

At that point, the crew cuts any structural connections between the existing grade beams and the existing bell-bottom piers. Individual jacks used to drive the new block piers are replaced with a "unified jacking system," setting the stage for a slow, steady, continuous lift.

LIFTING THE STRUCTURE

Lifting a house can take all day, or even several days, using the unified jacking system. One central hydraulic pump operates all the jacks in the system, allowing smooth calibration and a simultaneous lift. "Most of these houses require a 24-port system," said Contreras. Each port can run three jacks, so the system permits as many as 72 lift points under the slab. As the jacks slowly raise the house, the lift crew pauses the lift every so often to stack the cribbing and block supports higher under the building.

The lift proceeds at least up to the required flood elevation for the location, but some lifts go higher (at an additional cost, of course). In the example shown on page 42, a full story was added underneath the existing house. The ground-level space is not allowed to be occupied, but it may be used for parking, recreational activities, or storage of belongings.

Elevating a Slab Home

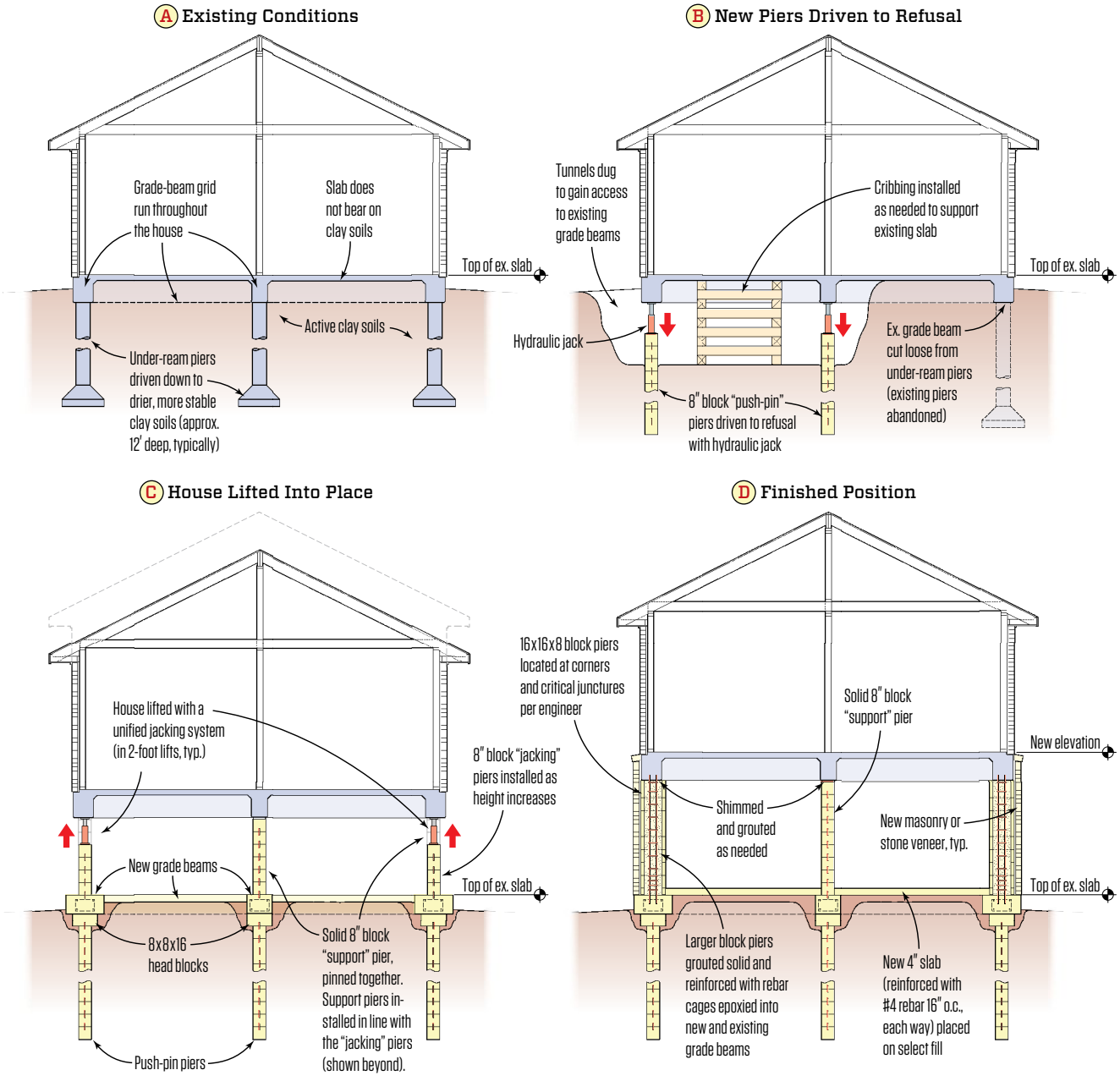

Illustration by Tim Healey

Old tree, new roots. Existing houses at street level in Meyerland and similar Houston neighborhoods may have slab foundations resting directly on difficult clay soils but are likely to have foundations as shown in figure A, with deep bell-bottom piers supporting grade beams that in turn carry the first-floor slab. To lift these houses, Arkitektura drives push piers into the soil around the existing grade beams (B), driving piers to the point of refusal. Once the piers have developed sufficient capacity, a unified jacking system begins to lift the house (C), with pin piers and cribbing installed with every 2 feet or so of progress. Finally, permanent supports are added (D), including 16-inch reinforced piers at corners and critical interior locations.

Finishing touches. Arkitektura's work is set apart from that of many house-lifting companies by the attention to architectural and finish detail. Above is a new entry stair in the grade-level space under the house **(10)**. Exterior decorative details are also key. Here, a mason clads a new exterior column on the street side of the building **(11)**, using original matching brick **(12)** salvaged from the home next door, which was demolished after the flood.

SUPPORTING THE SLAB

As the jacks lift the house and its slab up into the air, workers pause every 2 feet or so to stack additional blocks onto the supporting piers and to add cribbing in areas of the slab that span long distances between reinforced beams. Once the blocks and cribbing have gotten high enough to support the building at its new permanent height, the lift is stopped and the building is set gently back down onto the new supports.

The original house was supported by its steel-reinforced concrete grade beams, which rested on the earth but were also supported by deep concrete piers with under-reamed bell footings. The reinforced slab of the original house had some capacity to span between these grade beams, but it was also partially supported by the ground. Once the house is lifted, the ground is no longer helping to support either the grade beams or the slab. So the new pin-block columns have to be spaced closed enough together to hold up the grade beams. Also, steel beams may be necessary at mid-span points under some wider areas of the newly elevated slab. In cases where the design calls for open spaces under the house for the homeowners to use, steel beams may also be used to support the grade beams between larger columns, in order to replace some of the block supports (see facing page).

ENGINEERING OVERSIGHT

All this heavy engineering requires expert supervision. To learn more, *JLC* spoke with professional engineer Chandra Womack, of Aran and Franklin Engineering, near Galveston, Texas. Womack's firm works closely with Arkitektura on every house lift, starting with a preliminary evaluation. "Once the house is raised," said Womack, "we can look at how big the foundation is, how deep it

Fitting in. The leafy tree-lined streets of Meyerland **(13)** define the neighborhood's character. As Arkitektura lifts house after house to the new required elevations, Contreras designs and builds transitional elements to join the elevated homes to their existing streetscape **(15, 16)**. Homes that are lifted high enough also get customization of the ground level **(14)**.

is, how wide it is. It's hard to tell these things before they dig it out and raise it; but to do that, they need a permit. So we do an initial permit drawing set of our best guess. Then after they dig it out and start raising, we make some field adjustments based on actual conditions."

Besides the initial evaluation, Womack's team does at least four more inspections during the job—what Womack calls "30-60-90 inspections" plus a final inspection. "Thirty is when the piers are pushed, and the house is lifted; sixty is when the grade beams are formed, and they are forming the columns. Ninety is where everything structurally is in place—so all the columns are done, grouted, cored, attached, and the grade beams are completely done. And then final is when the skirts are on, the vents are in, the air conditioning platforms have been lifted and raised, the stairs are in—all those finishing things to actually access and use the house are done."

ARCHITECTURAL FINISH DETAILS

But Contreras brings his own expertise to bear in those final details: skirts, stairs, railings, and the like. "We use a little more time on the details at the base of the house," he said, "to make it a lot more interesting and to integrate more into the house, instead of just looking like a house that was lifted and some masonry thrown up around it."

"People love this neighborhood," said Contreras, "and people love their homes. That's another reason for elevating rather than replacing that I hear a lot from people. They say, 'Okay, we're going to tear down and rebuild.' And the wife says, "Okay, but I want this same house.' They want the same floor plan, the same everything. And so in the end, they say, 'Well, then let's just lift it!'"

Ted Cushman is a senior editor at JLC.

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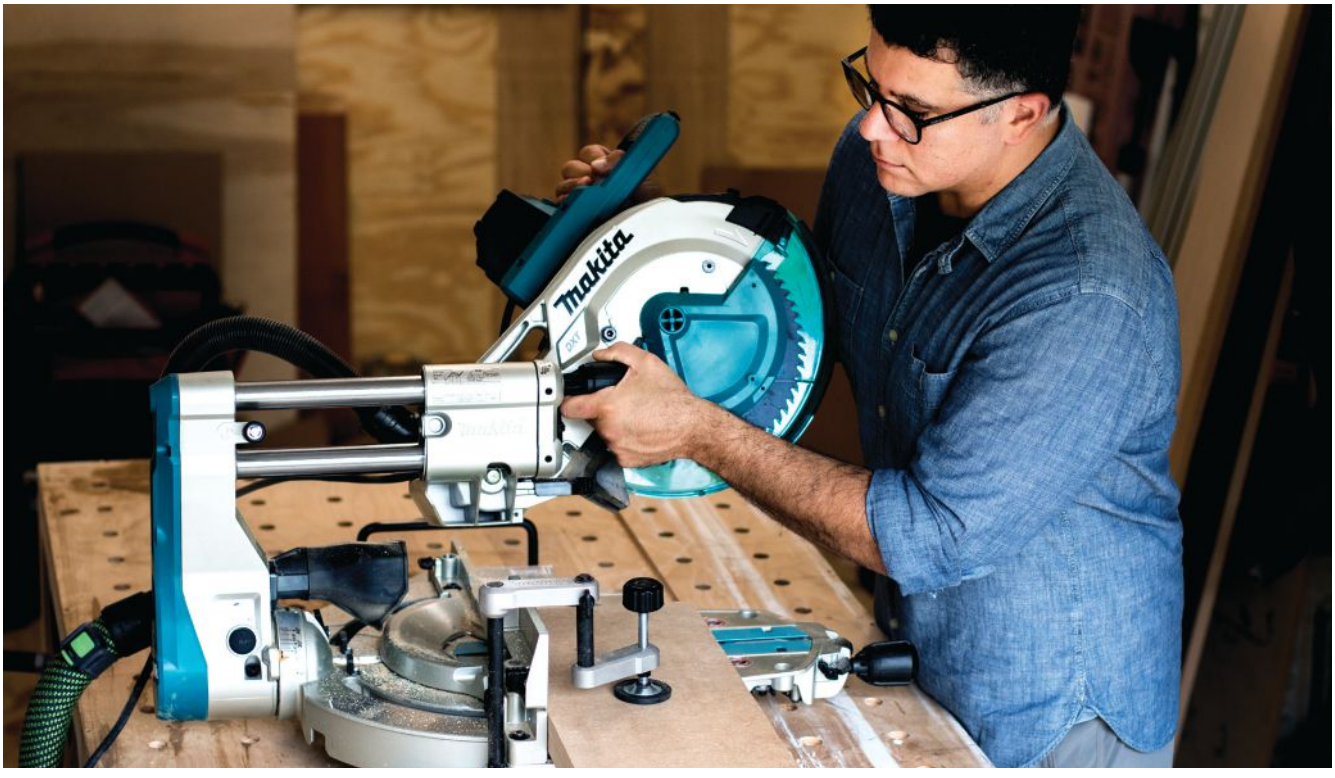


Photo this page by Meaghan M Golden

10-Inch Sliding Dual-Bevel Compound Miter Saws

A close look at eight saws to find the best model overall and the best value

BY CHRIS ERMIDES

Sliding miter saws have come a long way since Hitachi created the category in 1988 with its 8 1/2-inch slider. At the time, it was a trim carpenter's dream tool. Today, carpenters can buy a dual-bevel sliding compound miter saw in a variety of blade sizes: 7 1/4-, 7 1/2-, 8 1/2-, 10-, or 12-inch. And now, some of those saws are available in either cordless or corded options (so far, DeWalt offers the only 12-inch model—it can be powered by a cord or by batteries). And while more cordless 10-inch options are likely to be coming to the market (Milwaukee and Makita already offer one), the category is still dominated by corded power.

There are more 10-inch sliding compound miter saws on the market than the ones I tested here. As for the ones I did include, I looked for the highest-end model from each of the manufacturers, and requested them. When I began this test, Hitachi asked if I would include its new C10FSHC, which at the time hadn't hit the market yet (I'd requested the older C10FSHPS), and I agreed. Most of the saws tested run in the $500 to $600 range, with two coming in well under—at $350—and one coming in at triple the price: $1,475. Most, but not all, perform at the expected value.

TESTED AND REVIEWED

Each of the saws was tested in a shop environment over the course of several months. I used new blades provided by Diablo on each saw to keep testing consistent. Tests were performed with a variety of materials, using the proper blade for each material type: 12-inch-wide-by-1 7/8-inch LVLs; 2x10 spruce and 2x8 PT framing; 1x8 poplar, MDF, and finger-jointed pine crown, casing, and baseboard; 1x8 rough-sawn pine; 3/4-inch MDF ripped to various widths; and 4x4, 4x6, and 4x8 Douglas fir, 1x12 cellular PVC, and 5/4 Trex decking.

BOSCH CM10GD

Motor: 15 amp; belt drive; no soft start; blade brake; 4,800 rpm
Miter angle: 52° left to 60° right; stops at 15°, 22.5°, 31.6°, and 45°; detent override
Bevel angle: 47° left to 47° right; stops at 0°, 33.9°, 45° and 47° (L/R)
Horizontal cut width at ¾ in.: 12 3/8 in. at 90°; 8 ¾ in. at 45°
Horizontal cut depth: 3 5/8 in.
Vertical cut height at ¾ in.: 5 ½-in. through cut at 90°; 5 ½-in. shave cut at 45°
Nested crown capacity: 6 in.
Dust collection: 2 lb. 13 oz.
Weight: 64 lb.
Price: $600
Website: boschtools.com
Comments: There's a lot to like about this saw, especially the slide mechanism and the fact that it can be pushed up tight against the wall. Also, all of the bevel controls are up front, which is a bonus. Adjusting the saw's miter alignment is easy, and it has a heavier detent plate than other saws, which in theory means it will hold up over time. The slide accuracy at 90° was very good at 1/128 inch (.0078 in.) in 12 inches, and the chop accuracy was excellent at 1/256 inch (.0039 in.) over 4 inches. The process for calibrating the bevel, on the other hand, is clunky—the adjustment screws are difficult to access, and because what's being adjusted is hidden, the process is not at all intuitive. On top of that, achieving an accurate bevel in thicker stock was very difficult due to the saw's heavy head; it deflects more than any other saw in this test. The fences were true to the table, and the table was flat out of the box. Blade changes are easy thanks to a blade guard that locks out of the way. Long, straight cuts showed some sway and were not perfect—a function of the slide arm traction, blade wobble, head deflection, or a combination of all the above. The miter gauge has markings for roof pitches, which to me says it all: How can you have a super-accurate trim-level saw that's also designed for rough framing? All in all, while this saw is a workhorse—capable of cutting anything you put under it—it's not the most accurate by a finish carpenter's standards. If you're looking for a high-quality trim saw, you'd do well to avoid this saw. At 64 pounds, it is a total beast, and while the footprint might be relatively compact, it has a significant height when in the up position. It fared worst in dust collection, and sawdust can build up over time, limiting the backward motion of the head. The slide function is smooth and adjustable, which is nice.

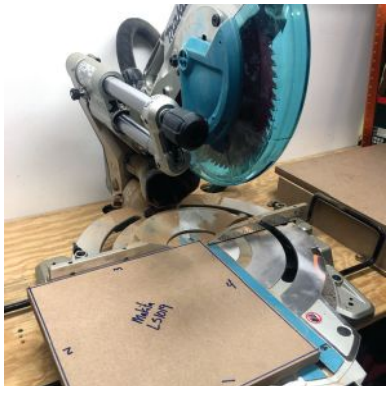
The process was part scientific testing and part user-review based on my experience in the field. I noted ergonomics, ease of using the saw's settings, power, accuracy, quality of cut, and dust collection. I also noted the saw's reported features, including cut capacity, table and fence alignments, and the ease of tuning miter and bevel settings for when the saw needs recalibration. (All saws, especially ones that get hauled from jobsite to jobsite, will eventually need to be recalibrated.) In addition to these features, I tested each saw for blade wobble as well as the accuracy of its bevel detent settings.

NO PERFECT MITER CUT

Because these miter saws can bevel to both sides and the blade can move along an axis, any inaccuracies in any direction will compound. So setting the saw up to cut square to the fence and square to the table is an essential first step in having it perform as designed. Blade alignment to the fence and table at 90° are two relatively easy, quick adjustments (depending on the saw, but more on that later). I used a try square to check the alignment of the blade to the fence and adjusted as needed until the saw blade and the square read true. Then I did the same to check and adjust the squareness of the blade to the table. If you take your time with both of these adjustments and use a high-quality square, you can get excellent results.

But how accurate does the saw cut at its full sliding capacity when the blade is set square? And how well does it do as a traditional "chop" saw?

I tested the accuracy of the chop cut on a 4-inch-square piece of 3/4-inch MDF (the



Once the saws' blades were trued up to the fence and table, the four-cut method was used to test each saw's slide-cutting accuracy. All but two cut well within an acceptable tolerance of .016 inch in 12 inches.

HITACHI C10FSHC

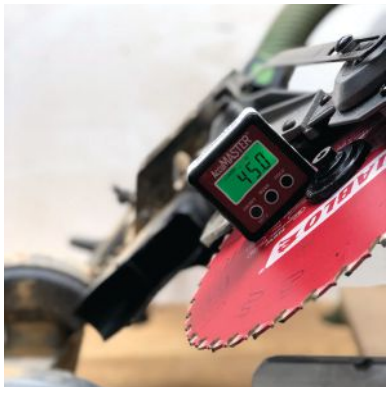
Motor: 15 amp; direct drive; soft start; blade brake; 3,200 rpm
Miter angle: 55° left to 60° right; stops at 15°, 22.5°, 31.62°, 45°; detent override
Bevel angle: 48° left to 48° right; stops at 33.9° and 45°
Horizontal cut width at ¾ in.: 12 ¾ in. at 90°; 9 in. at 45°
Horizontal cut depth: 3 ½ in.
Vertical cut height at ¾ in.: 4 ¼-in. through cut; 4 ¼-in. shave cut at 45° miter
Nested crown capacity: 6 ¼ in.
Dust collection: 3 lb.
Weight: 46 lb.
Price: $350
Website: hitachipowertools.com
Comments: Hitachi released this saw in the fall of last year. It has some nice features, particularly the up-front bevel controls and forward-facing rail system. This design means that it can be pushed up tight against the wall—a good feature for a shop. It's compact and lightweight—a great saw for carrying in and out of jobsites, as well. The unit includes an LED light, which I liked, and a laser, which I found difficult to adjust without removing the blade guard. I also found the accuracy of it to be fair. Chop accuracy on the saw was excellent at 1/256 inch (.0039 in.) over 4 inches, but the saw scored second to last in slide-cutting accuracy, at 7/256 inch (.0273 in.) in 12 inches. The detent plate is cast into the saw's base, which in theory means that its accuracy will hold up well over time. I really liked the bevel release lever up front, though calibrating the bevel was slightly more complex than it seemed it should be. It requires loosening three screws that are tucked way into the rear of the saw; it sounds like a simple maneuver, but in practice, the screws are difficult to access and then once they are loosened, the process is a bit of a juggling act. There was virtually no blade wobble detected, though the head did vibrate a fair amount in various materials—particularly harder woods like mahogany and LVLs. There's a fair amount of movement in the head compared with other saws in this test, which showed in the cut quality for both long miters and long bevels. Sliding functionality was the worst of all tested—the head moves smoothly and requires a fair amount of effort compared with the other saws tested. Dust collection on the saw was very good at 3 lb., though there's no sleeve in the port to hook up a hose. I liked the detent override and ease of tuning-in a miter cut. Overall, this is a decent general carpentry saw but not a workhorse or trim saw.

"chop test"). Then I tested the sliding accuracy on a 12-inch-square piece of MDF (the "slide test"). In both instances, I used the four-cut method, which is as follows: I made four cuts around the square and measured the variation of the fourth cutoff from one end of the cut to the other using a digital caliper. I divided the caliper reading by four to find the result.

Chop-test result. The Festool, Hitachi C10FSH, and Makita were the most accurate in the 4-inch chop test, with no measurable variation. All of the other saws cut within 1/256 inch over 4 inches, which equates to .0039 inch over the length of cut and is completely acceptable for a miter saw.

Slide-test result. In the slide test, the Festool and Hitachi C10FSH produced the best slide accuracy with excellent results: off by 1/256 inch (.0039 inch) in 12 inches (in his YouTube video "Four Cut Calibration," Gary Katz notes that 16/1000 or .016 is acceptable accuracy for a slide saw). I found the Bosch, Delta, DeWalt, and Ridgid saws to have very good accuracy—off by 1/128 inch (.0078 inch) in 12 inches—while the Hitachi C10FSHC at 7/256 (.0273 inch) and Makita at 1/32 (.0313 inch) had poor accuracy.

Note that this four-cut method is often used as a means for truing-up a saw in lieu of, or in conjunction with, a square (I prefer a try square, though theoretically, any true square will work). As you can tell, the tolerances on these saws are very good—and you'd be hard-pressed to tune anything beyond 1/128 inch in 12 inches. But in the case of the Hitachi and Makita, because these saws were cutting near-true in chop mode, I can't help but surmise that the inaccuracy is in the slide mechanism and not the



As a matter of course, detents were checked using a digital angle finder with the saws set on a flat, level surface. All saws came in either at exact readings for the respective detent, or within three tenths of it.

MAKITA LS1019L

Motor: 15 amp; direct drive; soft-start; blade brake; 3,200 rpm
Miter angle: 60° left to 60° right; stops at 15°, 22.5°, 31.6°, 45°; detent override
Bevel angle: 47° left to 49° right; stops at 22.5°, 33.9°, 45°; detent override
Horizontal cut width at ¾ in.: 12 3/16 in. at 90°; 8 1/8 in. at 45°
Horizontal cut depth: 3 ¾ in.
Vertical cut height at ¾ in.: 5 1/8-in. through cut at 90° and at 45°
Nested crown capacity: 6 5/8 in.
Dust collection: 2 lb. 15.6 oz.
Weight: 58 lb.
Price: $550
Website: makitatools.com
Comments: I had high hopes for this saw given the overall design. The forward-facing rails and up-front bevel controls are nice, though they limit bevel capacity to the left and line of sight in some configurations. They allow you to push the saw up to a wall, and this means that you don't have to reach behind it to change the bevel setting. The overall footprint is relatively small despite the larger table—a feature Makita fans of old will remember and new users can't help but appreciate (I loved this table). The tall fences are fixed and need to be removed for any bevel cuts, which some will dislike and others, like me, won't mind. I like the tall fence because it provides extra support to tall base and crown, but one side was bent significantly out of square to the table—likely from shipping. Despite an electronic control sensor that maintains rpm under load, the head vibrated a fair amount in slide cuts in denser woods like 8/4 mahogany. And when I first started using this saw, the blade brake did not engage immediately—the blade spun wildly and eventually stopped. After about 15 cuts, though, it did engage properly for the remainder of the test. The laser was difficult to dial in, and I found it fairly useless; it has an on/off switch, which is good. Overall, despite some vibration in denser materials, this saw cut easily and well through all other material in the test and showed no measurable blade wobble. The slide functionality is smooth and effortless. It performed among the best in the chop-cut accuracy test (0 inch in 4-inch cut), and worst overall in slide-cutting accuracy. Given the saw's packaging, I would recommend buying this saw in person instead of having one shipped. At this price point, Makita needs to address the way the saw is packaged, which I speculate accounts for the inconsistent experience users are reporting with the slide-cutting accuracy.

blade's relation to the fence. See the saws' individual write-ups for more on that.

Miter accuracy was tested by making opposing miters in chop-mode on two pieces, then putting them together in relation to a square. Here, I noted the quality of the miter joint as well. Festool and the Hitachi C10FSH came out on top again with equally excellent cuts, while the DeWalt and Ridgid cuts were very good. The Bosch, Delta, Hitachi C10FSHC, and Makita joints were fair in quality, but accurate.

Sliding miters were tested on 8-inch MDF and yielded similar results, though the Bosch, Delta, and Hitachi C10FSHC showed some minimal sway in the cut's straightness. This could be a function of some head deflection, blade deflection, head vibration, or something to do with the slide mechanism itself.

Bevel accuracy. I tested bevel cutting accuracy in a similar way. I cut opposing 45° bevels, then assembled them and noted the joint for crispness, straightness, and angle accuracy.

The Festool, Hitachi C10FSH, and Ridgid came out ahead here with near-perfect results. The cuts were straight, and the jointed miter was a perfect 90°. The DeWalt cut straight with no gaps (no head deflection) but was a hair proud of 90°, while the Makita was a perfect 90° but the joint was a hair open in the middle. The Bosch, Delta, and Hitachi C10FSHC all had enough head deflection that it was difficult to get better than paint-grade results.

DUST COLLECTION

I tested dust collection by making a series of cuts in a consistent variety of materials

Table and fence straightness was observed using a straightedge. All the saws had fences that could be adjusted for straightness, with varying degrees of difficulty. All the saw tables were acceptably flat.

DELTA "CRUZER" MODEL 26-2240

Motor: 15 amp; belt drive; no soft start; blade brake; 4,000 rpm
Miter angle: 50° left to 60° right; stops at: 12°, 22.5°, 31.6°, 45°; detent override
Bevel angle: 47° left to 48° right; stops at 22.5°, 33.9°, 45°; detent override
Horizontal cut width at ¾ in.: 12 1/8 in. at 90° (15 1/4 in. with special setup), 8 5/8 in. at 45°
Horizontal cut depth: 3 1/2 in.
Vertical cut height at ¾ in.: 5 1/2-in. through cut at 90°; 5 1/2-shave cut at 45°
Nested crown capacity: 6 1/4 in.
Dust collection: 2 lb. 13 oz.
Weight: 55 lb.
Price: $600
Website: deltamachinery.com
Comments: Delta hasn't made a miter saw in many years, so this new model has been a highly anticipated one. In lieu of a rail system, the head of the "Cruzer" rides on robotic-style arms similar to the Axial Glide system Bosch employs, except it's significantly smaller and lighter than the Bosch. It can be pushed up tight to a wall and has a compact footprint, with all controls up front. I have to say right off the bat that I really liked using this saw. The bevel controls were among the most user-friendly. It has detent overrides in both miter and bevel setting, and the slide mechanism is incredibly smooth with a tensioning adjustment on each arm to dial in a resistance you like. It's easy to calibrate, and though the head is stiff when chopping, the action feels stout and efficient. Initially, I had issues with the blade guard sticking in the up position, but that was easily remedied by loosening the nut; I think Delta could do a better job with this, as most other blade guards can't be overtightened. Also, there is the possibility for the blade guard to get hung up on the cord—another potential safety issue. The dust port on the Delta is close to the saw's handle and so it's difficult to make a good connection without jamming the fitting in. I think either the handle or the fitting will break in time in the field. The saw cut effortlessly and well through all of the material in the test and made decent-quality miter cuts in the chop setting. Chop-cutting accuracy at 90° was on par with other saws at 1/256 inch in 4 inches and slide accuracy was good at 1/128 inch in 12 inches. While the 90° straight cuts were good, slide miter cuts were only fair. The blade shows some measurable and visible wobble and the head has some deflection. Overall, this is a decent saw for remodeling and framing, though I wouldn't recommend this as a go-to trim saw; it's just not accurate enough for flawless miters in casing, base, or crown.

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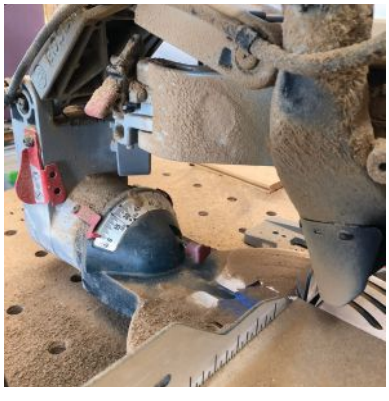
and gathering the sawdust with an extractor. Using a combination of doubled-up 3/4 MDF (x70), 4x6 Doug fir (x12), 1x6 poplar (x12), and 1x8 pine (x12), I made a total of 106 square cuts with each saw, and then weighed the bag for the amount of sawdust captured. I used a Festool CT extractor equipped with a HEPA filter and the new 1 1/16-inch (27mm) flex hose; I installed a new fleece bag for each saw. Once the cuts were complete, I weighed the fleece bags, yielding weights from 2 lb. 13 oz. to 3 lb. 2.2 oz. of dust.

It's important to note here that while the results seem close to one another, they really aren't. Here's why: An ounce of MDF sawdust is about two handfuls. That's a fair amount of dust. I've seen some folks test the amount of dust captured and the amount of dust not captured. While I think that's a fair and very accurate test, it was beyond the scope of this review. My goal was to find out how the saws fared in comparison to one another.

None of the saws captured all of the sawdust—but a few did stand out. While my test methods were consistent, it is possible to achieve some variation of the results given different setups. For example, cutting nested crown or cutting long miters may yield some variation in these results, but I believe they would be relatively consistent with my findings when comparing one saw with another.

In my testing, the DeWalt collected 1.7 ounces more dust than the runner-up, the Kapex. The shrouds on the Kapex and the Makita got hung up on taller material like 4-by, and I didn't have this problem as much with the DeWalt, which has a thinner



The dust-collection test was conducted using a new 60-tooth Diablo blade in each saw. Consistent numbers of cuts were made in the same material types. Dust was captured in a bag and then weighed.

FESTOOL KAPEX

Motor: 13 amp; direct drive; soft start; blade brake; variable speed: 1,400–3,400 rpm
Miter angle: 50° left to 60° right; stops at 15°, 22.5°, 30°, 45°; no detent override
Bevel angle: 47° left to 47° right; no detents; counterbalanced micro-adjustment knob
Horizontal cut width at ¾ in.: 12 3/16 in. at 90°; 8 ¾ in. at 45°
Horizontal cut depth: 3 5/8 in.
Vertical cut height at ¾ in.: 4 5/8-in. through cut at 90° and at 45° (specs say 4 ¾ in.)
Nested crown capacity: 6 5/8 in.
Dust collection: 3 lb. 0.5 oz.
Weight: 47 lb.
Price: $1,475
Website: festoolusa.com
Comments: At first glance, it is impressive—and after using it for a long while, I can attest that it is built as you'd expect a Festool would be. Everything is precise—from the table, to the fences, to the lasers (it has two lasers, one for each side of the blade; they're accurate and you can adjust them both independently). The Kapex has a unique arbor nut that is fitted with a carbon material that allows it to act like a brake pad. Should the blade bind, the pad will allow it to spin slowly—significantly minimizing the potential for kickback. It utilizes a special-sized blade (10 ¼ inches) that has a larger-than-common arbor hole (30mm). According to the manufacturer, this large arbor virtually eliminates any blade deflection because it supports more of the blade's plate. It's a nice feature, but one you pay a premium for, especially with respect to blades; a 60-tooth 2.5mm kerf blade will set you back $155. Cuts were virtually flawless, the head has no perceived deflection, and there is no blade wobble. It excels at dialing in a bevel angle, and at bevel accuracy. On the other hand, micro-adjusting a miter angle is not easy, and if you are looking for a half-angle near a detent, it'll take you several tries to get there. Festool gives you an angle finder for fine-tuning the miter using its onboard laser, but it doesn't give you any way to micro-adjust the miter setting. You can't lower the head without partially depressing the trigger, and of all the saws tested, I had more issues with small offcuts catching (or, in one instance, jamming) the blade guard. I found the blade guard on this saw extremely annoying—particularly when cutting taller stock. If you're going to pay three times more money for a miter saw, it should be outstanding in every way. Make it possible to micro-adjust the miter angle (or at least add a detent override), increase the vertical cutting capacity, fix the blade-guard issues, and improve the ramp-up time, and then it would be a worthy investment.

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shroud. The Kapex does have a removable shroud, which is nice because it gets hung up on nested crown and other taller material.

All of the saws with the exception of Ridgid and the two Hitachis have 1 1/16-inch-diameter vacuum ports. The hose was slightly sloppy on the Ridgid, which accepts 1 1/4-inch wet/dry vac adapters. The Hitachis both have a 2 1/2-inch-diameter port, which is huge for a miter saw. While the larger port may account for the decent dust extraction results of both saws, it's cumbersome to use a hose that size on a miter saw. I used the same 1 1/16-inch-diameter hose with reducing couplings to maintain consistent results.

Makita has devised a newer extraction setup that pulls dust from behind the workpiece and at the blade as well. In theory, when you look at it, you think it's an ingenious design and should capture everything. It didn't, though it did OK compared with the others. But of all the saws, this was hands-down the loudest when running with an extractor; the configuration of this port creates a whirring sound that's so loud it sounds like a jet engine.

BLADE WOBBLE

I tested each saw's blade runout just above the gullet, noting the highest reading. For this to have been a purely scientific test, I would have needed to use a machined plate on each of the saws. But I didn't have one available, and I also wanted to get real-world results that matter to carpenters. I tested blade wobble after the dust extraction test—when each saw was equipped with a 60-tooth Diablo blade. It can be argued that any given blade could have some variation in it. But the results were all so close and completely corroborated by visual observation that my method felt justified as a comparison.

All in all, they did quite well—with a couple of them not doing so well. Both Hitachis, the Kapex, and the Makita had no measurable wobble. This was confirmed in test cuts and in kerf cuts that I measured. The DeWalt had slight (.006 at the gullet) wobble but produced clean, perfect cuts. The Bosch and Delta had measurable and visible wobble, which showed in most test cuts.

TOP PICKS

Choosing the best saw was not easy. While all of the saws performed as expected, a few rose to the top.

Best overall. To pick the winner, I factored in the saw's performance in testing,

HITACHI C10FSHPS

Motor: 12 amp; belt-drive; soft start; blade brake; 3,800 rpm
Miter angle: 45° left to 62° right; stops at 15°, 22.5°, 31.62°, 45°; no detent override
Bevel angle: 45° left to 45° right; stops at 33.9°, 45 °(L), 45°(R)
Horizontal cut width at ¾ in.: 12 5/16 in. at 90°; 8 3/8 in. at 45°
Horizontal cut depth: 3 5/8 in.
Vertical cut height at ¾ in.: 3 5/8-in. through cut at 90°; 4 5/8-in. shave cut at 45°
Dust collection: 3 lb. 0.3 oz
Nested crown capacity: 6 5/8 in.; requires optional auxiliary fence
Weight: 43 lb.
Price: $510
Website: hitachipowertools.com
Comments: This saw really surprised me because it is the most basic of all the models, including Hitachi's newer C10FSHC. There are no bells and whistles on this saw and all of its levers and settings are very simple. In fact, all of the tuning adjustment settings on it are hex-head bolts, which require a separate tool. There's no onboard tool storage and no auxiliary fence on the right side (it's an optional accessory), and the auxiliary fence on the left side flips out of the way—this I liked because it extends the length of the fence on the left side of the blade while keeping the fence attached so you don't have to completely remove it. While everything about the levers and controls on this saw says "basic" to me, this saw is incredibly accurate. The table is perfectly flat and the fence was straight and square to the table. In fact, it tied with the Kapex on the slide-accuracy as well as the chop-accuracy tests. It produced absolutely flawless bevel cuts. There's little deflection in the head when making long bevel cuts, and the accuracy on miter cuts was spot-on. The soft-start motor ramps up very quickly. This saw showed no blade wobble and made consistently accurate cuts in both miter and bevel positions. The miter scale is a little off—it reads properly to the left but is about a degree off to the right of the blade. This discrepancy is a function of the gauge sticker not being applied properly (you can't adjust this without pulling the sticker off, which would likely ruin it). I found the laser useful and accurate when making miter cuts with no bevel, and I like that you can switch it to either side of the blade at the turn of a dial. Unfortunately, the laser comes from behind the stock and so can be obscured by taller moldings. When cutting 8/4 mahogany, the saw fared well—it didn't struggle, but it didn't cut it easy-breezy either. It's the lightest saw of the bunch. For a trim carpenter who likes to add his or her own auxiliary fences, this saw is a good fit.

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its overall features, ergonomics, and ease of use, as well as the saw's price: Does the saw provide good value? With those factors in mind, the DeWalt DW717 (see page 52) won top honors. It was a solid performer, was consistent and easy to adjust and maintain, was built with professional remodeling contractors and trim carpenters in mind, and at $500, is fairly priced. A close second was the Makita LS1019L. Had it performed better on the slide accuracy and not been banged up due to poor packaging, it would have tied with the DeWalt.

Best value goes to the new Ridgid R4210 (see page 52). At $350, it's packed with features and performed very well. While it's 4 pounds lighter than the DeWalt, its footprint is large, so it's not a great option for a small shop. But it's a strong performer for the money.

The saw that seemed least accurate in terms of quality cuts and head deflection was the Bosch CM10GD, which was a disappointment to me. I also think the Delta Cruzer needs a bit more internal refinement for it to be a go-to trim saw, but it is a solid performer overall.

In summary, professional carpenters will get good results with any of these saws. If your main line of work is trim, then the DeWalt DW717, Hitachi C10FSH, and Ridgid R4210 would all be money well-spent. Decking, framing, siding, and general contractors would do well with almost all of the saws in this test, although the Kapex, which has so many bells and whistles, might be overkill for a lot of rough work.

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

Blade-wobble results were verified by recording the running saw blade in slow motion, and then visually observing if the pin jumped around. Kerf cuts were made in 4-by material and measured with a caliper.

BEST VALUE

RIDGID R4210

Motor: 15 amp; direct drive; no soft start; blade brake; 4,000 rpm
Miter angle: 70° left to 70° right; stops at 15°, 22.5°, 31.62°, 45°, 60°, 67.5°; detent override
Bevel angle: 48° left to 48° right; stops at 15°, 22.5°, 33.9°, 45°
Horizontal cut width at ¾ in.: 12 ¾ in. at 90°; 9 in. at 45°
Horizontal cut depth: 3 ½ in.
Vertical cut height at ¾ in.: 6-in. through cut at 90°; 6-in. shave cut at 45°
Nested crown capacity: 6 5/8 in.
Dust collection: 2 lb. 15.9 oz.
Weight: 47 lb.
Price: $350
Website: ridgid.com
Comments: This saw has a unique miter-angle adjustment that allows you to cut 70° on both sides—useful for cutting siding, stair parts, and other steep angles (cut capacity at 70° is about 5 inches). It is well-balanced and easy to carry, and has a 6-foot cord. Another nice feature is the quick-release bevel adjustment that allows for quickly setting bevels at various detents. You can most easily access the safety switch with your forefinger on the right hand, but if you're left-handed, you'll be able to use it. The LED shadow light can be turned on or off and is accurate, but it could be brighter; I found that the blade needs to be so close to the material that it was essentially like using the blade. The blade ramps up quickly, but stops slowly. There's no blade wobble in this saw and it made very good cuts in trim material. It had plenty of power for framing material and didn't struggle through anything I put in front of it. It's got a large footprint, so it's not the best option for a small shop. The weight and balance make it fairly portable, especially when mounted to a stand. This saw would do any contractor or carpenter well—especially for the price.

BEST OVERALL

DEWALT DW717

Motor: 15 amp; belt drive; no soft start; blade brake; 4,000 rpm
Miter angle: 60° left to 50° right; stops at 15°, 22.5°, 31.62°, 45°; detent override
Bevel angle: 50° left to 49° right; 22.5°, 33.9°, 45°; detent override
Horizontal cut width at ¾ in.: 12 ¾ in. at 90° (16 in. with special setup), 8 7/8 in. at 45°
Horizontal cut depth: 3 ¾ in.
Vertical cut height at ¾ in.: 6-in. through cut at 90°; 6-in. shave cut at 45°
Nested crown capacity: 6 ¼ in.
Dust collection: 3 lb. 2.2 oz.
Weight: 51 lb.
Price: $500
Website: dewalt.com
Comments: This saw was a solid performer in every manner of testing—from framing to making precise, crisp trim cuts, it was reliable and accurate. Calibrating the miter and bevel settings was easy to do. The saw has impressive cutting capacities, making it extremely versatile, and with the detent override, you can dial-in a miter angle with ease. Though the bevel controls are located toward the back of the saw, you don't have to reach completely around to access them. You can disengage the bevel detents with the flip of a lever that's easy to reach. The only thing I didn't like was the bevel-locking lever mounted toward the back (below the bag in the photo above); it can be awkward to access at times. There's minimal perceived head deflection in the slide function, though of all the saws tested, this one didn't slide as easily. Slide functionality is perfectly smooth; it's just not as effortless as most of the others. The miter table dipped about 1/32 inch on the right side, though that didn't impact any of my cuts. The fence and auxiliary fences were perfectly square to the table. All in all, this saw performed very well, and for the money, I think it's the best saw overall.

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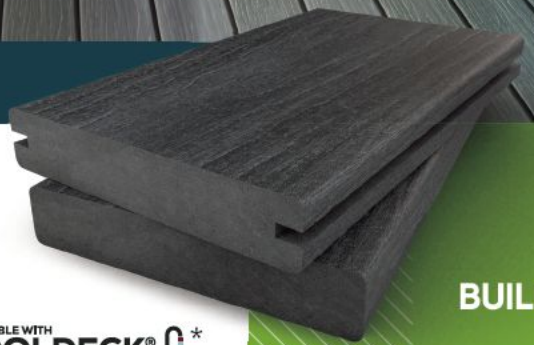

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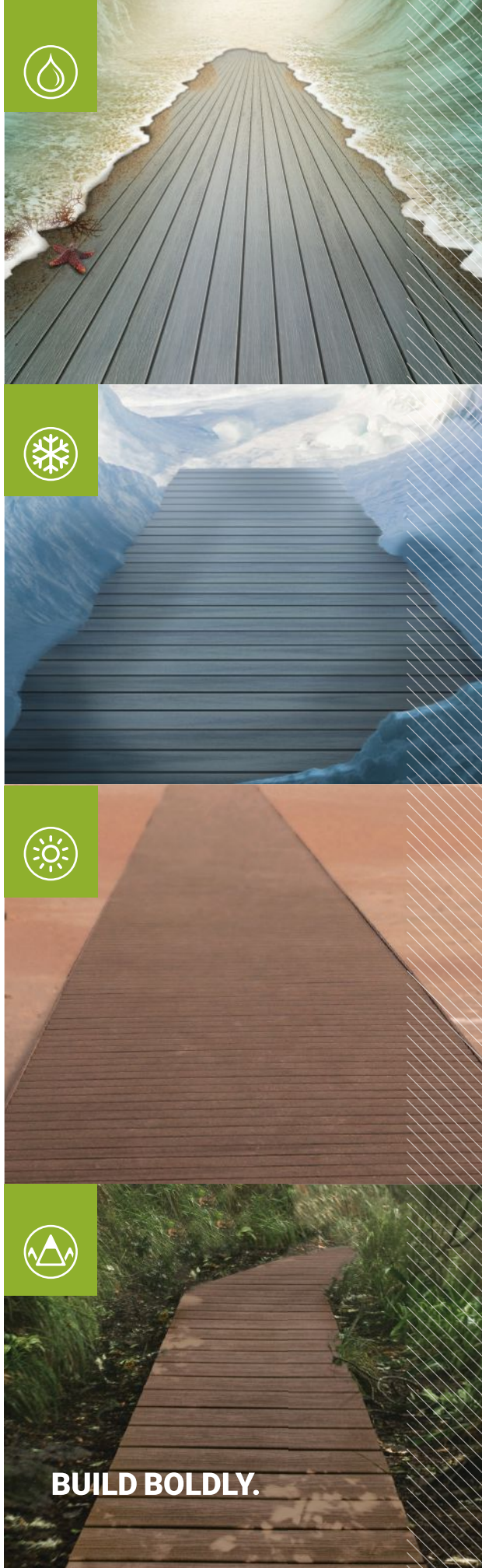

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Mouseproof Your Low-Voltage Deck Wiring

by Tim Brown

We've been having trouble with rodents chewing through our ground-level low-voltage wiring. After trying several different solutions, we finally came across one that works. We run our wires through stainless steel braided sleeving and put zip ties or shrink tube on the ends at the lights. This keeps the wire flexible for quick installation and allows us to use the same staples and holes we normally would, while providing protection from rodent teeth.

We purchase the sleeving online at McMaster-Carr (mcmaster.com), a handy resource for virtually any type of pipe or tubing. The sleeves are available in several diameters, but we find the ¼-inch ID size seems to work fine for most low-voltage wiring. If we're running 12-gauge wire, we buy sleeves that are a little larger.

While the sleeves cost about $2/lineal foot, we typically use them only on wiring that is within about 2 feet off the ground. The braided sleeves are made of stainless steel, so they won't corrode and have to be replaced, and the nominal added cost easily outweighs the cost of a return trip (or trips) to repair damaged wire. ❖

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

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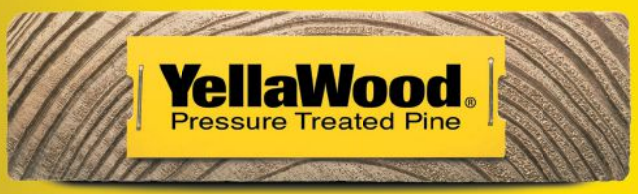

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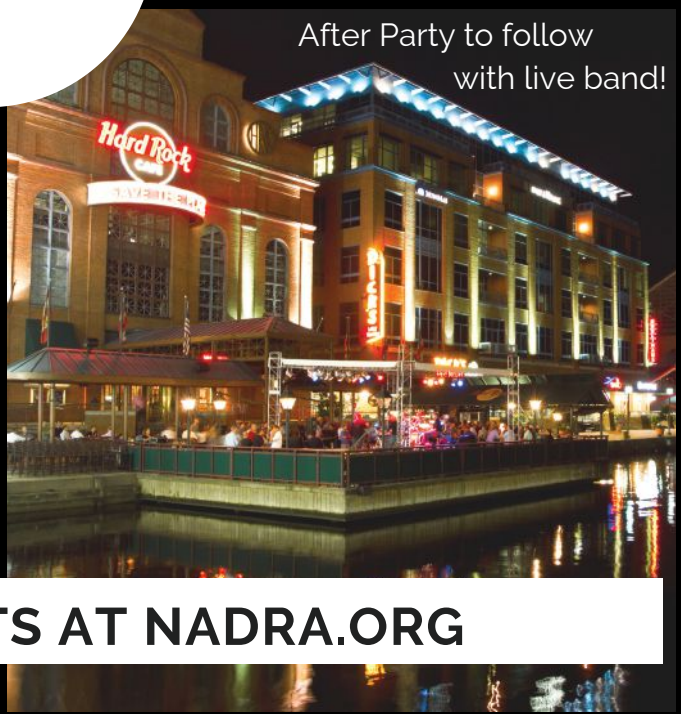

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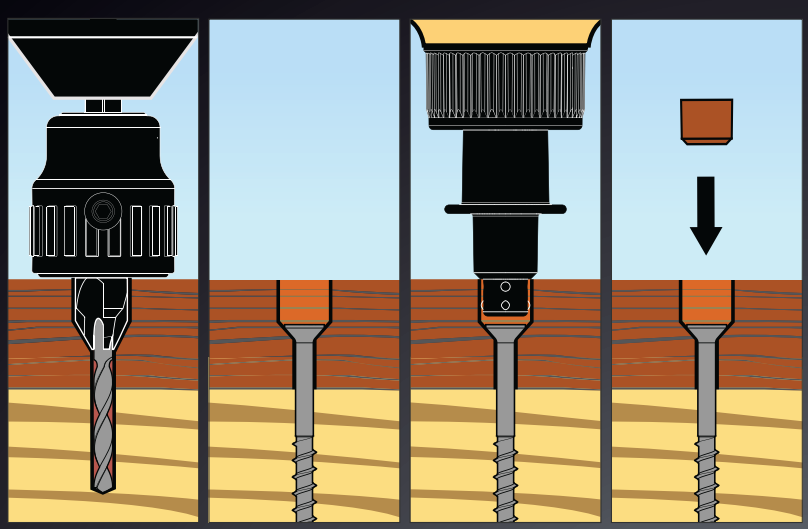

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Swage vs. Swageless?

Q Several of my clients have expressed interest in cable railings for their decks, so I've begun researching the various systems that are available. But different companies seem to be using different terms to describe their hardware, making it difficult to compare products. What are the pros and cons of swaged versus swageless fittings?

A Steve Sherritt, president of SD Independent Construction, a deck and railing specialist in San Diego, responds: Our company began installing stainless steel cable railings in 2003. At that time, the few systems specifically designed for residential or light-commercial use had limited distribution and were relatively expensive, so we assembled our railings using spools of stainless steel cable and various off-the-shelf marine rigging parts such as eyebolts, turnbuckles, and crimp eyes. At first, we hand-swaged our fittings using a variety of low-cost crimping tools and smaller swaging tools meant for field-installing cable fittings. Later, we bought a press swager that utilizes a 30-ton jack, making it relatively portable so that we could bring it out in the field with us.

As the industry matured and the internet improved, the technology and the demand for cable railing systems changed dramatically. Today, the cable-railing market is much larger, and the variety and availability of hardware have exploded, even while the cost of some stainless cable has dropped significantly compared with 10 years ago. One of the biggest changes has been the introduction and evolution of swageless fittings, which don't require any type of crimping or swaging. Instead, swageless fittings utilize a small, one-way locking mechanism that allows the cable to enter in one direction while grabbing the cable if pulled in the other direction.

Between the DIY movement and the advent of swageless fittings, we don't see too much hand-crimping done these days. In fact, it has been years since we have actually crimped a cable fitting. I realize there are still quite a few installers who field-crimp fittings, but for our company, the only possible benefits would be cost

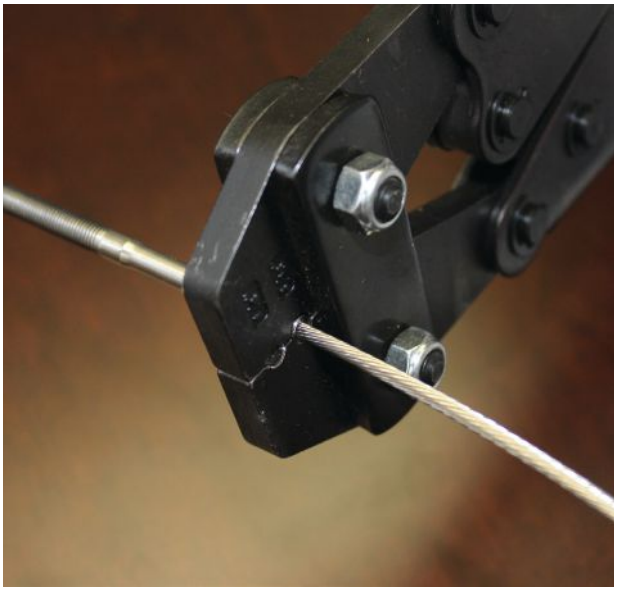
Swageless fittings (top) cost more than machine- or hand-swaged fittings but don't require any special installation tools and are available at many lumberyards and home-improvement centers. Field-swaged fittings (above) are widely available and relatively inexpensive, but the crimp marks are noticeable and the fittings are susceptible to corrosion where the metal has been marred by the crimping tool.

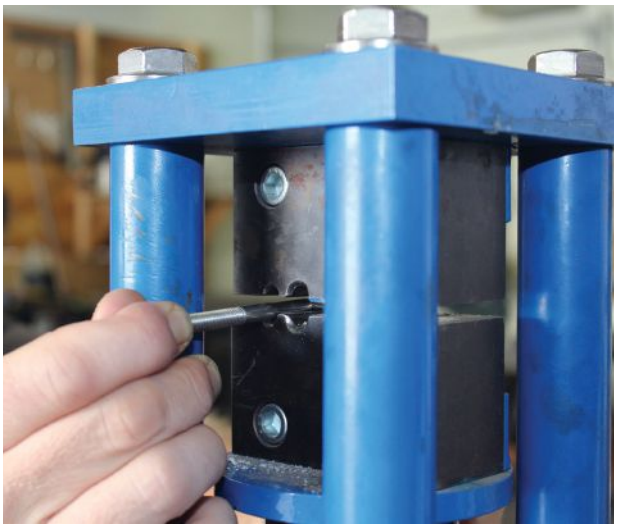
PHOTOS COURTESY SAN DIEGO CABLE RAILINGS

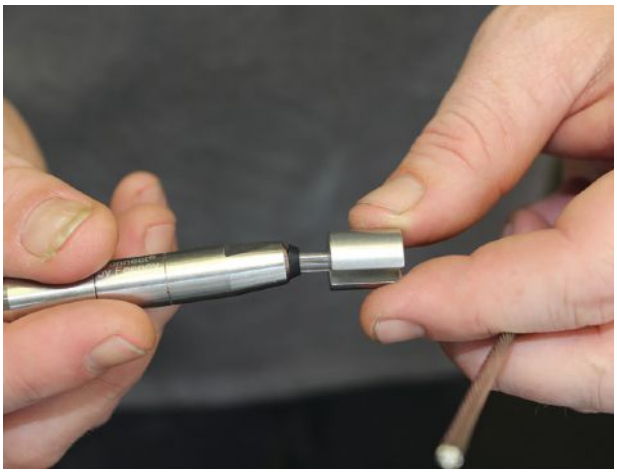
savings or availability. Convenience almost always comes at a price, and swageless fittings are no exception; they carry a premium. However, for our company, the speed of installation, lack of need for special tools, and the slick appearance of these fittings largely outweigh the cost factor.

Both swaged (either by hand or by machine) and swageless fittings can provide a solid connection between the cable and fitting that will equal or exceed the breaking strength of the cable. This assumes the use of either 1/8- or 3/16-inch-diameter cables—the most common sizes for residential and light-commercial railings—and correct assembly of the fittings. To ensure that installers know that they are getting the right amount of clamping force with a swaged fitting, hardware manufacturers call out specifications for the desired diameter of a "crimp." A swageless fitting, on the other hand, relies on a mechanical connection rather than a cold weld, so our company doesn't use any of the cheaper, imported knock-off fittings that can be found online (which we occasionally are called out to replace when they've failed).

That said, there are distinct advantages and disadvantages for each method of attachment. Many suppliers have combined the technologies to maximize cost effectiveness and still allow for field installation. They do this by providing a machine-swaged end on one side of the cable and furnishing a hand-crimp or swageless fitting for the field-installed end. A retail cable assembly will often contain a specified length of cable, swaged fitting, finish hardware, and a swageless fitting. Whatever system you choose, stick with a proven supplier, and carefully follow the installation instructions. ❖







With hand crimpers (top), multiple crimps are often necessary to achieve a proper connection. A true machine swage is created in a shop using a rolling swager or a press swager (center), which cold-forms the fitting around the cable with extreme force and results in a strong connection. Swageless fittings can be disassembled using a special tool that releases the cable from the locking mechanism inside the fitting (bottom).

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Code Requirements for Outdoor Kitchens

by Glenn Mathewson

Barbecue grills shoved into a corner of the deck have evolved into full-blown outdoor kitchens. As a "code guy," I should point out that the IRC has a few things to say about kitchens, and it doesn't care if the kitchen is inside or outside the house.

Cooking With Gas

Other than following all of the manufacturer's installation instructions and using only tested and listed appliances, there are no specific code requirements for built-in or freestanding BBQ grills. That said, be sure to observe minimum clearances when designing the space, to minimize the risk of fire. Look for eaves extending beyond sidewalls and possibly over the grill, and be careful when designing a porch roof over a grill area. An exhaust hood can be expensive, but it is effective at managing smoke when the grill is under a roof or near a window and may prevent smoke from entering the home and triggering the alarm system.

Building codes definitely apply when a gas distribution system from the home is extended to permanently serve the outdoor grill. Regardless of licensure requirements, which vary from state to state, only trained and professional plumbers or mechanical contractors should install gas lines; however, there are a few things you as the designer should understand and consider. First, make sure the construction schedule allows for painting the common black iron gas pipe for protection from corrosion.

The plumber also needs to be guided on how far to stub the line up from beneath the deck, and that means knowing the thickness of the decking. In order to tighten the threaded fittings on gas pipe, a pipe wrench needs sufficient unthreaded pipe to clutch. The IRC requires that the gas pipe extend through the floor enough to expose a minimum of 2 inches of unthreaded pipe. Simple to do, but simple to overlook. Also, the pipe stub cannot be located behind a door, where it would be subject to physical damage should the door repetitively be opened into the pipe.

Electrical Convenience

While the IRC requires that all kitchens be provided with two 20-amp circuits dedicated to receptacle outlets, I have never heard of an inspector requiring this on an outdoor kitchen. The requirement for these receptacle circuits is to minimize the need for extension cords or receptacle splitters to serve toasters, blenders, and other small appliances commonly used in a kitchen. For the optional (and often seasonal) outdoor kitchen, these appliances—and the outlets needed to supply power to them—are not commonplace. Of course, if you choose to include receptacles in your design, installation would need to follow standard requirements.

Water

The installation of an outdoor sink is not commonplace, so discussion with the local building department during the planning phase is critical. Many details regarding the fresh water supply and drain for waste will be dependent on locally established rules and the climate, and not the IRC.

In freeze-prone areas, water can be supplied by a seasonal service similar to a landscape sprinkler system, with a stop and waste valve installed in the conditioned portion of the house that can be shut off and the outdoor piping drained when the weather turns cold. For year-round water service, the sink will need to be placed against the exterior wall of the house and supplied with a hot–cold frost-protected hose bibb. Of course, adding a sink to retain water introduces the need for a drain.

In some areas, code might not specifically prohibit simply draining the sink to the yard, but it may still raise a red flag with the inspector. No one cares if you wash your hands in your sink, and it drains to your yard, but what about washing the cutting board after prepping chicken shish kabobs out on the deck? To avoid this problem, a drain can be permanently connected to the home's DWV (drain, waste, and vent) system, which requires the use of a P-trap to separate the occupant using the sink from the sewer system below the ground. But a P-trap can freeze, and while there are a number of ways to address this issue, the building department could question all of them.

Outdoor kitchen design and features can vary considerably and thus so do the IRC requirements regarding their installation. Keeping in mind the environmental differences between an outdoor kitchen and an indoor kitchen and considering the IRC can't protect us from every possible hazard, just the probable, will help you get off on the right step in your design. However, many features of an outdoor kitchen could be uncommon to your building department, so always consult with it first. ❖

Glenn Mathewson is a code expert and former building inspector living in Westminster, Colo.

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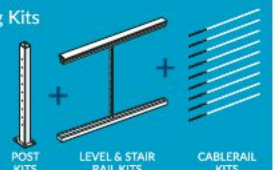

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PHOTOS BY EMANUEL SILVA

Rebuilding a 'Waterproof' Deck

Finding and fixing a small leak on an elevated deck uncovered major problems, leading to an extensive repair job

by Emanuel Silva

When I was asked last year to fix a leak on an elevated deck that doubled as a porch roof for a ground-level entry, I didn't realize that this seemingly simple repair job would turn out to be one of my most challenging remodeling projects.

Measuring about 17 feet by 12 feet, the 10-year-old deck included an L-shaped flight of stairs with a mid-flight landing. There were entrances into the house on both the upper and lower levels, and the builder had waterproofed the deck by installing plywood sheathing over the joists followed by an EPDM rubber membrane. The decking was then fastened to 2-by sleepers laid over the membrane.

Finding the Leak

Viewed from below, water damage appeared to be concentrated underneath a pair of guard posts at the top of the stairs (**Figure 1**). So this is where I started my investigation, pulling the composite post sleeves off the 4x4 PT posts to check out the flashing. Here is where I uncovered my first surprise: Short 4x4 blocks had been added to the tops of the posts to provide backing where the upper rails were fastened to the post sleeves. Apparently, the posts were too short when originally installed, and the builder hoped that the post sleeves would be strong enough to hold the assembly together. This wasn't the cause of the leak, of course, but was certainly a structural problem.

Shallow notches had been cut into the post bases to make room for the membrane flashing that extended up from the roof deck. But with no counterflashing, it was possible that water running down between the posts and the post sleeves was causing the leakage visible underneath. I couldn't be sure, because it also looked like cracks had opened up in the membrane around the post. Compounding the problem, the deck framing had very little pitch (probably to maximize headroom underneath), so water drained off poorly, if at all.

Whatever the cause, peeling the roof

membrane away from the posts revealed the extent of the water damage to both the plywood sheathing and the framing underneath. I knew that I would have to remove the rest of the decking and the sleepers, strip off the rest of the membrane, and replace the damaged sheathing. That's when I discovered significant rot damage in the triple support beam underneath the posts, which would have to be reframed.

As I peeled away the layers, more problems emerged. The roof-to-wall flashing membrane lapped over the weather-resistive barrier behind the shingles, for example, creating a reverse lap that allowed water draining down the WRB to flow behind the flashing. The flashing membrane was also perforated with hundreds of staples. Because the homeowners complained that water was leaking in around a couple of ground-level windows, I continued to strip shingles off the wall to find the problem. What had started out as a deck repair now expanded into a siding job too (**Figure 2**).

Figure 1. Evidence of leaking could be seen on the built-up 2-by support beam under the guard posts at the top of the stairs (A). These posts had been extended with 4x4 blocks, raising structural concerns (B). The porch decking was fastened to sleepers laid across a membrane-covered plywood roof deck, with the posts flashed to the membrane; there was no counterflashing (C). Water damage to the plywood sheathing was evident after the waterproofing membrane was removed (D).

Code Violations

Despite the post "extensions" hidden inside the post sleeves, the stair guardrails themselves were only 30 inches high and wouldn't pass inspection. Worse, they had been notched around the 2-by framing, leaving only a 2x2 cross-section. They would have to be replaced (**Figure 3**).

An even bigger problem was the way the stair stringers were attached to the landing. With minimal bearing surface at the bottom of the stringers (less than 1½ inches, and it was at the toe rather than at the heel), there was no way my inspector would allow those stairs to remain. The entire landing would have to be reframed.

That's when I discovered that the concrete piers supporting the stairs would have to be replaced too. When I am working on an existing deck, I typically dig down to take a look at the condition of the piers and footings to make sure they are built and sized properly. In this case, the first pier I inspected extended down less than half the 48-inch depth required by local code, and it rested on a large boulder.

More digging revealed more boulders and more shallow piers. It looked like the boulders had been intentionally placed there when the foundation for the house was built, and that they had interfered with pier installation when the deck addition was built. To satisfy the inspector, the existing piers would have to be replaced (**Figure 4**).

This was probably the worst part of the project, because I had to do the job by hand. My helper and I were finally able

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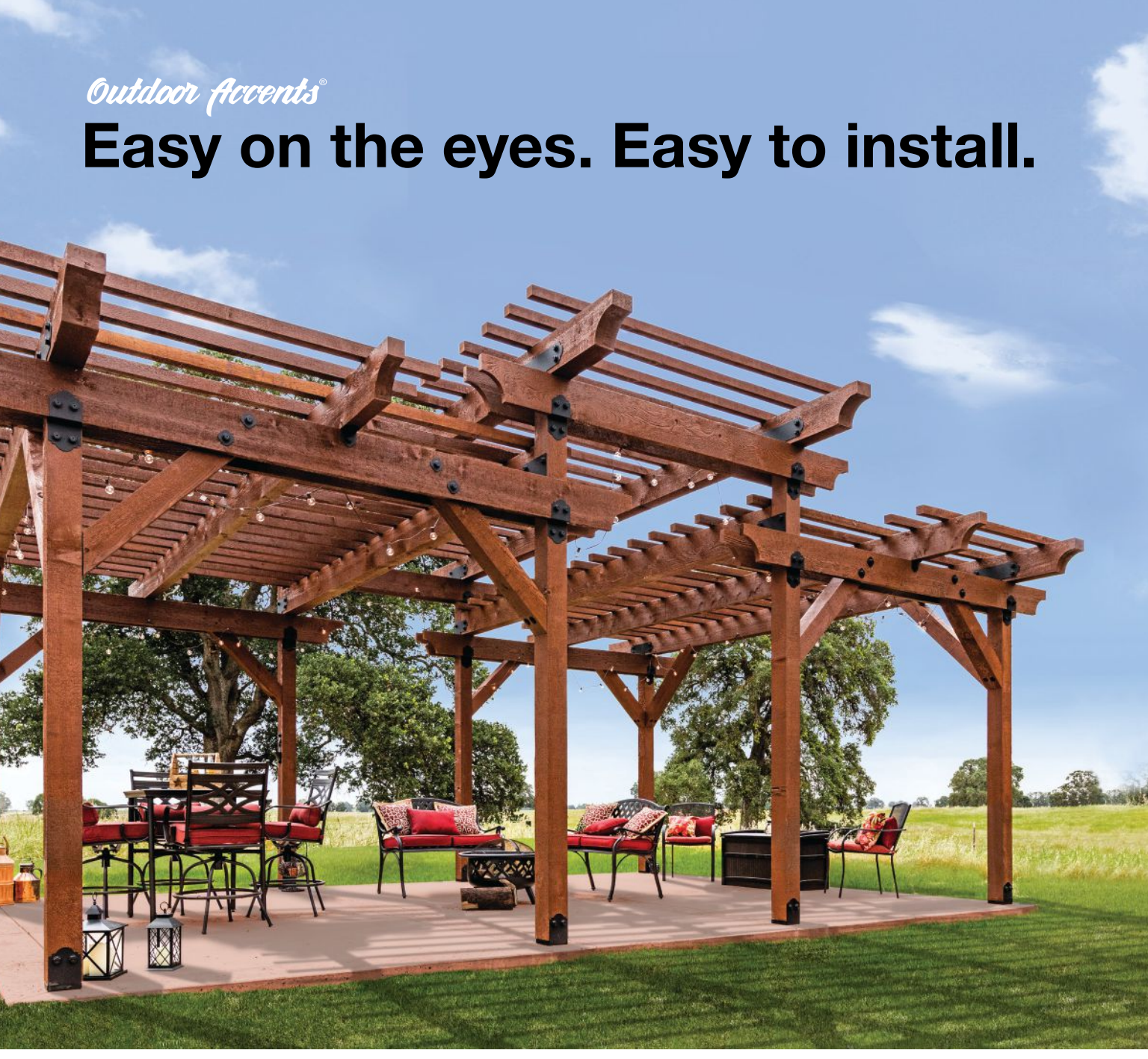


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Figure 2. Water that had seeped down into the triple support beam below the posts had caused significant rot (A). The water-resistive barrier (WRB) had been punctured by hundreds of staples, and deck-to-wall flashing was reverse-lapped over the WRB underneath the wall shingles, creating potential pathways for water to penetrate the structure (B). Windows had also been improperly sealed to the WRB underneath their sills, preventing drainage (C). To eliminate these problems, it was necessary to strip the shingles back to the window sills and install a new WRB (D).

Figure 3. Deep notches had been cut into this 4x4 post, critically weakening the post (top). In addition, the stair stringers weren't fully bearing on the landing, creating another structural problem (above).

to dig and pour proper footings, but not before a lot of grunt work; in the end, we still had to leave one of the largest boulders in the hole because it was just too heavy to lift without a machine.

Weatherproofing and Waterproofing

When I repair a deck like this one that's at least partially enclosed by walls, I like to extend the weatherproofing up the wall at least a couple of feet by installing a self-adhering rubberized membrane. That's because rain falling off the roof onto the deck will splash back onto the siding, and in the winter, snow will often pile up against the walls. Wind-driven rain is always a concern too.

On this project, I stripped the shingles back to the bottom of the window flanges so that I could properly detail the walls from that point down to the roof deck. Then I installed the new EPDM roof membrane, carefully detailing the flashing around the posts to make sure they wouldn't leak in the future (**Figure 5**).

Molded one-piece EPDM boots are available to fit over 4x4 and 6x6 posts, but usually I fold my own from scrap pieces of membrane. Afterward, I liberally apply black lap sealant to the joints for an added level of protection.

Building on Existing Footprint

Once we formed and poured the new piers, framing the new landing platform was straightforward. I upgraded the support posts from 4x4s to 6x6s, used appropriate metal hardware for the column bases and post-to-beam connections, and reinforced the guard-post connections with plenty of blocking.

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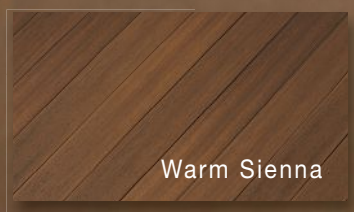

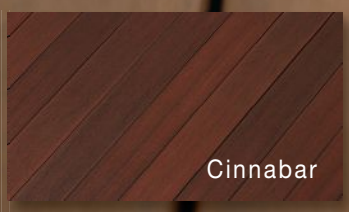

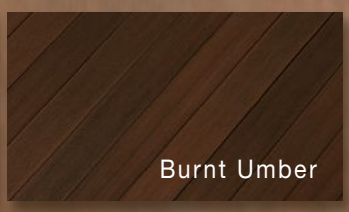

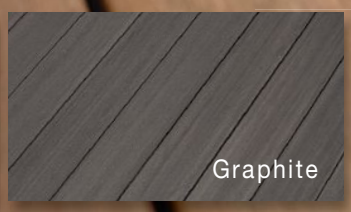

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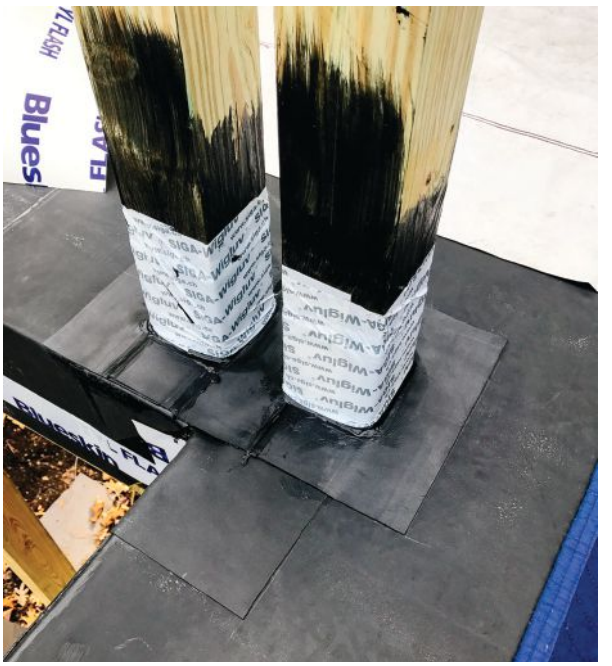

Figure 4. The piers supporting the landing were too shallow, probably due to the boulders that had been buried under the slab (top left). Removing them was a difficult but necessary job (bottom left).

Figure 5. The roof flashing boots were sealed to the posts with Siga Wigluv, a high-performance tape (top right), then the posts were wrapped with SAF flashing membrane (bottom right).

To make sure the stairs and landing were exactly square to the existing deck, I built an overhead frame to help with the layout. I had to use the existing layout for all four footings—to avoid triggering a permit review—so I started by leveling two boards out from each corner of the deck, then squared the ends where they intersected over the platform, using a plumb bob to make sure they landed over the corner footings. It took a bit of tweaking to square the landing to itself and the deck (**Figure 6**).

Having the frame above, I was able to locate each post along with each footing by dropping a plumb bob down to each one. There was no other way to make this work. The platform ended up lining up with the deck perfectly, along with being square. In my experience, taking the time to make jigs and templates always makes the job easier.

My inspector also likes the fact that I make it a practice to treat all end cuts and notches with preservative. This step is required by code (the IRC references AWPA Standard M4), but he tells me most builders skip this step. In fact, my lumberyard explains that it doesn't typically keep preservative in stock because

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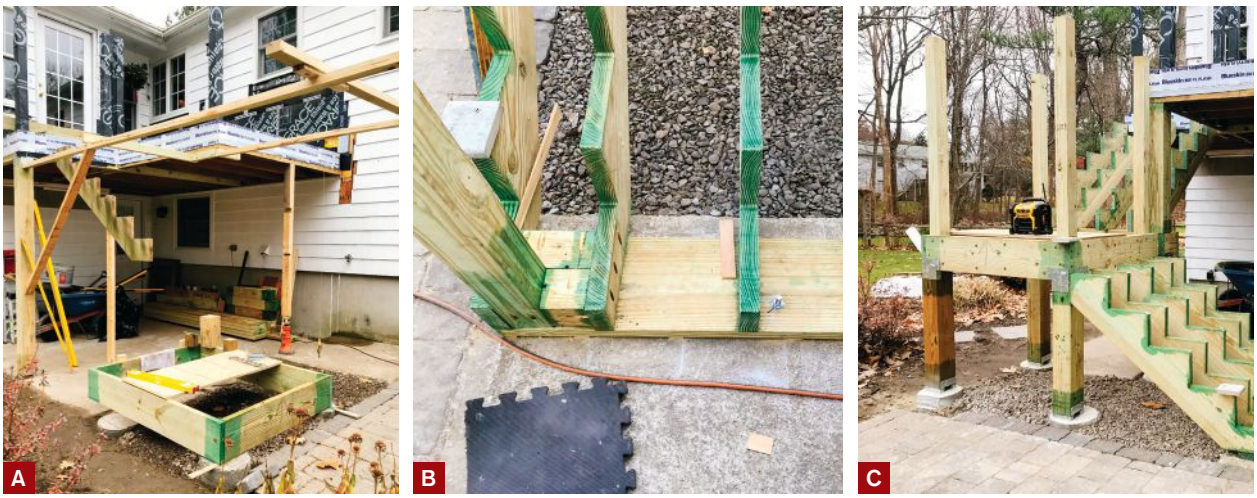

Figure 6. A temporary overhead frame defined the stair layout, ensuring that the new support posts and landing would be accurately located on top of the piers (A). The lower stair stringers are pocket-screwed to a 2x10 that's wedge-bolted to the concrete-slab landing (B). Here, the stairs have been reframed and are ready for tread and riser installation (C).

Figure 7. To fit the multiple flashing layers that were used to waterproof the 4x4 guard posts, the author installed composite post sleeves sized to fit 5x5 posts (left). The new deck looks similar to the old one, but has more useful dry space thanks to the new flashing details and new screening that encloses the area underneath the deck (right).

it doesn't sell enough of it, so I usually have to special-order it. There are several types of approved copper-based preservatives, but I prefer Copper Care's Tenino Copper Naphthenate.

From this point on, the job became fairly straightforward. My clients chose to replace the old PVC deck boards—which had visible mold and mildew—with capped composite decking. I fastened it to the sleepers with hidden fasteners.

Because I had wrapped the 4x4 posts with waterproofing membrane, I decided to use 5x5 post sleeves to account for the extra thickness (**Figure 7**). Even so, I had to trim away a bit of the core at the base of the sleeves so that they would slide down easily over the flashing boots and overlapping membrane. I did this by fitting my recip saw with a fine-tooth 12-inch blade and having my helper carefully hold the sleeves down on the work table with a protective cloth while I slowly cut each side.

The rebuilt porch and stairway occupies essentially the same footprint as the original, with similar details and finishes. But now that the deck above would stay perfectly dry, my clients asked me to screen in the area below, a nice finishing touch that added useful outdoor living space to the home. ❖

Emanuel Silva owns Silva Lightning Builders in North Andover, Mass.


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Concrete-Free Deck Foundations

Many decks can be supported by metal hardware rather than concrete piers

by Andrew Wormer

As Mike Guertin reminds us in "Ground Rules for Grade-Level Decks" (May 2017), freestanding decks don't need to be supported by footings that extend to the frost depth. But they do need to be well supported; in fact, code requires a minimum footing depth of 12 inches below undisturbed ground surface. But there are several options for meeting that requirement that don't require tedious digging and lugging around heavy bags of concrete.

Most builders are already familiar with one alternative: helical piles, which are basically screw-shaped plates welded to steel shafts that are screwed into the ground (see "Helical Pile Deck Foundations," May 2012). Various sizes are used depending on anticipated loads and soil conditions.

Helical piles need to be installed by trained technicians using special hydraulic machinery. But that's not the case with Titan Deck Foot anchors (titanbuildingproducts.com), which look a little like miniature helical piles but function a bit differently. They don't require special machinery and can be installed with hand tools. Titan anchors are strictly designed for use with freestanding structures, unlike helical piles, which can be used to support deck framing that is also attached to a ledger.

Titan Deck Foot Anchors

One example of just how useful Titan's hand-installed metal anchors are can be found in Chambersburg, Pa., where contractor Jim Hill used them to fix a deteriorating boardwalk running through a low-lying wet area along a south-central Pennsylvania stream. Hill wasn't familiar with the hardware, but it had been specced in the bid documents for the project.

The design called for new crossbeams to reinforce the existing boardwalk framing. But instead of being supported by PT posts bearing on concrete footings (the boardwalk's existing foundation system), the drawings showed the beams bearing directly on the metal anchors.

There are actually three parts to each anchor: a galvanized-steel post bracket, a cap plate, and an auger that is screwed through the cap plate into the ground (**Figure 1**). The auger looks a little like a helical pile, but its main job is to resist uplift rather than provide bearing strength. That job is done by the cap plate, which the company says can resist loads of more than 19,000 pounds per square foot. The beauty of the system—especially on this boardwalk project—is that the auger can be installed with a hand-held impact driver, eliminating the need for heavy equipment (**Figure 2**).

The company makes both 24-inch-long and 36-inch-long augers and says that the 24-inch auger is fine for most soil conditions. Hill decided to use the 36-inch-long version, however, to provide better pull-out resistance in the soft soils along the stream. Titan says that auger length doesn't affect the footing's resistance to frost movement, and Hill expects that this boardwalk will rise and fall seasonally. But to prevent damage to post–beam connections, the anchors are engineered with what the company calls "Terra-Shift" technology. These are basically slots instead of round holes in the brackets that allow the post to slide up and down instead of being locked in place by the fasteners when frost exerts a force on the deck.

Figure 1. Titan's Deck Foot anchor consists of a galvanized steel post bracket, a cap plate, and an auger that is screwed through the post bracket and cap plate into the ground. The cap plate supports loads, while the auger resists uplift.

PHOTO COURTESY TITAN BUILDING PRODUCTS

Hill says that his company ended up taking most of the old boardwalk apart and replacing it, due to the amount of rot damage they found. Where they could, they retained the framing, which was in better shape than the decking, and used most of the original order of 100 anchors to strengthen and reinforce the structure. They did this by installing pairs of anchors on either side of the boardwalk framing midspan between posts. 4x8 PT crossbeams installed between each pair of anchors support the joists (**Figure 3**).

While reinforcing the framing, Hill's crew found that a number of existing PT posts had deteriorated beyond repair. Instead of replacing the damaged posts with new posts, he ordered another 53 Deck Foot anchors. His crew appreciated the fact that they were able to transport relatively light steel hardware instead of heavy bags of concrete along the length of the boardwalk to make repairs. Another plus: Hill reports that it only took between 15 and 30 minutes to install each anchor, which helped keep project costs under control.


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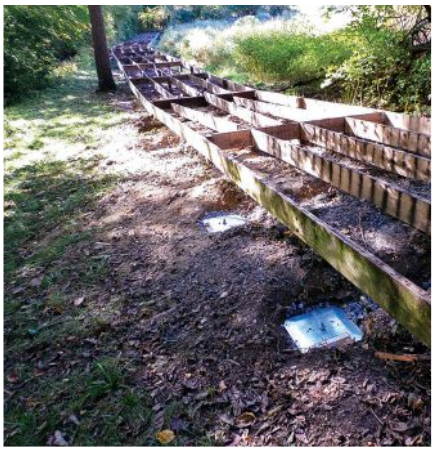

Figure 2. An impact driver screws the anchor's auger into the ground. Then the cap plate is slipped over the auger and bolted down tight so that it rests firmly on the layer of crushed stone (right). Post brackets will be threaded onto the anchors to support 4x8 PT crossbeams, which in turn reinforce and help level the existing framing (far right).

Figure 3. Considerable rot was found in the existing posts supporting the boardwalk (far left). The damaged posts were also replaced with metal anchors, then new 2x6 PT decking was installed to complete the repairs (left).

Oz-Deck

California builder Richard Houghton told me that he had worked for years as a union carpenter and plumber before shifting his focus to decks a few years ago. Digging deep holes and hauling heavy bags of concrete is tough on a 50-year-old body, and a few projects into his new gig he decided there had to be a better way to support a deck. An internet search led him to Ozco Building Product's Oz-Deck foundation system (ozcobp.com), which Houghton refers to as something of a eureka moment for him.

The system consists of 12-inch-by-12-inch 6-gauge HDG steel deck plates and 36-inch-long Oz-Post post anchors, which are driven through the deck plates and into the ground with a jackhammer. The post anchors are available to fit both 4x4 and 6x6 posts and can also be used without the deck plates to support fence and sign posts. Each post-plate assembly is rated for a load of 1,600 lb., with a recommended spacing between posts of no more than 6 feet (**Figure 4**).

The Oz-Deck system is designed to eliminate both concrete and shovels, but on the project shown in this article, Houghton placed the posts in shallow excavations instead of at ground level. That was because he wanted the top level of the deck to be flush with the inside floor of a home built on a slab. Brackets for connecting a beam directly to the anchor are not currently available.

The company says that decks as high as 8 feet above grade can be supported with its system, but in general, Houghton limits his Oz-supported decks to no more than 2 feet above grade, to avoid the diagonal and lateral bracing that would be required with a taller deck.

Houghton says that in the right soil, it takes about a minute to drive in one of the Oz-Posts with his electric jackhammer (which he picked up from Harbor Freight for about $600). The posts can also be installed manually—and tediously—with a sledge hammer. Ozco offers installation kits for either option,

PHOTOS COURTESY R.A.HILL INC.

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Figure 4. Oz-Post bases are typically installed on-grade using a jackhammer and a special bit that fits inside an insert placed in the base (A). On this project, the post bases were placed in shallow excavations (B) to keep the carrying beams close to ground level (C). The author typically limits his use of Oz-Posts to low freestanding decks on level ground, like this one (D).

with both including a spacer that fits inside the post base. The jackhammer version of the kit, which also includes an installation bit for a standard 1⅛-inch jackhammer chuck that fits inside the spacer, costs about $50.

Occasionally, explains Houghton, he'll run into a rock or root and have to back out the post and relocate it, something to keep in mind if you're building in bony soils. Getting approval from your building inspector may be a problem too, though Houghton reports that it is much less of an issue now than it was when he first started using the posts. Ozco says the system is suitable for use anywhere in the country for building a freestanding deck, but Houghton adds that he occasionally will use Oz-Posts with ledger-supported decks, since he builds in an area with no frost. This works because the process of jackhammering the posts into place also compacts the soil under the plate and around the post, minimizing seasonal movement.

Houghton is quite confident in the load-carrying ability of the system; in fact, he is currently working with an engineer on plans to use Oz-Posts to support a freestanding hot-tub deck. Still, there are limitations. For example, Houghton doesn't use them to support decks that are taller than 6 feet above grade, nor does he use them on steeply sloped sites. Houghton estimates he uses them on about 50% of his projects. ❖

Andrew Wormer is editor of Professional Deck Builder.

PHOTOS BY RICHARD HOUGHTON

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Skilsaw Southpaw Circular Saw

by John Carroll

In the 1970s, I grew into the carpentry trade using a standard 7 1/4-inch sidewinder saw, with the blade to the right of the motor. During those early years of my career, I developed habits of workmanship that are now deeply ingrained, including how I set up my saw station, hold the material, hold the saw, and follow the line. Sure, I know that the line of sight is much better when the blade is on the left side of the saw, as is the case with wormdrive and hypoid saws. But I've adjusted to the less-than-perfect sight line on my sidewinders and am willing to put up with it in exchange for the full support that I get on the "keep" side of the line as I finish the cut.

Of course, there are times when a left-bladed saw is handy, such as when I need to cut something in place and the motor on my right-blade saw is in the way. Or when I make the bevel cuts on an open-stringer stair skirt and need to tilt the saw in the opposite direction that my right-blade saw is capable of tilting. I've also found the clear line of sight on a left-blade saw is a big advantage for cutting plywood and for cutting rafter tails in place. So even though my main circular saw is a right-blade sidewinder, I also keep a left-blade saw handy and consider it an essential part of my tool arsenal.

That's why I was eager to check out Skilsaw's model 67M8-01 7 1/4-inch blade-left saw (skilsaw.com), which Skilsaw calls the "Southpaw." After installing the included 24-tooth Skilsaw carbide blade, I found the Southpaw ran smoothly and was relatively quiet. Even though the blade seemed to be of average quality, it cleanly cut the plywood and framing lumber I was using.

Because the shoe and guard are made out of magnesium, the Southpaw is pretty light—it weighs a little less than 9 pounds, according the specs. Compared with my two other 7 1/4-inch sidewinders, it weighs 0.4 pound less than one of them and a full 2 pounds less than the other. I like this lightness because when I cut things in place, I often have to hold the saw high or at difficult angles.

The Southpaw draws 15 amps, so it has plenty of power. The sides of the table are a hefty 3/8 inch thick, and they're square to the bottom. This provides an excellent surface to run along a straightedge. There's no blade brake or built-in rafter hook, however.

One neat feature is the way the arbor wrench clips into a slot at the back of the table. Instead of going AWOL almost immediately, the wrench will be handy whenever I need to change the blade. This clever detail warmed my gadget-happy heart.

Cutting capacities for the Southpaw are standard for a 7 1/4-inch saw. At 90 degrees, it cuts 2 7/16 inches deep; at 45 degrees, the depth of cut is 1 7/8 inches. Not so standard is the saw's ability to tilt way past 45 degrees and all the way up to 56 degrees.

This is a well-designed, professional-grade saw that's well worth the price ($109, if you shop around). You may not think you need a left-bladed saw, but you do. And if you don't have one already, I highly recommend this one. ❖

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

Seeing the Light

by Jason Russell

My clients' beautiful home on Lake Tapps, a man-made reservoir just east of Tacoma in Washington, had a problem: The sloped backyard living area overlooking the lake was terraced with multiple stone patios and concrete staircases, a recipe for disaster for their two small children. They wanted to simplify the space and make it safer by replacing the hardscaping with a single-level PVC deck that had fewer elevation changes and not as many hard, sharp corners.

My initial design achieved those goals, but met resistance from the neighbors, who wanted us to drop the main deck elevation by at least 30 inches in order to preserve their own views of the lake. Back to the drawing board.

I like to push the envelope a bit, and in my follow-up design, I introduced the idea of glass panel railings for their new—but lower—deck. These panels wouldn't require a top rail, unlike the cable railings in the original design, and would provide clear, unobstructed views of the water.

When I showed the couple some photos of what I had in mind, the wife loved the idea. Not so the husband; he was worried about keeping the panels clean. That's a legitimate concern, but from experience I know that rail panels treated with a self-cleaning hydrophobic coating will effectively repel dirt and water, greatly reducing the problem.

To help sell my idea, I set up a sample railing and left it overnight. This particular system—called CrystalRail by Regal Ideas—features low-iron 10mm tempered-glass panels and aluminum mounting brackets with built-in LED lighting that illuminates the panels at night. Once I powered up the temporary railing, my clients never looked back.

Installation is fairly straightforward, though the stairs require a bit of planning since the stair panels come in only three lengths and are only available to fit stairs with a 35-degree pitch. But as these photos show, the effect is pretty spectacular, especially at night, both on the deck itself and when you're looking back towards the house from the lake. ❖

Jason Russell (aka Dr. Decks LLC) lives in Tacoma, Wash., where he has been building custom decks for 25 years.

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1. Modern-Design Door Glass

Masonite is introducing three new decorative glass styles for its interior and exterior doors: Double-Water, Cruz (shown), and Focus. Double-Water is made to "evoke the waves of the Mediterranean" with textures that provide privacy and allow natural light; Cruz has opaque glass and clean lines meant to complement urban aesthetics; and Focus, a mixture of frosted and clear glass, reportedly complements modern farmhouse design. Pricing ranges from $600 to $1,010. masonite.com

2. Easy-Install Valve System

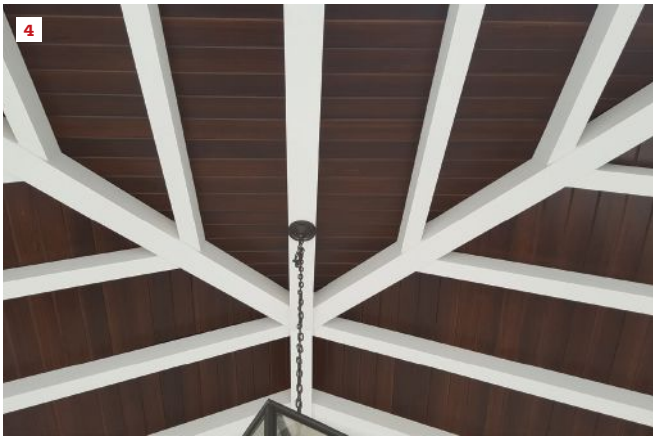
Gerber designed its Treysta rough-in valve system, for tubs and showers, to work in a range of plumbing situations. The compact, brass-forged body has mounting holes, while vertical inlets allow for flexibility in the wall and installation next to a stud in PEX applications. Its mounting system and plaster guard with depth indexing were engineered for quick installation, says the manufacturer. Treysta accommodates back-to-back installations and reversed hot and cold inlets. Pricing starts at $65 and increases depending on configuration. gerberonline.com

3. Six Pro Utility Knives

Fiskars' new line of Pro Utility Knives has six models, including fixed, retractable, folding, painter's, drywaller's, and 18mm and 25mm snap-off utility knives. Each knife has a blade locking system to prevent accidental release. A proprietary Carbon-Max coating is designed to keep the blade sharp longer than competitive blades, according to the manufacturer, and the grips are molded to provide comfort regardless of hand position. Prices for the knives range from $18 to $30. fiskars.com

4. Coating for Exterior PVC

Versatex has partnered with water-based-coating provider Aqua-DIY to create a coating system, called Aqua-DIY D100, that offers a virtually unlimited range of color options—including wood-grain finishes (shown)—for its PVC trim, ceiling, and soffit products. The company says that its system incorporates heat-reflective pigments and a water-based vehicle that bonds with PVC at the molecular level, resulting in a finished substrate that resists heat buildup and a coating that will not chip or peel. Retail price is $165 per gallon. versatex.com



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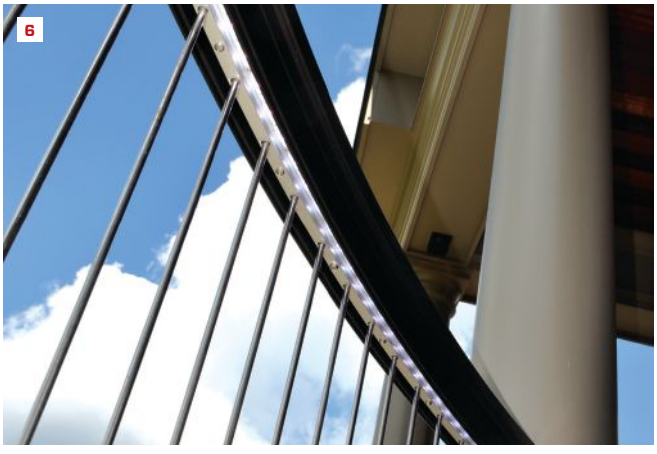

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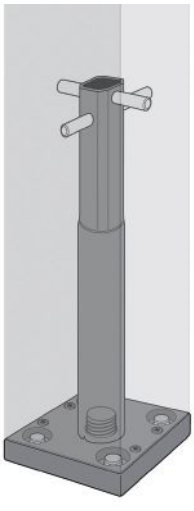

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5. Thermally Modified Wood

Thermory USA's thermally modified wood, which is treated in Europe using only heat and steam, is a dimensionally stable product that offers enhanced strength and durability, according to the manufacturer. The treated wood has a Class 1 durability rating for rot and decay resistance for 25 years. The decking features both solid and grooved profiles; the cladding is designed for a blind-fastener installation. Pricing ranges from $4 to $12 per square foot. thermoryusa.com

6. Cable-Rail Alternative

Invis-A-Rail developed its infill railing system as a less-expensive, less-complicated alternative to cable railing. The design consists of two main components: a pair of anodized aluminum support channels that come in 6-foot or 8-foot lengths, and vertical 304-grade stainless steel rods with hooked ends. The vertical rods are inserted into slots spaced 3 inches on-center in the channels, and the channels are screwed to structural upper and lower rails to create each rail section. A 10-pack of 30-inch balusters costs $60, while a 6-foot-support-channel kit costs $50. invis-a-rail.com

7. Structural Anchor for Wood Posts

Titan's Evolution structural post anchors provide a surface-mounting solution for wooden columns. Each kit consists of a 1/2-inch-thick HDG steel base plate with a black powder-coated finish, a 1 1/4-inch-diameter-by-11-inch-long threaded steel tube, and a 1 3/4-inch-long threaded stud that joins the tube and the base plate together. The base plates, which are available for 4x4 and 6x6 posts, are fastened to concrete and stone surfaces with 3/8-inch-diameter-by-3-inch wedge bolts. The holes can be plugged to conceal fasteners. Cost for the kits starts at $60. titanbuildingproducts.com

8. Molding Miter Snips

Crescent/Wiss' new molding miter snips were designed to make accurate miter cuts fast and in any type of small molding, including pine, PVC, and MDF, says the manufacturer. The snips are composed of durable steel and have a re-sharpenable blade. A built-in angle guide has marks for 120, 105, 90, 75, and 60 degrees with a stop at 45 degrees. Pricing starts around $20. crescenttool.com

9. Neutral-Palette Tile

Daltile's Koncrete glazed ceramic tile was developed for the company's spring line and was intended to blend the looks of soft cement and fabric. With a natural color palette, the tile pairs well with many kitchen and bathroom materials and is offered in a variety of applications, including for floors, walls, mosaics, and trim. The line has six sizes available, along with a decorative accent that comes in beige, greige, white, and grey. Pricing for the tile starts at $3.25 per square foot. daltile.com

10. Wiremold Floor Box

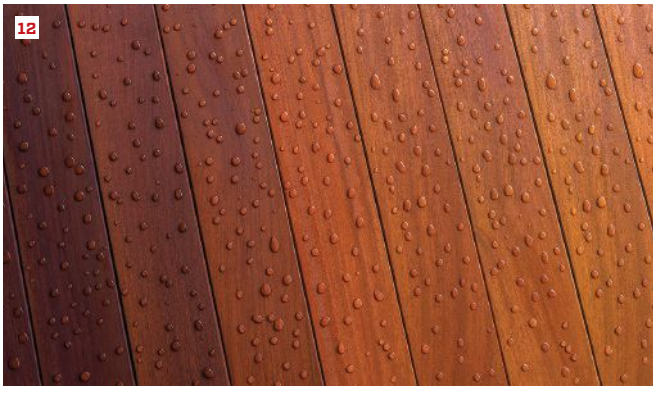
Legrand's new Wiremold residential floor box kits aim to meet modern power needs with outlets and USB-charging stations that mount into any floor type with wooden subfloors, including carpet, tile, natural stone, and wood. The kits are available in two varieties, the rectangular Dual Outlet Floor Box Kit and the circular USB Charger & Outlet Floor Box Kit, and two surface finishes, nickel and brass. Both Wiremold boxes are constructed from PVC and require a 4-inch hole saw for installation. The 5 5/8-inch cover allows easier installation and a recessed receptacle can hide most kinds of cords. Suggested retail price is $98. legrand.com

11. Algae-Fighting Roof Shingles

Legend Designer Fiberglass Shingles are among Atlas Roofing's latest releases. These 3-tab shingles resist algae growth with Scotchgard Protector, which helps prevent black streaks on homeowner's roofs, says Atlas. Shingles are built to withstand 110-mph winds in harsh weather conditions and come with a 40-year limited warranty. The Legend shingles are available in five colors: black shadow, desert shake, hearthstone gray, heather-blend, and weathered wood. Pricing varies per market; contact a local distributor for exact price. atlasroofing.com

12. Waterproofing Hardwood Sealant

Deckwise's Wisecoat water-based zero-VOC coating is designed for both interior and exterior use on tropical and American hardwoods and thermally modified wood. According to the company, Wisecoat coats the hardwood fibers at the cellular level with a flexible, non-film-forming barrier, guarding against water intrusion. The water-based semi-transparent coating has an amber tint with UV blockers, and cleans up with soap and water. The product is priced at $60.90 at retail. deckwise.com



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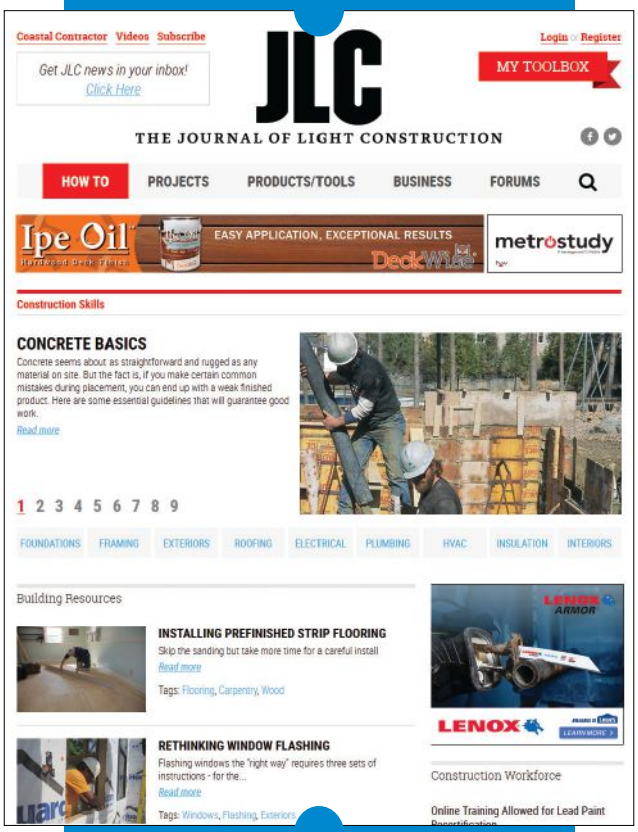

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DINNER•AWARDS•• TICKETS

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NADRA.org

Baltimore National Aquarium

Wednesday October 10th, 2018, 6:30pm

- Cocktail Reception, Open Bar
- Tour 3 levels of Pier 3 exhibits
- Annual Meeting
- Awards Presentation
- Dinner Celebration on Pier 4, Open Bar
- After Party at the Hard Rock Cafe - Live Band

NADRA•EDUCATION•• AT•DECKEXPO•

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Deck Evaluation / Inspection Program

Tuesday October 9th, 2018, 8am - 12pm

This program will allow Inspectors the opportunity to evaluate a deck using the NADRA Deck Evaluation checklist. Certification available.

Down the Load Path - New 2018 IRC Provisions

Tuesday October 9th, 2018, 1pm - 4pm

This is part 3 of a 4 part series. 1,2 & 4 available online.

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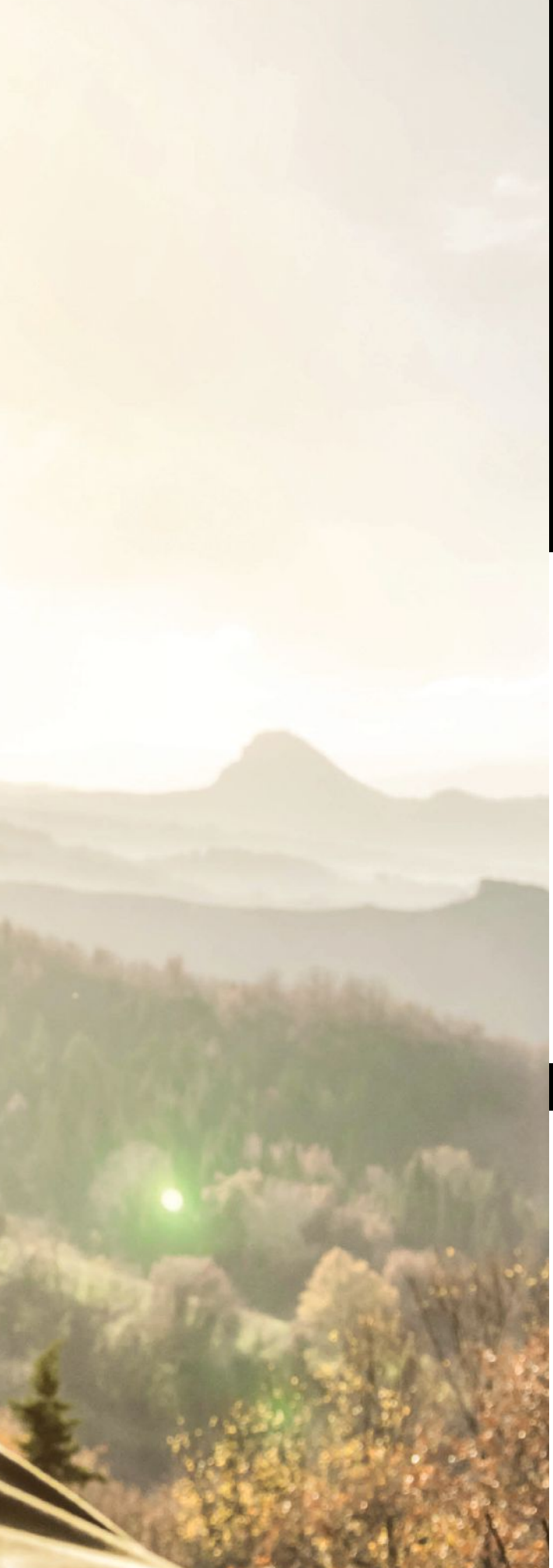

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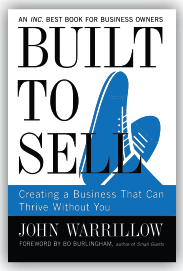

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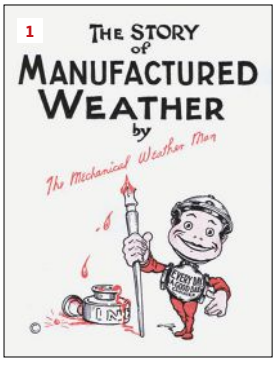

Carrier Engineering Corp.'s early marketing efforts featured a cartoon mascot, The Mechanical Weather Man (aka "Mech"), whose control-valve body touted "Every Day a Good Day" **(1)**. Willis H. Carrier, circa 1919, is pictured here **(2)**. Mech "authored" his own book ("The Story of Manufactured Weather") in 1919, featuring testimonials from satisfied customers (photo excerpt) **(3)**. A 1921 newspaper ad notes, "You can manufacture weather" **(4)**.

Images courtesy Carrier Corporation

The Birth of Air Conditioning

The very first whispers of indoor air conditioning, as we know it today, began around the turn of the last century at The Buffalo Forge Co.—an industrial manufacturer of forges, fans, and blast heaters. There was a reason manufacturing facilities were dubbed "sweat shops" during the industrial revolution, and Buffalo Forge saw an enormous business opportunity in cooling and dehumidifying work environments. Improving the plant conditions would safely extend work hours and increase worker productivity. Buffalo Forge planned to develop a new line of equipment to sell to clients, along with equipment that contributed to sweltering work conditions.

This wasn't a new business quest. Firms had been in the business of heating, cooling, and dehumidifying plants for decades, but precise control of humidity in a manufacturing environment eluded the industry. The engineer tasked with solving this problem for The Buffalo Forge Co. was 26-year-old Willis Carrier. After being handed the assignment by a senior engineer, J. Irvine Lyle, Carrier landed on the idea of using a spray of water as a condensing surface. By driving humid air through the water spray, he could dry the air; and by adjusting the temperature of the water spray, he could adjust the air's humidity. The science of psychrometrics had been born.

Carrier dubbed the process "dew point control," and it was a prime feature of The Buffalo Forge Co.'s new line of industrial "air washers." In a 1906 catalog, Carrier provided data about his air washer and included the first psychrometric chart. Indeed, the task of explaining to plant managers what he was doing proved as important as what he was able to do. Every successful invention is the product not just of good engineering, but of marketing, as well.

While the business took off, the Buffalo Forge Co. backed off from it when the country entered World War I. As labor and material grew scarce, the company scaled back to its original lines. Carrier and Lyle weren't ready to abandon the project, and with five other engineers, founded the Carrier Engineering Corp. in 1915. Two years later, the nascent company's biggest customers were munitions makers who clambered for technology to control indoor humidity, which helped reduce static charges that could touch off explosions around flash powder. Fuses and some explosive compounds in bomb manufacturing could not be produced in unstable indoor environments. As the war progressed, air conditioning in textile plants and candy factories also proved lucrative. After the war, food processing plants became the next big market for "manufactured weather."

Curiously, the term "air conditioning" was not Carrier's. Carrier filed his first patent as "An Apparatus for Treating Air." "Air conditioning" was a phrase used on a different 1906 patent, filed by Stuart Cramer, a textile engineer, for a device specifically designed to condition yarn.

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