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On the cover: George Botelho of G. Botelho Excavation, in Waquoit, Mass., uses the bucket of his skid-steer machine to smooth the backfill around the foundation for a home in Woods Hole. Photo by Roe Osborn

FEATURES

DEPARTMENTS

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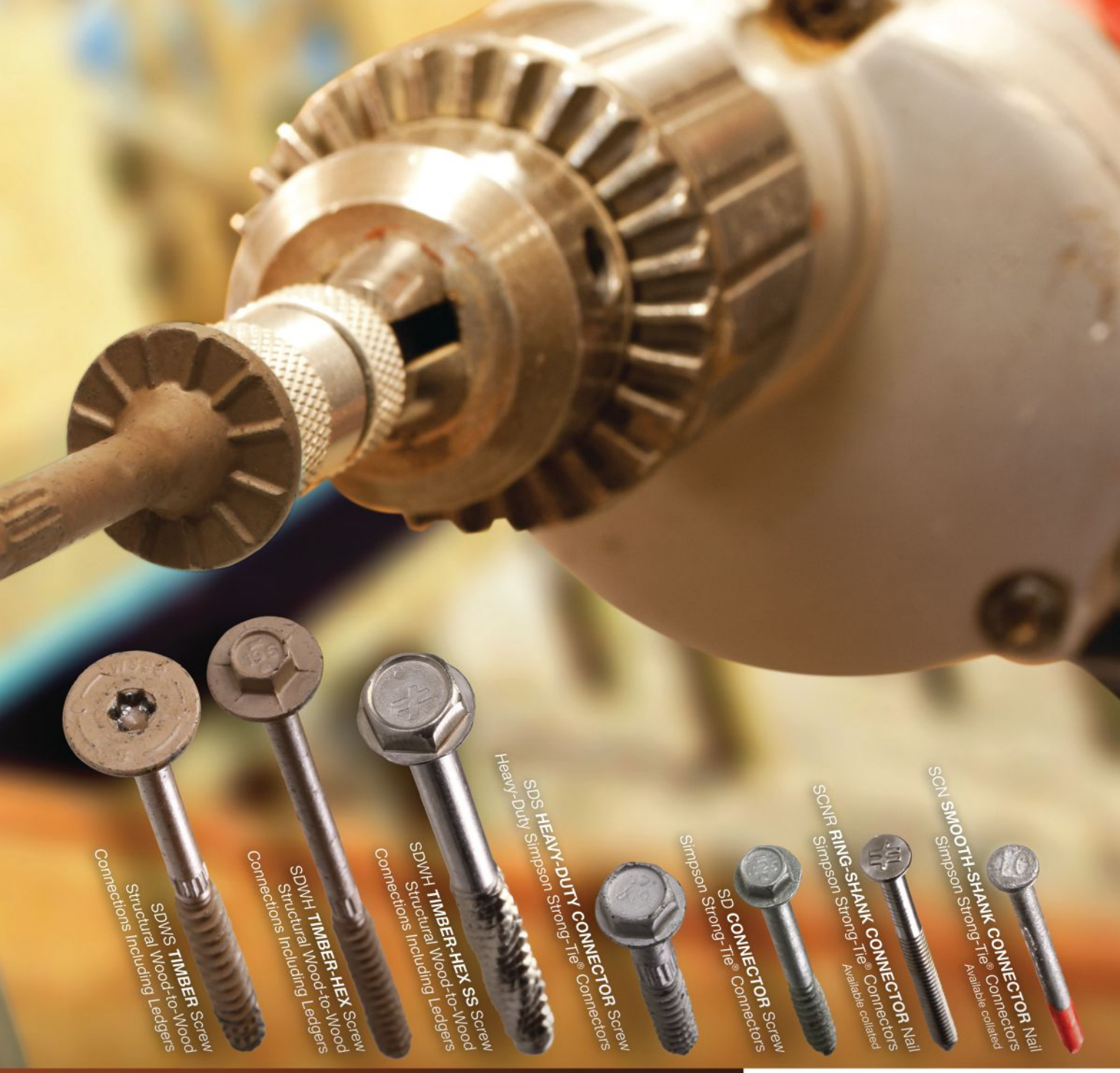

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Editor Clayton DeKorne, cdekorne@hanleywood.com
Art Director Sarah Bell, sbell@hanleywood.com
Managing Editor Laurie Elden, lelden@hanleywood.com
Illustrator Tim Healey, thealey@hanleywood.com
Senior Editors Jefferson Kolle, jkolle@hanleywood.com; Roe Osborn, rosborn@hanleywood.com
Graphic Designers Jen Aranyi, jaranyi@hanleywood.com; Kim Lofgren, klofgren@hanleywood.com
Contributing Editors Michael Byrne, Michael Chotiner, Ted Cushman, David Frane, Bruce Greenlaw, Dave Holbrook, Joe Stoddard, Jon Vara, Charles Wardell, Andy Wormer

Senior Web Developer Braddock Bull, bbull@hanleywood.com
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SALES OFFICES

HEADQUARTERS

Rick Strachan Group President, Residential Remodeling
202.736.3332 Fax: 202.785.1974
rstrachan@hanleywood.com

Trow Meier Senior Vice President, Sales
773.824.2417 Fax: 202.785.1974
tmeier@hanleywood.com

NORTHEAST/MID-ATLANTIC

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(Including CT, DC, DE, MA, MD, ME, NH, NJ, NY, PA, RI, VA, VT, WV)
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Larry Rice Account Manager
802.324.0913 Fax: 802.879.9384
lrice@hanleywood.com

CANADA

John Magner York Media Services
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Fax: 416.598.9191
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UNITED KINGDOM/EUROPE

Stuart Smith Regional Sales Manager
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"CLIPSTONE—FAUX STONE VENEER THAT WON'T ROT SHEATHING" (ONLINE VIDEO, 12/15/14)

Kevin Thompson: After viewing this video, I was wondering how you install the product along a sloped roofline? How would you attach the stone if you had to cut off the mounting clips when making angle cuts?

John Bailey of Environmental Stoneworks (manufacturer of ClipStone) responds: ClipStone is a mortarless stone veneer product. It's mechanically attached to wall sheathing with an integral clip system that provides a drainage plane. At the top, two screws fastened through eyelets on a mounting clip secure the stone to the wall, while at the bottom, two legs bent outward provide tension to help hold the stone piece in place. The 5-inch-wide clip system is centered in the stone along its length, and the stones vary from 8 to 20 inches long.

When ClipStone is installed along a sloped roofline (or interior ceiling), the likelihood of needing to cut off part of the top mounting clip increases for shorter pieces and on shallower roofs. For a cut piece, we recommend at least one eyelet of the top mounting clip and both bottom legs be left in place. To ensure this, we advise starting a new course at the cut piece, rather than installing full-size pieces and working from the center of the wall out toward the roof slope; this way you can make sure the cut piece fits tight and can be secured with at least one screw.

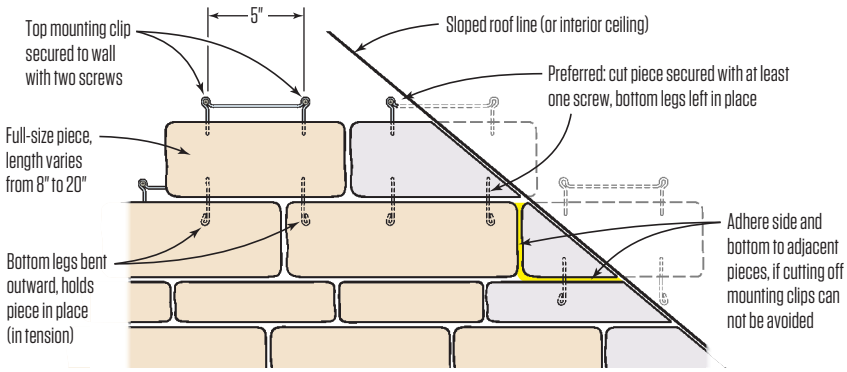
Gable-end walls are a little trickier, but the principle is the same: Start at the cut pieces and work toward the center, cutting the field pieces as needed to complete your row. The key to the installation is to try not to have too many smaller-cut pieces at the ends because they have a higher chance of not having a clip to fasten to the wall. If you have to remove both of the mounting clip's eyelets, use masonry adhesive (such as Loctite PL Construction Adhesive) on the bottom and side to secure it to the adjacent stone (see illustration, below).

"BUILDING AN EYEBROW DORMER," BY DANIEL LEWIS (12/14)

Daniel Lewis: I've posted more pictures that didn't fit into the print version of my *JLC* article. They can be found at daniellewisarchitect.com/jlc-eyebrow.html.

Mostly, the photos show the final patterns and how the pieces fit within the constraints of the stock that I used. They also show the shape of the garage, which is not rectangular: It's actually a polygon with only one right angle. The site constraints were very tight, and sometimes one has to work within the space available.

Attaching ClipStone at Sloped Roof



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Q I usually use ridge vent and eaves vent to ventilate the attics in the homes I build. How do you calculate the requirements for that type of system, and do they change when the roof pitch changes?

A Paul Scelsi, presenter of Air Vent's "Ask the Expert" seminars, responds: Most of us understand that proper attic ventilation can keep an attic cooler during warmer months, but it also helps to reduce moisture and to keep an attic dry during colder months. Proper attic ventilation can also help prevent destructive ice dams from forming.

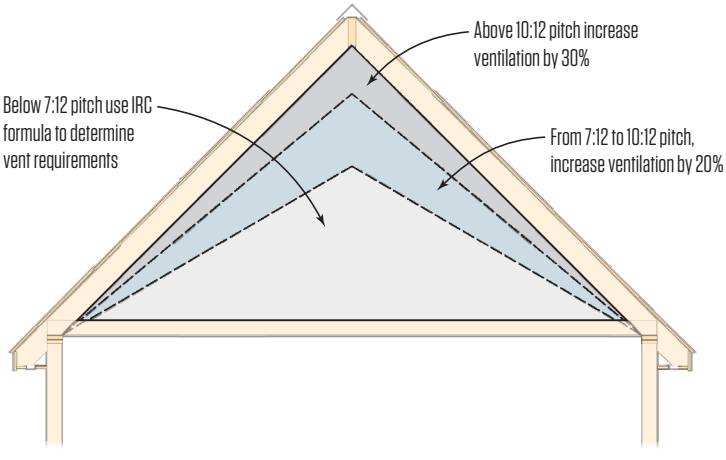
Installing a balanced attic ventilation system is the key, and one of the best ways to do this is with paired ridge and eaves vents. This system uses thermal flow (warm air rising) plus the effect of wind blowing over the ridge to draw air out at the ridge and take in fresh air at the eaves. But no matter what type of vent you use, the system must be balanced to work properly.

"Balanced" in this case means that the net free area (NFA) of the intake vent at the eaves or low on the roof must be equal to or greater than the NFA of the exhaust vent at or near the ridge. So for a typical gable roof, the NFA of the eaves vent along each side of the roof should be *at least* half the NFA of the ridge vent at the peak.

Section R806.2 of the IRC says that in most cases a 1:150 ratio (NFA of vent to total attic square footage) should be used to determine the minimum size requirements for the vent. So for an attic that's 1,000 square feet, you would divide 1,000 by 150 to calculate that 6.6 square feet NFA of ventilation would be required. To achieve a balanced system, half that amount is intake and the other half is exhaust, so each should be 3.3 square feet or 475 square inches. Most vent manufacturers supply the NFA for their products, so use their figures to determine how many linear feet of the product you need to install to meet code requirements.

The second part of your question is trickier. Unfortunately, the building code doesn't address—or ask roofing professionals to factor in—the actual volume of space under the roof. The volume for a 1,000-square-foot attic under a 12:12 pitch roof is not the same as the volume under a 5:12 pitch. In Air Vent's educational seminars and in the online calculator at airvent.com, we recommend increasing the ventilation by 20% for roofs with a pitch from 7:12 to 10:12. For roofs steeper than that, we recommend increasing ventilation by 30%.

Calculating Ventilation



Q What type of weather resistive barrier (WRB) should be used behind brick veneer?

A Matt Risinger, owner of Risinger Homes, a custom builder and whole-house remodeling contractor in Austin, Texas, responds: When selecting the proper WRB for behind a brick veneer, it's important to understand that brick is not waterproof. In fact, brick is highly porous and absorbs water readily, so it cannot and should not be depended on to stop moisture from entering a wall system.

You also need to realize that brick gives up its moisture pretty readily. That means that it dries quickly to the outside under most conditions. The one exception is when the sun beats down on moisture-laden brick. In that case, solar-driven moisture from the brick is pushed into the air space behind the brick, and unless the proper WRB is in place, the wall sheathing on the other side of the air barrier can be at risk.

I recommend using a WRB with a perm rating lower than that of conventional housewrap. A lower rating means that the WRB is less likely to let moisture from the air space behind the brick reach the wall sheathing. A product like Tyvek CommercialWrap has a perm rating of 23 to 28—compared with a perm rating of 58 for regular Tyvek HomeWrap—and is a better choice for a WRB behind brick veneer. When I'm applying a WRB to sheathing before installing brick veneer, I like to put on a layer of CommercialWrap and cover that with a layer of 15-pound felt as added protection.

I do most of my work in the hot, humid south. In my area, a peel-and-stick membrane, which typically has a perm rating of less than one, can be used as a WRB behind brick veneer. An important caveat for this application is that you must be sure there is no additional vapor barrier inside the walls of the house that could trap moisture and cause damage inside the walls.

Drainage detailing with brick veneer is just as important as the type of WRB material that you choose. All penetrations such as windows and doors should have through-wall flashing that's integrated into the drainage plane at the sheathing. Through-wall flashing should also be used at the base of the wall, along with weep holes to let any accumulated moisture drain away safely. And finally, I always install mortar net at the bottom of the air space. This mesh product is designed to catch and trap mortar that falls while the brick veneer is being constructed, to keep the weep holes free of debris.

Q Do you have any quick tips for keeping air tools and compressors running smoothly in cold weather?

A Jim Glover, a building contractor in Pierre, S.D., responds: Severe cold can affect all the tools and materials used in construction, but none more dramatically than pneumatics. And when it's too cold to be reaching into my nail bags with fingerless gloves, I depend on my air nailers and staplers even more. Several years ago, I wrote an article for *JLC* titled "Cold Weather Tool Care" (Feb/08); here are the highlights of the section on pneumatics.

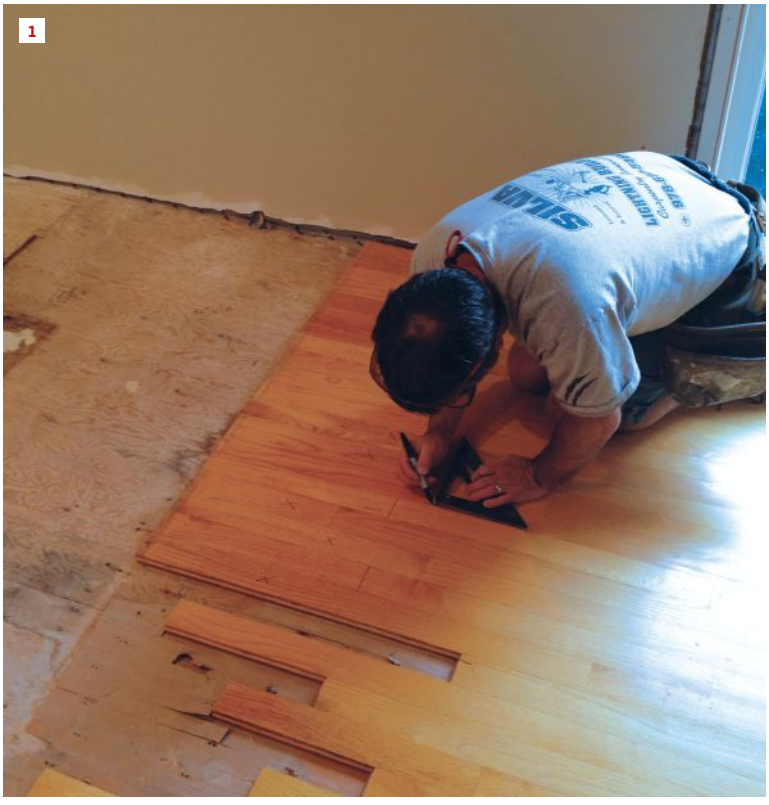
Keep tools acclimated to the temperatures you're working in. If you're working in the warm indoors, store your tools and compressor in a warm place or let them warm up to room temperature before using them. If you're working in the cold, store your compressor in the cold (such as in your truck), and don't put your compressor indoors with hoses run outdoors to where you're working. (Otherwise, moisture in the warm air will condense and freeze in the cold hoses.) If you work in cold, moist conditions, it may help to install an in-line desiccant drying system to keep your hoses from clogging with frost.

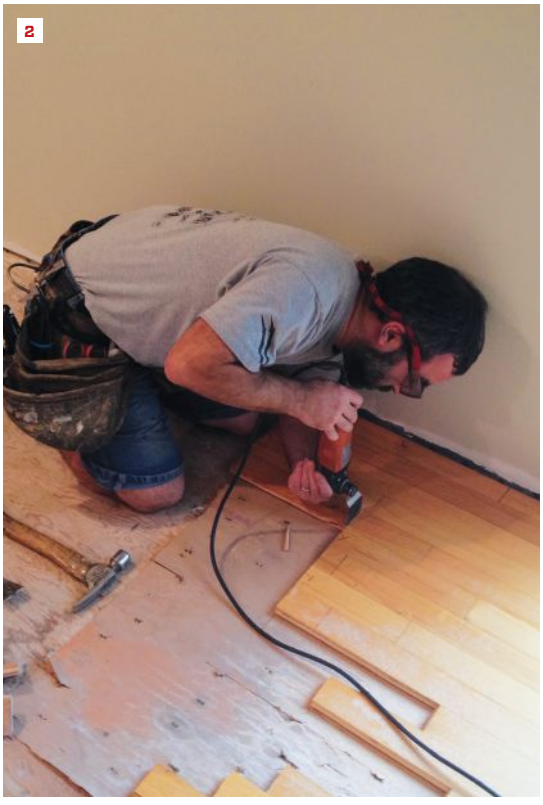
Use a winter-grade lubricant made for pneumatic tools in your guns. When working consistently in temps below 20°F, I use a de-icer, such as Kilfrost 400 (kilfrost.com).

Avoid using ¼-inch-diameter hoses that clog with frost easily.

Finally, use a magnetic oil pan heater to warm up the oil in your compressor to get it started. Once the compressor is running, the oil should stay warm enough without the heater.

BY EMANUEL A. SILVA





Repair and Replace Strip Flooring

Late last summer we were called in to remodel a kitchen. One of the client's top priorities was refinishing the 20-year-old oak strip flooring that ran through the kitchen and into an adjacent dining room. I agreed, but when I looked more closely, I found that there was no flooring under the appliances and cabinets and that the original base cabinets were bigger than the new cabinets we would be installing, which would leave gaps in the flooring around all the cabinets. Like so many of my projects, a seemingly simple job suddenly became more complex.

REMOVING BOARDS WHERE OLD MEETS NEW

I started by removing all the cabinets and exposing the kitchen subfloor. Patching each individual section where the flooring was missing would have been time-consuming and expensive, and the finished floor would have looked like a patchwork quilt. I also discovered that the original flooring installers had reversed the direction of the strips in the kitchen as they filled in around the base cabinets. So to save time and effort in the long run (along with wear and tear on my knees) and to create a better-looking finished product, I opted to remove all the flooring from the kitchen area and start from scratch. By being careful, I was able to save most of the boards.

Where the kitchen floor met the dining room floor, I cut back the boards, staggering the seams for an invisible transition between the old floor and the new. Working along the straight seam where the flooring abutted the cabinets, I first removed all the boards that ran into the dining room floor about a foot or so and that stepped back to an adjacent board. These boards popped out fairly easily. Areas where I had to remove a section of board

Photos: John Simmons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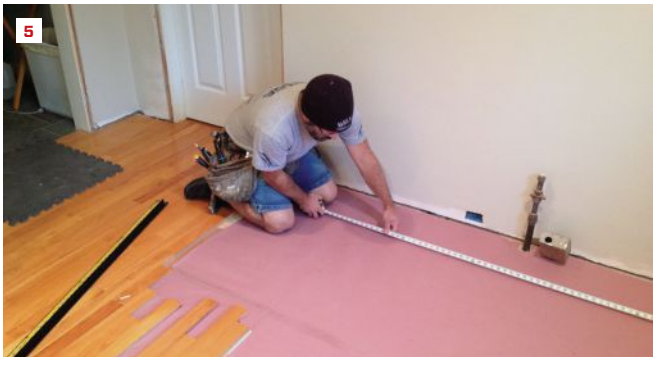
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flanked by two longer boards required a bit more attention. I marked the butt seams of those boards using a black Sharpie and a measuring square **(1)**. I then sawed across as many boards as I could using my circular saw, making the waste pieces as short as possible. When I wasn't removing the waste back to a factory seam, I cut the marked ends using my oscillating saw set on a slow speed **(2)**. I made the cuts perfectly square across each board, but gave the cut a slight back bevel for a tight fit.

To remove shorter lengths (less than 12 inches) I dug a chisel into the face of the board and tapped it with a hammer until the board slid out **(3)**. To remove longer boards (or shorter ones that wouldn't come out with pounding), I used a different strategy. I set the blade of my circular saw at a 30-degree angle with the depth slightly more than thickness of the flooring. I made a rip cut along the length of the board, stopping just shy of the end, and finished the cut with a chisel to keep from damaging the adjacent boards. With the bevel cut, the pieces came out easily—the piece with the long bevel first and the other side next **(4)**.

When the flooring installers had reversed the direction of the boards in the original kitchen, they had used a spline, glue, and face nails to join two courses groove-to-groove. To remove this transition seam with minimal damage, I ripped the length of the board next to the seam. The splined boards then pried out easily and left me with a clean edge to blend in the new kitchen floor.

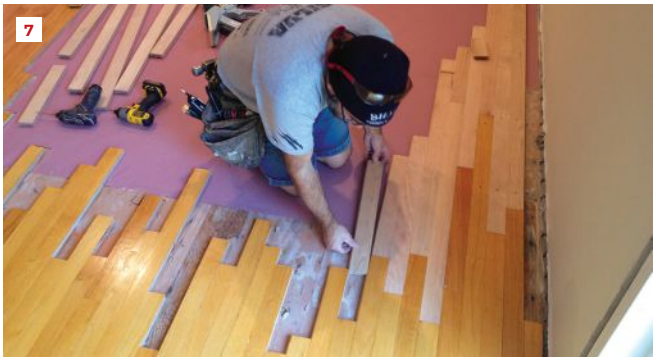
INSTALLING THE STARTER COURSE

Once I'd removed all the boards, I checked the subfloor for damage and repaired a small area of dry rot where the original sink base had been installed. I also secured any areas of the subfloor that seemed loose, using GRK structural screws.

Red rosin paper had been used as underlayment for the original floor, so I put down a layer in the kitchen area to create a slip sheet, which allows the strip flooring and subfloor to move independently of each other and helps prevent the floor from squeaking. I cut and fit pieces to go around the staggered ends of the boards and taped the seams to keep the paper from tearing while we installed the floor.

Starting from scratch with the flooring let me begin along the wall to match the board orientation for the rest of the floor, but it also meant that I had to install the boards perfectly parallel to the original floor so the final piece wouldn't be tapered. I dry-fit the first row along the wall and took several measurements against the existing flooring to ensure that the board was parallel **(5)**.

When I'd positioned the starter course perfectly, I faced-screwed it in place so that it would stay put while the rest of the flooring was driven against it **(6)**. I completed the next couple of courses, notching around the plumbing for the kitchen sink and checking that the courses stayed parallel. I continued face-screwing the courses until I had enough room to use my flooring nailer.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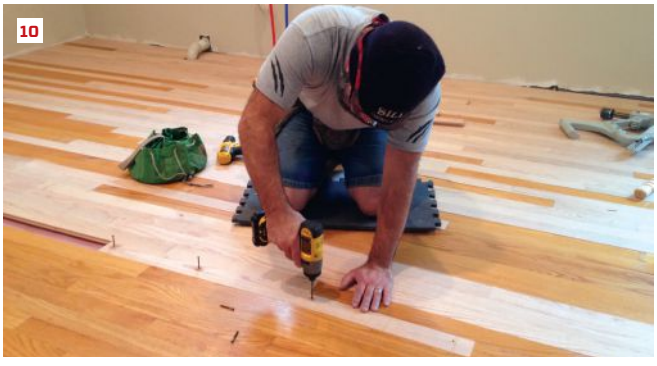
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PATCHING IN THE NEW FLOOR

To install the new flooring, I began each course at the existing floor. I made sure that the tongue and groove on each piece were clean, with no splinters that might interfere with the boards mating, especially on boards I was re-using. I also made square cuts on the ends that would meet the boards on the existing floor. Where the end of an original course was exposed in a step fashion, I simply tapped the new board into place and tapped the end to make sure the butt joint was tight before nailing it down about every 8 inches with a flooring nailer.

For the courses where the original butt was recessed between two adjacent courses, I held the filler piece at a slight angle to engage the tongue and groove **(7)**. After tapping it against the neighboring board, I slowly tapped the end, using a scrap for protection, until the butt joint was closed **(8)**.

As I progressed across the floor, I measured every third course to make sure the courses were staying parallel. When I reached the last row to close against the flooring on the other side of the kitchen, I needed a different strategy. There wasn't enough space to slide in a board, as with the other rows, so I ripped off the groove's lower edge using a table saw with the blade set at a slight bevel, which let the board clear its neighbor's tongue as I tilted it into place **(9)**.

I installed the closure board with the butts a few inches apart, tapping it down flush with a scrap of flooring. Then I tapped the end with a small scrap block until both ends met in a tight joint. When the board was in position, I pre-drilled holes every 12 inches and screwed it down with trim-head screws **(10)**. I filled all the screw holes with plugs. After completing that row, I continued the same process to finish the small remaining section.

SANDING AND FINISH

At that point, I handed the finishing job to my flooring contractor, who sanded the floor down to bare wood with two passes on his sander, making the new and old boards blend perfectly. He filled any remaining holes and gaps and then made a final pass with his sander.

The first coat he applied was a sealer, which helped to prevent any bleed-through from the boards and created a continuous finish between the two rooms. To match the other rooms, we started with a clear oil finish. The second coat was straight poly applied with a lamb's wool applicator and edged with a brush. To minimize damage while the kitchen was being installed, the flooring contractor applied his final coats after all the trades were done. Before applying that coat, he buffed the entire floor, meticulously vacuumed, and went over the floor with tack rags. After allowing the floor five days to dry, the clients were able to move their furniture back in.

Emanuel Silva is a frequent contributor to JLC *and owns Silva Lightning Builders in North Andover, Mass.*

1. A level layout line marks the location for the bracket on which the minisplit's indoor head unit will hang. Before the drywall was installed, blocking was added to the wall framing for support.

2. The author traces around the knock-out for the unit's through-wall penentrations.

3. Before installing the bracket, he cuts the drywall for the through-wall penetrations.

Minisplit Installation on an Interior Wall

BY LEE MCGINLEY

In 2013, Vermont homeowners installed 2,400 air-source heat pumps—or minisplits—nearly all of them in existing buildings. No doubt some people were motivated to reduce their carbon footprint, but probably, the overwhelming majority were interested in lowering their annual heating bills.

In other parts of the U.S., minisplits' effectiveness at lowering energy bills is documented. The Pacific Northwest's Bonneville Power Administration (bpa.gov) study showed up to 50% savings in electric consumption with minisplits when compared with zonal electric heaters. Efficiency Maine (efficiencymaine.com) promotes the installation of cold-climate heat pumps with a video featuring a couple who took advantage of Maine's $500 incentive grant and saved 75% on their annual $2,900 fuel-oil costs when they switched to a ductless heat pump. Its website also has a chart comparing the cost of various heating options, including firewood, wood pellets, natural gas, propane, oil, baseboard electric, and minisplits (search "compare heating costs & options").

I heated my previous Vermont house with a Buderus oil-fired boiler and panel radiators (see "Heating With Panel Radiators," Sep/03). But with my new house, I wanted to avoid the expense of a boiler, fuel tank, and attendant pipes. And although wood heat is common in Vermont, I didn't want the inconvenience of feeding a wood stove—or the worries about creosote build-up.

COLD-CLIMATE HEAT PUMPS

Minisplits caught my attention. Also known as ductless heat pumps, they consist of an indoor "head" with a fan coil and an outdoor compressor connected by refrigerant lines. You're probably familiar with the floor-mounted registers common to motels, the difference being that those appliances combine the compressor with the fan coils, whereas the minisplit separates—or splits—them, hence the name.

Minisplits are extremely efficient, capable of delivering—on a watt-for-watt basis—up to five times as much heat as a resistance heater. They achieve this because

Photos: Lee McGinley

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4. After the mounting plate is screwed to the wall, the indoor head is hung on the bracket.

5. The line set (insulated with black foam insulation) and 4-conductor wire is laid through the open joist floor system.

6. The insulated line-set tubing is fed through holes in the top plates on its way down the sidewall and eventually to the exterior of the house.

they do not create heat, but rather move heat from the outdoors to indoors. Since refrigerant is naturally much colder than even the coldest of outdoor temperatures, it absorbs heat from outdoors and transfers it to inside the house. In the summer, the process is reversed: Heat is transferred from inside your house to outside. Your electric bill reflects the amount of electricity used to run the compressor and fans.

Minisplits are available with a single indoor head—typically centrally located—or with multiple indoor heads serving individual rooms. I rejected the latter because they have a reputation for being inefficient (see "Ductless Heat Pumps," Jul/12).

Online research showed me two heat pumps that would perform well in northern Vermont: Mitsubishi's Hyper-Heat units (mitsubishicomfort.com) and Fujitsu's Halcyon RLS2H Series (fujitsugeneral.com). The former is rated to -13°F, the latter to -15°F.

I chose the ductless Mitsubishi 12,000-Btu indoor wall unit (MSZ-FE12NA) paired with a 12,000-Btu outdoor unit (MUZ-FE12NA), in part because of its local popularity but also for its reputation as a solid product. (Since the time of my installation, Mitsubishi has released newer 12,000-Btu units—the indoor wall unit MSZ-FH12NA and the outdoor unit MUZ-FH12NA—which have minor differences from the units I installed.)

My super-insulated house has 1,910 square feet of conditioned space; R-45 walls; an R-45 floor above a crawlspace; and an R-80 attic. The calculations from the energy modeling software I use, Passive House Planning Package (passivehouse-international.org), showed a heat loss of 14,124 Btu per hour, when modeled with a heat load of -18°F.

While I could manage with two 9,000-Btu units, the 12,000-Btu units would generate nearly 5,000 Btu per hour in additional heat over the modeled heat load. Unlike with traditional AC systems, there's no performance penalty for oversizing a minisplit system. Indeed, larger units become more efficient because the load is smaller.

My installation follows current best practices for two-story houses: Each floor has its own minisplit—consisting of an indoor head and outdoor compressor—rather than both floors being served by a single minisplit on the first floor that's oversized to handle second-floor heating and cooling needs. This article covers the installation of the first-floor minisplit; my second-floor installation was nearly identical.

INSTRUCTIONS? WHAT INSTRUCTIONS?

Typically, the indoor head for a single-head configuration is mounted on an outside wall with the refrigerant line set (consisting of two runs of insulated copper tubing) exiting directly behind the unit and running down the outside wall to the compressor. The condensate drain—which carries condensate (a natural byproduct of heat-pump design) away from the head—is typically bundled with the line set. Outside, this grouping is often covered with a decorative PVC line-set cover.

My setup was different. In order to get the best distribution for heating and cooling, I located the head on an interior wall **(1, 4)**. This presented two challenges: First, the 50-foot line set would run above the first-floor ceiling before exiting the house. Second, the condensate line would run independent of the line set and tie into the plumbing waste line, which would have to be trapped to keep

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7. To curb air leaks where the line set passes through sheathing, it's wrapped with Rissan tape. Scuff marks and tears on the foam insulation will be repaired with duct tape.

8. The outside compressor is mounted on a wall bracket, with the sub-panel on the right. The line set and 4-conductor wire pass through a sleeve to the interior. Before bracket installation, the author applied bituminous membrane to the sheathing and exterior trim to accommodate the finish siding.

9. The flexible condensate drain is run inside a diagonal 1 ½-inch PVC pipe that empties into the DWV line. Note the P trap. Slack in the line set and wire allows maintenance or repair of the head without crimping the copper tubing.

sewer gases from escaping into the house.

Mitsubishi's installation instructions don't anticipate this alternative, and the online instructions weren't consistent with those that came with the unit. Neither set of instructions was clear, and the drawings lacked detail and clarity. The good news is that a 15-minute phone call with my wholesaler cleared up my confusion.

I like to install mechanicals to accommodate future servicing, and I try to anticipate the most efficient way to access components that might be hidden.

The interior head of the minisplit hangs on a metal plate attached to the wall **(2)**, but the line-set connections have to be made to two copper stubs attached to the head. For an indoor head hung on an outside wall, the stubs are long enough to pass through the wall and bend downwards before connecting to the line set. First you hang the wall unit, and then make the connections.

For my installation, however, the stub-to-line-set connections would need to be made before hanging the wall unit. This required two people—one to hold up the unit, one to make the flared connections. Fortunately, I'd framed a 16-inch-wide chase, built of two parallel 2x4 walls. It was intended to hide ERV ductwork and DWV pipes, but would also allow me to hang the wall head, poke the connected stubs through a partition wall, and make the rest of my connections with the head securely mounted to the wall. I left 2 feet slack in the line set so that if the unit needs to be removed for service or replacement, there will be no strain on or kinking of the copper tubing.

To achieve this, I broke away the knockout in the hanging plate **(3)**. This allowed me to run the tubing stubs through the partition wall. I had already blocked between the studs for mounting-plate support and hung the drywall.

RUNNING THE TUBING

The 50-foot generic line set includes one ¼-inch flexible copper tubing and one ⅜-inch flexible copper tubing, both wrapped in ⅜-inch foam insulation. Without going into the physics of vaporizing and liquefying the refrigerant, the smaller tubing handles high-pressure liquid and the larger tubing carries low-pressure vapor. A helper and I snaked the pair through an open joist floor system **(5)** to an outside wall, then bent the tubing downward before bending it again to exit the wall **(6)**. We were careful not to kink the tubing. When the wrapped tubing dragged against framing members, the foam insulation easily tore; we used duct tape to make repairs.

Running in tandem with the line set is a 4-conductor wire that powers the indoor head from the outdoor compressor and allows communication between the two. I used zip ties to bundle together the tubing and wire. Where the tubing and wire passed through the wall sheathing, I sealed the wall penetration **(7)** with Siga's (siga.com) impermeable, highly elastic Rissan tape.

Mitsubishi instructions call for the stubs to be insulated and wrapped with tape prior to commissioning the system. The tech that commissioned the system completed this.

HUNG UP

Several considerations need to be taken into account when locating the outdoor compressor. Aesthetics is the first: Although the compressors are not unattractive, clients

10. The tech tops off the lines with R410A refrigerant.

11. Inside, the tech tests the minisplit's operation. He'll run it in both heating and cooling modes before he leaves.

12. During commissioning, gauges are hooked up to the compressor to monitor evacuation and add R410A refrigerant. Here the tech prepares the 4-conductor wire that runs to the indoor head.

will not want one sitting in their front yard.

The next consideration is protection. It's a good idea to locate the compressor on a gable end, safe from roof snow slides. If you must place it under eaves, consider a canopy roof above it for protection against falling snow and ice.

Finally, there's a choice between placing the unit on the ground or hanging it off the wall aboveground. In snowy climates, I recommend the latter. Two feet above grade will reduce the chances of the compressor being covered with snow that interferes with its operation. If you decide to place the compressor on the ground, locate it away from a wet area and fasten it to 6x6 pressure-treated "logs" to keep it off the ground. Rubber and fiberglass risers are manufactured by Big Foot systems (bigfootsystems.com) and DiversiTech (diversitech.com).

I hung my compressor on a gable end and used a bracket kit from Rectorseal (rectorseal.com) **(8)**. Because the compressors would be hung before the siding, I trimmed behind the brackets with 5/4 pine. I also used a through-wall sleeve (goductless.com) to tidy up the line-set wall penetration.

Typically, the condensate drain line exits the building with the line set and water trickles out when the minisplit is in air conditioning mode. (In winter, any condensate created is at the outside compressor, and it, too, empties to the ground.) Because my indoor head was located on an interior wall, I had to find another way to remove the condensate. I already had a 2-inch drain line in the 16-inch chase, so I tapped into that, installing a P-trap to keep sewer gases from entering the house **(9)**.

The National Electric Code requires that minisplits have their own sub-panel and that an outlet be within 25 feet of the sub-panel. Mine was sized (220V with two 20A circuits) to handle both compressors.

SAVING ON THE INSTALLATION

Despite the initial learning curve, the units are easy to install: Mount the indoor head on a wall, run the line set, mount the outdoor compressor on a bracket. If I were to repeat my setup, it would require five to six hours (including the condensate drain), plus another half-hour for a helper to help run the line set overhead. A straight through-the-wall installation would reduce installation time by a couple of hours.

After mounting the major components, I called in a licensed refrigeration technician—required by code—to make the connections between the indoor head and line set and the outdoor compressor and line set, evacuate the lines **(10)**, check the refrigerant level, and test-run the AC and heating operations **(11, 12)**. In my rural area, local qualified techs are hard to find, but my wholesaler knew a tech willing to travel and just do the commissioning, even though I hadn't purchased the equipment from him.

Installation prices appear to vary widely, depending on location—Massachusetts and Maine seem to have lower installed prices than Vermont—and local competition. Where I live, my configuration would run between $5,000 and $6,000, not including electrical work. By purchasing the equipment myself and hanging the units, my cost, including my electrician's bill, was slightly more than half of the lower end of this range. Compare that with a typical oil-fired hot-water heating system starting at $20,000, and the savings are impressive.

STAYING WARM ... AND COOL

The first-floor minisplit was installed in April 2014 while I was still finishing the house's interior, and when daytime highs were in the 30s and 40s. I wanted to evaluate the single minisplit's performance before I installed a second one upstairs prior to moving in. From morning start-up and within three hours, the first-floor minisplit heated the downstairs to 70°F with the upstairs five degrees cooler. My super-insulated house held heat very well overnight when the minisplit was turned off. In the mornings, I walked into a 60°F, warm house.

We don't have much humid weather in Vermont, but when we do, it's nice to have a refuge. For two weeks in the summer of 2014—with humidity in the 90s and daytime temperatures not much lower—I set the standard-issue remote (you can also install a wireless thermostat to program heating operations) to 68°F and within a few hours I had reached the set point. But that was downstairs. As I climbed the stairs to the second floor, the humidity returned, confirming that a second minisplit upstairs was needed, at least for the summer.

BOTTOM LINE?

My initial impressions are favorable. When heating or cooling, the indoor fan ramps up and down, and there's a background hum, but it's quieter than my new refrigerator. The outdoor compressor whirls away, similarly ramping up and down. Unless I open a window, I don't hear it.

There's some online chatter that the indoor wall-hung heads are unattractive, but they're certainly less obtrusive than radiators or air vents throughout the house. An added benefit of the wall-hung unit is that it doesn't interfere with furniture placement.

Aside from interpreting the instructions, the other hurdle was finding knowledgeable, local resources. Fortunately, I found someone who not only commissioned minisplits, but also had one in his house and was generous in sharing his experience.

I moved into the house in late 2014 and haven't been in it long enough to determine annual operating costs. However, when nighttime temperatures have dropped into the single digits—and daytime temps hovered in the teens—I've been toasty warm. I haven't noticed uncomfortable temperature differentials between rooms, helped by the fact that the house is virtually draft-free.

In a future article, I hope to report on operating and maintaining the minisplits, compare the advantages and disadvantages of the hand-held remote control versus the wall-mounted wireless controller, and identify hot and cold spots. I'll also check in on cost savings compared with my previous house of about the same size. Preliminary modeling shows a significant savings.

Lee McGinley is a Certified Passive House Tradesperson who designs and builds high-performance homes. He lives in Addison, Vt.

BY MELANIE HODGDON

Project vs. Profit

Recently, when I was remotely connected to a client's computer, I admired his desktop wallpaper, which featured a photo of a stunning project. His response to my compliment perfectly exemplified the challenges faced by contractors: "So we've proven we can build a house, but now the question is, can we make money doing it?"

Few contractors come to the business from the economic side of things. Most aren't MBA graduates who look around for profitable work and pick construction/remodeling! Instead, most either inherit a family business or start out in the field. The problem is, as the saying goes, "if the only tool you have is a hammer, everything looks like a nail." If your skills as owner of a contracting company are all production-related, that's where your focus will be—especially if the economy is supplying a steady stream of work, and what appears to be a healthy cash flow masks the true financial situation.

Here's a question for you: Which makes you money, producing work or selling work? The answer is that you can make money only by selling. Producing costs money. Most contractors feel really good about production—the work is a testament to their expertise and craftsmanship. But pricing and selling, which are really, really important, exist outside of that "happy place" and often don't receive the attention they should. So if the emphasis is on production, but it's the selling that's important, is it any wonder that contractors find themselves working harder and longer, year after year?

So let's look at what it takes to sell appropriately. First of all, you need to understand your costs, since you obviously must sell work at a price that's greater than your costs. Once you have your costs calculated, it becomes a relatively simple matter to sell at a price that covers them. Costs fall into three main categories:

1. All the costs associated with producing projects
2. Overhead required to maintain the company
3. Profit

Contractors tend to do a pretty good job of estimating production costs, although very few have a handle on the true burdened cost of labor—what it actually costs you to put a worker in the field for an hour performing tasks that are part of your scope of work.

Overhead is often overlooked, yet it's the one cost that you can't ignore because these are the dollars that have to be paid in order to keep your doors open.

Profit should be considered just another cost that must be covered. If you don't think of it like that, then your profit will continue to be a happy accident comprised of whatever dollars happen to be left over.

Contractors who wouldn't dream of bringing only a hammer to a jobsite need to look at their business as a project that requires a host of different tools. Each one has a specific purpose and it's their combined use that produces a successful project. A hammer won't do what a drill does. All the production knowledge and experience in the world won't help you know how to price and sell your work. If you want your business to work as well and last as long as the projects you build, consider adding some new tools to your belt.

Melanie Hodgdon is owner of Business Systems Management and co-author of the book, A Simple Guide to Turning a Profit as a Contractor. *melaniehodgdon.com*

Illustration: Tim Healey

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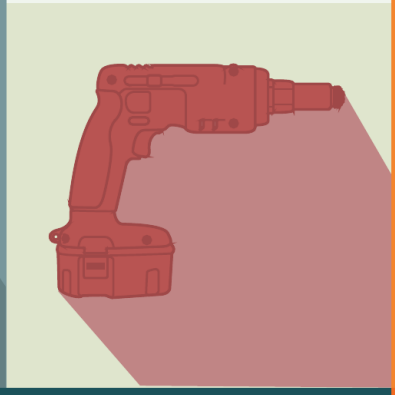

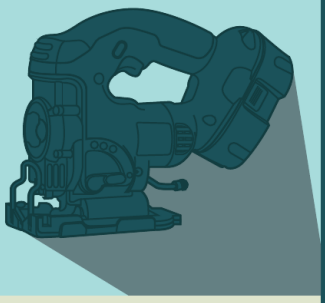

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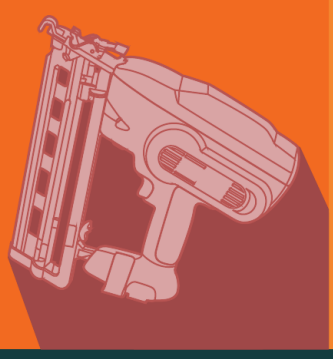

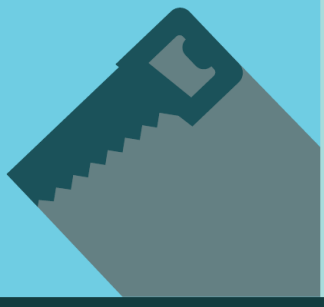

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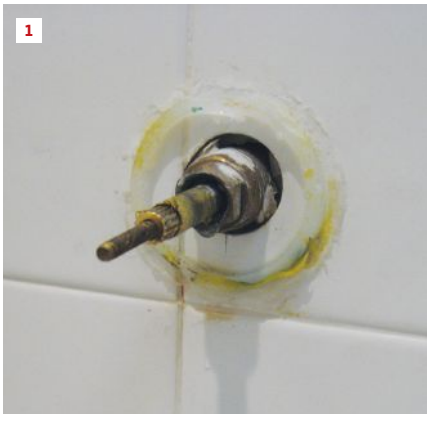
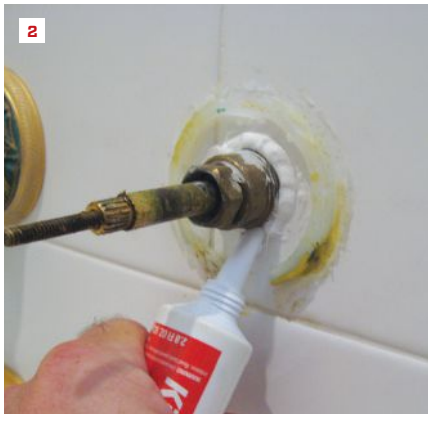
BY DOUG HORGAN





Sealing Shower Valves

Leaks in showers are common problem in many existing homes, and I've written here in the past about some of the enormous problems with drains (see "Leaking Shower Pans: How Far to Go?," Jun/14) and shower curbs (see "Preventing Shower Curb Problems," Oct/14) that we've seen over the years. A shower pan holds a lot of water and when it fails, the damage can wreak havoc on the structure and finishes below. But sometimes the problem occurs higher up on the wall—something to keep in mind while searching for the source of a leak.

EXISTING SHOWERS

On one home we were called in to investigate for a possible shower leak, the shower was in a bathtub. There was no pan or curb to leak, and nothing apparently wrong at the tub-tile intersection. But when I started poking around and removed the escutcheon, I found the problem right away: Someone had very carefully sealed all the way around the escutcheons **(1)**. Water could still enter where the handle went into the escutcheon, and it pooled up inside until it poured through the wall around the incoming pipe. This one was an easy fix: I sealed carefully around the valve coming through the wall **(2)**, and cut away the old escutcheon sealant at the base, proving a much-needed weep hole to allow water to drain **(3)**.

Some of the escutcheons we install come with a flexible gasket that goes only about seven-eighths of the way around, leaving a gap at the bottom to allow water to drain. But not all valve trims come with this type of gasket. We're seeing a lot of contemporary designs with very slender escutcheons. These "minimalist" trims can be only ⅛ inch thick and are not strong enough to stay flat on the tile, allowing a lot of water to enter. With these, or any other non-gasketed unit, we seal the escutcheon to the shower wall at the top and along the sides, but never at the bottom.

We usually use a clear silicone, unless the valve manufacturer specifies a different sealant. Silicone is compatible with most finishes, but it's a good idea to check first. My understanding of how escutcheons work is that they only need to touch the tile, and water running down the wall will mostly follow the edge of the escutcheon. You can't get a whole lot of water behind it except when you seal the bottom and allow it to fill up. So even though silicone caulk loses adhesion after awhile, the physical contact it creates should get the job done.

Often there's guidance on sealing in the instructions that come with the valves. Granted, installers who have put in hundreds, or even thousands, of shower valves aren't always inclined to read the instructions. But it's worth doing with a valve you haven't installed before.

NEW SHOWERS

When building a new shower, you should start by installing a water-resistive barrier behind the tilebacker. A lot of tradespeople think that if they're using a cementitious backerboard for the tile base they don't need

Photos: Doug Horgan

to install building felt or plastic over the framing first. But it's like working on the exterior: You want some kind of water-resistive barrier to create a drainage plane behind the finish assembly. In the case of a shower, that drainage plane should drain any water that gets past the tile into the pan or the bathtub. It is possible to seal this protective drainage layer to the plumbing so water that gets past the face tile around the escutcheon will hit the waterproofing layer and drain safely into the pan.

On our jobs, we usually rely on a different approach—installing a watertight layer, such as the Schluter Kerdi System (schluter.com), on top of the wall assembly. This does mean that any water that gets past that surface protection will become a leak, and where the valves penetrate the face is certainly a vulnerable area. But the Kerdi system is well-designed and relatively easy to install. Schluter makes conical seals that protect openings at valve bodies or pipe stems **(4)**. The geometry of the round seal slopes toward the tile, so gravity works in your favor. And it has a flange made of the Kerdi material that integrates with the rest of the shower membrane. The trick is making sure you match the seal to the valve body. Seals come in different sizes, but sometimes the round seal doesn't fit the particular valve body you're using **(5)**. If it's close in size you can squish the seal to make it fit. Just be careful you don't create a problem that will direct water into the wall instead of away from it. You may need to take a custom approach by sealing around the valve with pieces of the membrane and a compatible sealant.

There are some valves we've used, such as a system from Grohe, that include a flexible flange. On these, the valve body sits in its own plastic box, which makes it easy to seal to a waterproofing membrane. I would use these all the time if I could, but in our world, the client makes the selection and we make it work.

Doug Horgan is vice president of best practices at BOWA, a design/build remodeling company serving the Washington, D.C., metro area.

BY TED CUSHMAN

The Science of Kitchen Ventilation

Last September's Passive House conference in San Francisco, Calif., featured a broad array of expert speakers—including many whose interests range much wider than Passive House. *JLC* was at the conference, and we sat in on a presentation by scientists from the Lawrence Berkeley National Laboratory (LBNL) about kitchen ventilation. LBNL researcher Brett Singer, the principal director of Indoor Air Quality efforts with the LBNL Residential Building Systems group, laid out the lab's research into kitchen range hoods and exhaust fans—including some findings that will be as useful to remodelers working in old leaky houses as they are to builders who specialize in high-performance homes.

In the field, Singer and his colleagues have been taking a close look at the pollutants added to indoor air when we cook—including not just the emissions of gas burners, but also the particles generated by electric range elements, and even the particles formed from volatile gases given off by cookware and by the food itself. And in the lab, the LBNL researchers have been working to find out how well different range hoods and fans work, and to learn how cooks can adjust their practices to help the equipment get the job done better.

Photo: Berkeley Lab, Roy Kaltschmidt

Researchers at the Lawrence Berkeley National Laboratory (LBNL) tested the exhaust efficiency of seven different kitchen vent fans with a variety of gas and electric cooktops.

THE PROBLEM

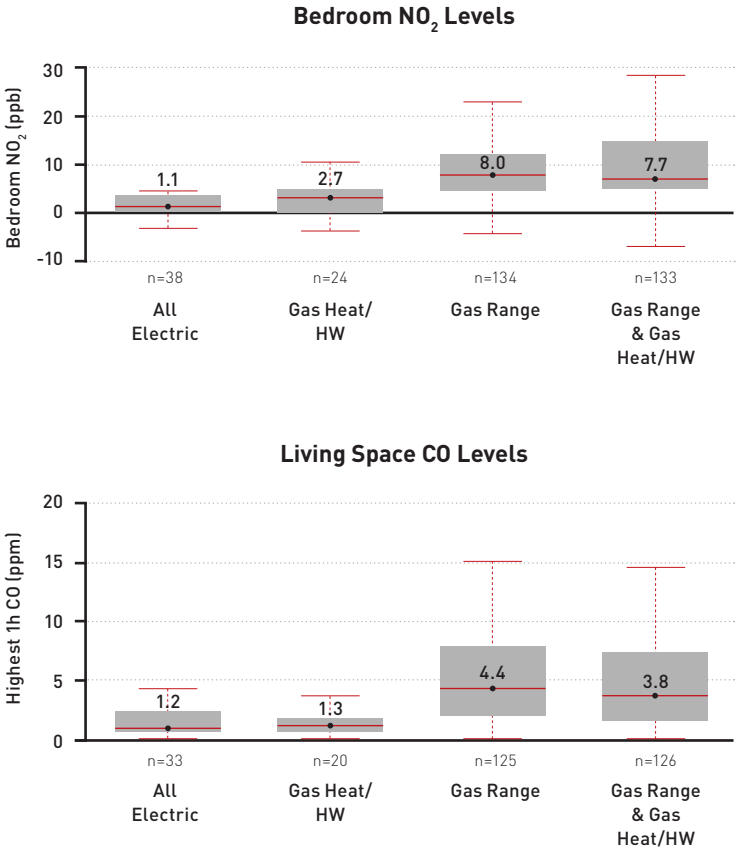
Scientists have studied indoor air pollution for many decades. Research in the 1970s and 1980s found that indoor cooking on gas ranges was a big source of gaseous pollutants like nitrogen dioxide (NO_2) and carbon monoxide (CO). Cooking also produces fine aerosol particles, with varying chemical makeup, that are potentially risky to human health. How risky? Singer is quick to caution, "You can't compare frying with oil to diesel exhaust." It's clear that outdoor-particle pollution is a health problem—"many studies have found that when outdoor particles increase, more people wind up in the hospital with various health ailments," he says. But indoor cooking-related particles, while similar in size, tend to be chemically different from vehicle or factory emissions—and scientists aren't sure which particles might or might not be dangerous.

"So if you're sitting at a bus stop you're breathing diesel particles, not cooking particles," says Singer, "and those are different. But since we don't know how hazardous the various kinds of fine particles are, it might be wise to take the precaution of trying to limit our exposure to any kind of fine particles. It's your home, right? Why not?"

The good news is that outdoor sources of those pollutants, such as industrial emissions and auto and truck exhaust, are actually decreasing in the U.S. as environmental regulations take hold and technology improves. The bad news is that the indoor sources of NO_2, CO, and particulates haven't been controlled equally well. In studying hundreds of California homes, Singer and his colleagues have learned that when people cook with gas ranges, quantities of indoor-generated pollutants often measure higher nowadays than pollution levels in the outdoor air.

SOURCE CONTROL

If cooking with gas is polluting your house, one easy answer is: Don't cook with gas. Singer's team



Studies done by the Lawrence Berkeley National Laboratory (LBNL) on 350 California homes showed the range of nitrogen dioxide (NO_2) and carbon monoxide (CO) levels from cooking and heating appliances of different fuel types. Electric appliances emit less noxious gases than gas-fired ones, and cooking with gas contributes the highest concentrations of pollutants. The takeaway is to point out to your clients the importance of an effective kitchen venting system that will exhaust pollutants from the kitchen before they spread to other spaces in their home.

measured CO and NO_2 pollution in 350 California houses, and they found that houses with electric ranges showed much lower levels of CO and NO_2 than houses where people cooked with gas. In homes with gas furnaces, it was the cooking—not the furnaces and water heaters—that created the pollution. The data also showed that NO_2 wasn't confined to the kitchen, but spread quickly to bedrooms as well.

But electric ranges, while they don't create NO_2 or CO, do create particles, formed when cooking vapors contact the hot electric coils. New-fangled induction burners don't get hot, but they heat up the pan with magnetism and don't appear to create any particles on contact. "We're not sure about the coils under glass tops," says Singer.

But even induction burners heat up the pan, and the hot food gives off some quantity of particulates. Says Singer: "Cooking is the act of adding lots of heat to break chemical bonds in the food to produce new things. And when you do that, all kinds of things happen chemically and physically. When you're stir-frying, it's not just the oil that is producing particles. It's the broccoli or beef or whatever you're stir-frying. The chemical bonds in the food are being broken to create different chemicals, which are then going to become particles in the air."

The more you cook, the more of those particles you may breathe in. So no matter what kind of stove a kitchen has, Singer and his colleagues argue that there should be an effective range hood and exhaust fan—and that homeowners should be advised to use it whenever they cook.

RATING THE EQUIPMENT

But that recommendation raises a question: Do range hoods and exhaust fans work? Singer and his colleagues are studying that question in the LBNL test kitchen. In their recent study, Singer and co-researcher William Delp bought seven different range hood and fan combos from local stores and installed the units over a gas range in the lab. Then they measured how well the fans captured CO_2 from the front burners, rear burners, and oven when operated at low, medium, and high speeds.

An ideal range hood and exhaust fan should be affordable enough so people can buy it and quiet enough so that people will use it. The hood should effectively corral the gases rising up off the range (what the researchers call "capture efficiency"). And the

Chart data: Adapted from LBNL

fan should move air well at all speeds.

Unfortunately, Singer's and Delp's results don't make shopping easy: Even with the handful of units they tested, the data was all over the map.

Some units moved air well, but were noisy. Units with good "capture efficiency" didn't always have the best fan performance. And some units that performed well for the back burners didn't necessarily do as well when the front burners were used.

Still, the limited tests did yield a few practical observations. "For one thing, you don't need many hundreds of exhaust CFMs [cubic feet per minute] to be effective," Singer says. "If you can get to 150 cfm and cook on the back burners, most hoods actually do pretty well."

The tighter the house, of course, the more makeup air becomes a concern. In the building code, Singer notes, exhaust fans moving more than 400 CFM must be provided with makeup air. "But if you get down to 3 ACH50 for airtightness, then even a 200-CFM exhaust fan can depressurize the house a little bit," he says.

Ductwork is another issue. "The better fans have more capacity to overcome pressure drops in the ducts," says Singer, "but you pay for better fan performance. But you'll make it easier for your fan if you have straight shots of adequately sized ductwork. So we're talking 6 inches or larger—stay away from the 4-inch ducts—and stay away from a lot of bends or transitions."

Finally, says Singer, "None of these things are effective if a fan doesn't get used. The main reason people don't turn on a fan is that it doesn't occur to them that it is needed." Singer urges contractors to use the vent fan as a selling point—telling clients, for example, "I installed this high-quality unit because I think it's important for your health."

But the other reason people don't use their kitchen fans is because they're noisy. So Singer says, "Ideally you should install something that generates 150 CFM at two sones or less. Then, hopefully, there's a low speed that is one sone or less."

Contributing editor Ted Cushman is based in Peaks Island, Maine.

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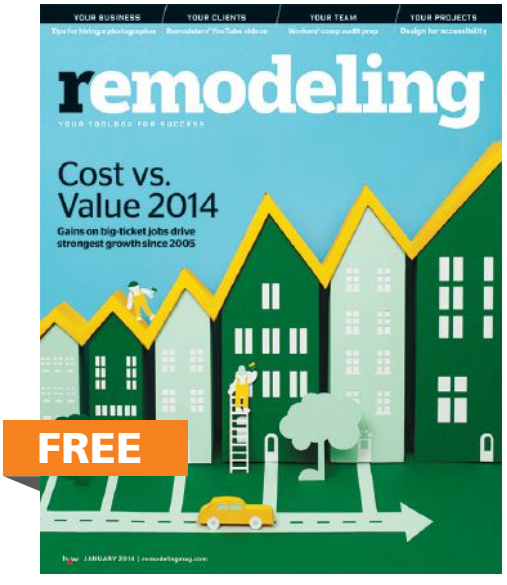

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Photo: Roe Osborn

Roughing Out Site Work
Lessons learned taming a difficult site

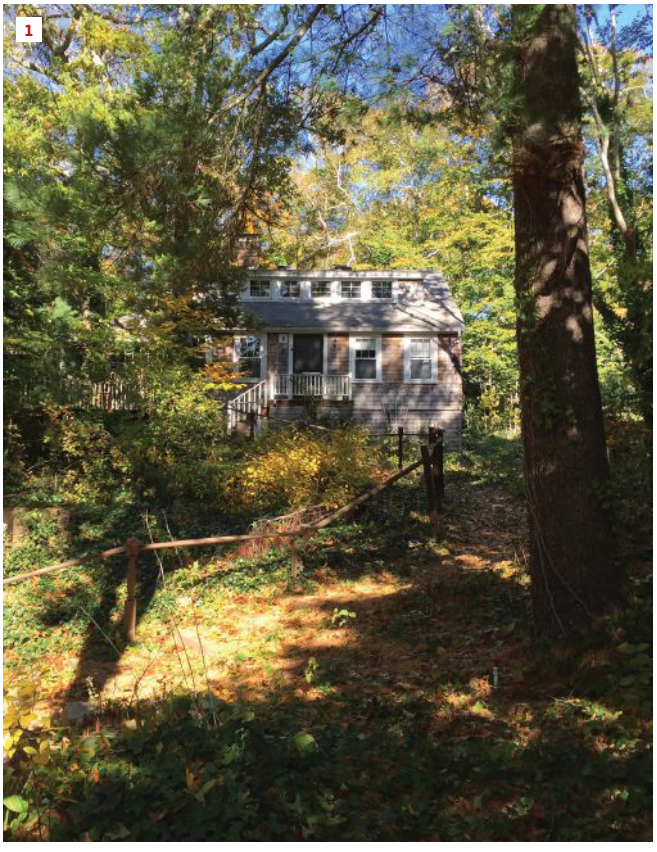
BY ANDREW BORGESE

Site work is fundamental phase of many building projects, but it's often overlooked and underappreciated, particularly by clients unfamiliar with the nuances of the construction process. To untrained eyes it can seem as if little progress is being made until the actual structure begins to rise from the ground. But just as a good foundation is required for a sound structure, well-engineered and properly executed site work is crucial to a strong, stable foundation.

Site work may include the clearing of trees and vegetation, excavation, grading, roadway and driveway construction, septic system installation, sewer connection, stormwater management, and installation of underground utilities. On more complex projects, it may also include hazardous material removal, installation of irrigation systems, rock or ledge removal, protection of neighboring properties or sensitive environments, construction of retaining walls, or drilling for wells or soil borings. The scope varies with each project. For this one, the combination of tasks required literally transformed the site—above and below grade—and helped create a more functional home.

ASSESSING THE SITE

We began by taking a close look at the site with my excavation contractor, George Botelho, and the site plans to get a rough idea of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the scope of the work. On this Cape Cod project, the clients owned a small cottage that sat in the back of a narrow, overgrown lot **(1)**. Built in the 1940s, the existing house was so far from being code compliant that demolishing it and salvaging materials from it was more financially feasible than trying to renovate it.

When I first visited the property, I noticed that the back corner of the house sat on what appeared to be a large boulder **(2)**. But with no other such outcroppings visible as the site sloped downhill, I wasn't overly concerned and didn't feel that my observation justified spending thousands of additional dollars to do soil borings throughout the lot to investigate what obstructions, if any, might lie beneath the surface. My excavation contractor had done extensive digging in the nearby area and although he had encountered some poor soil and rocks, he wasn't too concerned either.

However, as a precaution, we decided early in the design phase to locate the new house closer to the road (and farther away from the visible outcropping of stone). We also designed the rear uphill portion of the house to sit over a crawlspace with a shallower foundation; a full foundation would have required a much deeper excavation in that area.

Call Dig Safe. Before the first shovel hit the ground, we called Dig Safe to locate and mark underground utilities on the site. In this area, that call is required before the local building department will issue a permit. A free service, Dig Safe is a not-for-profit clearinghouse that notifies utility companies when a contractor or homeowner plans to dig on a property. In turn, those utilities come to the site and mark out the location of their underground facilities. In most states, dialing 811 connects you to a similar service.

STRIPPING THE SITE

The rough site work began with clearing any trees and vegetation located within the footprint of the new structure and in the access path of construction vehicles **(3)**. In this case, that meant getting the site ready for the equipment that would raze the house and remove the debris.

Once we had stripped the existing cottage of salvageable items, and all utilities were disconnected at the property line or at the street, the demolition team came in and removed the structure (including the existing foundation) with remarkable speed.

Typically, when demolition is finished, any valuable loam on a

Photos: 1, Andrew Borgese; 2, George Botelho

site is stripped and stockpiled safely on the lot for use during final grading. But because this site was so overgrown and littered with surface rocks, separating out the loam was not worth the effort.

EROSION CONTROL

A messy construction site is a sure way to sabotage your clients' future relationships with their neighbors. So as a best practice, we took measures to control runoff and to keep mud and mess contained on the site. Although not mandated in this area, these measures may be required for permitting in other locations.

Mud mat. One of George's first tasks was scooping out a 12-foot-wide by 10-inch-deep area along the length of the property where it abutted the street (which was also the lowest elevation of our sloping lot). He filled the resulting wide, shallow trench with crushed stone to create a large "mud mat" to filter runoff from the site and to help remove dirt from the tires of construction vehicles.

Straw wattle. As an additional measure, we placed a straw wattle along the edge of the crushed-stone mat, parallel with the roadway. This wattle is a biodegradable woven tube filled with absorbent fiber designed to collect any silt or debris that might get past the mat, and requires no special removal after it begins to break down from wheel traffic. The combination of mud mat and straw wattle was incredibly effective in keeping the roadway clean despite several days of heavy downpours during the excavation **(4)**.

Silt fence. To keep mud and debris from washing off the site onto neighboring properties on both sides, we installed a silt fence made from a plastic fabric that holds back soil while allowing water to pass through. We buried the bottom 6 inches of the fence in the ground, and it, too, was quite effective in keeping the excavated soil contained on site **(5)**.

DIGGING THE FOUNDATION HOLE

After we cleared the site and set up erosion controls, our surveyor staked out the corners of the foundation. Siting the house accurately is important on small, narrow lots such as this one, where the building setbacks from property lines can be within feet—and sometimes inches—of what is allowable under local zoning bylaws. We were finally ready to excavate for the foundation hole.

We had anticipated an easy dig through sandy soil (this was, after all, Cape Cod), but we were unpleasantly surprised to find

Photos: 3, George Botelho; 4 & 5, Andrew Borgese


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layers of clay and silt throughout the entire building footprint. This material has a poor capacity for drainage, so most of it wasn't suitable for backfilling around the foundation and couldn't be saved. Instead all unusable material had to be hauled off site, to be replaced by clean sandy soil after the foundation walls were installed. In the end, we were able to save and reuse only about 10% of the soil that was excavated from the site. This soil was piled at the rear of the lot until it was needed as fill.

Rock bottom. After removing 967 yards of clay and silt (George kept close tabs), we thought that we had exhausted our bad luck and had hit rock bottom. That is, until we actually hit rock. About 18 inches above our designed slab elevation for the crawlspace area, we hit glacial till. George found a "rock" that kept getting bigger as he tried to dig under and around it **(6)**. It was not to be moved.

The densely developed neighborhood where this property was located was definitely not a "blast-friendly" zone, so breaking up the rock with explosives was not an option. Breaking it up with a pneumatic impact drill was also ruled out as being too noisy. Instead, George chipped away at the stone protrusion by repeatedly dropping a one-ton steel-alloy weight (appropriately nicknamed "the headache ball") from the bucket of his excavator **(7)**. Eventually he broke the rock down to the desired elevation for the slab.

The possibility that we may find poor soil and large rocks during excavation is the reason why we include a clause in our clients' contracts that addresses "unforeseen conditions" to cover costs that are outside the scope of our original agreement. (We also explain to clients at the outset that site-work overruns are often unavoidable, and we are careful to communicate with them at every step during the process.)

Driveway base. Part of the excavation process was preparing the driveway area for the heavy construction vehicles, including the concrete pump truck, that would need to drive up the hill. A good driveway that would provide access to the main floor of the house was also a crucial part of the plan. George excavated the poor soils from the driveway area and brought in clean, structual fill that he installed in 6-inch lifts, compacting each layer before placing the next one **(8)**.

The footings and foundation for the house and garage went in smoothly. To put the main floor of the house at an accessible level, the foundation contractors formed a shelf in the upper part of the walls. It would support an I-joist floor that would be at the same

Photos: 6 & 8, George Boteiho; 7, Andrew Borgese


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level as the grade at the driveway and garage floor. On two sides of the house, the foundation walls extend almost two feet above the shelf to allow the grade next to the foundation to be higher than the floor and then slope away from the house properly **(9)**.

ACCESSIBILITY FOR AGING IN PLACE

Accessibility was a priority for our clients. As they were getting older, they were finding it increasingly difficult to travel from the parking area at the road to the front door more than 12 feet higher. One option was to build the garage at the street elevation and install a residential elevator. Because the cost of doing that was substantial, we decided to take advantage of the sloping site, instead.

By cutting into the site, we made use of the basement as finished space with a full bathroom and two bedrooms. Generous amounts of south-facing glazing will give it the feeling of a sunlit first-floor space. To create an evenly sloped driveway up to the garage and the entry at the main-floor level, George raised the grade along most of the east side of the site. This proved to be a successful strategy: Accessibility will no longer be a challenge for the clients in their new home.

Driveway slope and basement elevation. Because we opted to move the house's location forward on the lot—to a point where the topography had begun to drop—we were able to lower the elevation of the main floor, and at the same time reduce the driveway's slope. But that also required dropping the basement further into the ground. Eventually we found a compromise that provided a comfortably navigable driveway and located the basement floor about a foot below finished grade.

Backfill. Now it was up to the excavator to backfill the foundation and finish the rough grade for the driveway to bring it all together. Using the bucket on his excavator, as well as his skid steer, George backfilled around the foundation at the back and sides of the house with excavated material that had been piled behind the house **(10)**. He also used the bucket to fill the foundation of the garage with clean material, which he compacted using the bucket and a hand-operated compactor **(11)**. To make up for the materials that had been hauled off site, George brought in 400 yards of screened and structural fill material to finish backfilling the sides of the foundation and to fill the rest of the garage foundation as a base for the slab **(12)**.

Patio area. A design priority for the clients was creating a flat, accessible outdoor patio area. With such a narrow and sloping lot,

Photos: 9, Andrew Borgese; 10–12, Roe Osborn


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the only area that would work was behind the house. But the topography there continued to slope uphill, so our original design called for cutting into the grade and containing the patio area with 3-foot-high retaining walls. After backfilling the foundation, George began roughing out the ground behind the house. Sculpting and smoothing the grade with the blade of his skid-steer machine, he was able to carve out the area needed for the patio and then gently slope the grade up to meet the natural topography, eliminating the need for thousands of dollars worth of retaining walls **(13)**. Those savings at least put a dent in the unforeseen excavation expenses.

SEPTIC BEFORE FRAMING

One of the last steps in the rough grading was making the site safe and ready for the framers. This involved smoothing the ground with the skid steer after the backfill was placed **(14)**, and hand-grading the area immediately beside the foundation to get rid of what George called "ankle breakers"—chunky soil that when frozen can be dangerous underfoot **(15)**. Ideally, this last step would have been completed after the septic system (located in front of the house) was installed. But we were anxious to get the site ready for the framers, and George needed a window of about a week to complete the septic, during which time the foundation would be inaccessible. When weather delayed the arrival of the framers, we had the green light to go ahead with the septic.

The initial perc test done a few months earlier had shown a 4-foot-deep layer of medium sand that started 10 feet below natural grade, so we budgeted for a 12-foot-deep by 48-foot-long by 20-foot-wide strip out for the new four-bedroom septic system. This would have equated to approximately 430 yards of soil being removed.

Unfortunately perc tests don't reflect all of the conditions below grade, and excavation for the septic system uncovered the same clay and silt mixture that we'd found earlier. It wasn't until we reached a depth of 25 feet below grade that we discovered suitable sandy material. To excavate for the septic system, George dug out some huge boulders **(16)** and ended up removing 1,121 yards of material, more than twice what we'd estimated based on the perc test. Within a few days, George was able to complete the septic system **(17)**.

The extra work needed for the septic system also fell under the "unforeseen conditions" part of the contract, and I began to rethink

Photos: Roe Osborn


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my decision not to do the soil borings. But even those test results can't always be trusted when dealing with quirky soil conditions such as these, underlining the importance of preparing your clients for cost overruns and communicating with them throughout the process.

STORMWATER DRAINAGE

In this area, as in many places around the country, local code or zoning bylaws require that the stormwater from an owner's property be contained on that property and not be allowed to run off onto adjacent private or public lands. This becomes even more critical when there are sensitive environmental areas nearby such as wetlands or wildlife habitat. That was the case here—a vernal pond was located just a few yards downhill from the site. As part of the permitting process, we submitted plans to install a linear channel drain at the bottom of the driveway to collect runoff from the property and direct it to a dry well. The drain and dry well will be installed at a later stage so that they aren't damaged during construction. At that time, another dry well will be installed to collect water from the gutters and downspouts on the house.

The surface of the driveway will play a major role in how runoff will travel down the slope of the property. For that surface we considered materials such as pervious concrete, gravel, seashells, and pervious pavers, but decided to pave the driveway with asphalt, which will more successfully suit the clients' need for a hard, durable surface that will accommodate a walker or wheelchair. The paved surface also requires the least amount of maintenance and can be easily plowed during the winter. The final layers of compacted road base and pavement will be added in the final phases of construction.

Before packing up his equipment and leaving, George put down a layer of crushed stone on the driveway **(18)**. The stone will help keep the ground from turning into a soupy mess during freeze/thaw cycles as work progresses into the spring. The stone also created a clean, even surface for staging materials throughout all phases of construction that followed.

Andrew P. Borgese is an architect, a licensed construction supervisor, and the founding principal of INTEGRATA Architecture + Construction (integrata-ac.com), in Falmouth, Mass. To see more pictures of this project, watch the slideshow, "Site Work: Roughing Out A Lot Before Construction," at JLConline.com.

Photos: George Botelho

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Cool Tools for 2015

Noteworthy products from the annual STAFDA show

BY BRUCE GREENLAW

STAFDA—the Specialty Tools and Fasteners Distributors Association—held its 38th annual trade show this past November at the Charlotte Convention Center in North Carolina. Open to members only, the lively event allowed hundreds of manufacturers to show off truckloads of construction tools and hardware to distributors and retailers. Inspired by the NASCAR Hall of Fame next door, we sped up and down every aisle in the allotted 11 ½ hours to see what will be available over the coming year.

Here are some of the promising products we found—something useful for just about any builder.

1. SAWSQUATCH VERSUS BIG FOOT

Carpenters have been using the 10 ¼-inch Big Foot wormdrive saw for years for cutting 4-by or doubled 2-by lumber in one pass. Made by Big Foot Tools, it's actually a 7 ¼-inch Skilsaw wormdrive equipped with oversize upper and lower blade guards and a compatible base plate. The new 10 ¼-inch Skilsaw Sawsquatch wormdrive, on the other hand, is built from the inside out to handle these demanding cuts. Like other current Skilsaw models, the 16.5-pound saw is powered by a "Dual-Field" motor that promises to run cooler than competing ones. But the Sawsquatch motor is the biggest in the Skilsaw line, to deliver more power and torque.

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DEWALT

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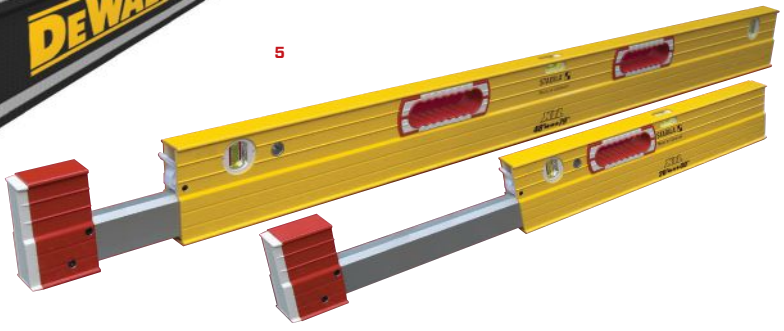

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Milwaukee
HOLE DOZER

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BIG BED

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GREX

Other welcome features include a magnesium upper guard, lower guard, base plate, and gear housing; a rafter hook; a side handle; a multi-function wrench that stores on the base plate; and a 40-tooth Diablo blade. The saw is already being sold through industrial channels and will be widely available in April. It costs about $450 and comes with a comforting 180-day money-back guarantee. skilsaw.com

2. MULTIMASTER REINVENTED

The new Fein MultiMaster FMM 350 Q corded oscillating multi-tool has a 350-watt motor versus the 250-watt motor that powered its predecessor, and is supposed to cut up to 35% faster. Yet according to Fein, the new model generates up to 70% less vibration and up to 50% less noise than the old one. Both models weigh 3.1 pounds. In the Fein booth, I held the new model in one hand and the old model in the other and turned them both on—big difference! Two kits are available. The Start kit includes a few basic accessories and a nylon bag and costs $200. The Top kit includes a wide assortment of accessories and a plastic case and costs $350. feinus.com

3. QUIETER SUBFLOORS

Beck Fastener Group's new SubLoc Pro Scrail nail screws, which are distributed in the U.S. by Fasco America, might be the ultimate subfloor fasteners. For starters, they come in 15-degree wire and plastic coils, 0-degree plastic coils, 33-degree strips, and 20-degree strips, so they can be driven with most full-head stick and coil framing nailers. Once installed, they can be adjusted with a drill/driver or an impact driver to eliminate squeaks. But the fasteners also have a new head design for improved pull-through resistance, aggressive top threads that grab the subfloor, and a spiral shank below that's dipped in a highly adhesive "Diamond Coating" for improved holding power. According to the maker, the fasteners resist withdrawal 41% better and head pull-through 10% better than ring-shank nails, and are in full compliance with applicable building codes. The fasteners come in lengths of 2¼ inches and longer. The 2¼-inchers cost about $46 to $51 per 1,000 fasteners. fascoamerica.com

4. CARBON-FIBER LEVELS

Carbon fiber has exceptional strength for its light weight, which is why it has appeared in everything from golf clubs to jetliners. I lifted one of DeWalt's new Carbon Fiber box-beam levels at the show, and it felt as light as a feather. According to DeWalt, it's also accurate to the industry standard of 0.0005 inch per inch. Slim but protective end caps allow you to carry your layouts into corners. The level is scheduled to hit the market in the second quarter of this year and will come in lengths of 48, 72, and 96 inches. Prices have yet to be determined, but I would expect to pay a premium. dewalt.com

5. EXTENDABLE LEVELS FOR WINDOWS AND DOORS

Stabila plate levels, which can extend from 6 to 10 feet or 7 to 12 feet depending on the model, have been around for awhile. When two leading window and door manufacturers asked Stabila to develop similar levels for window and door installers, the company complied. Stabila's new XTL-26 expands from 26 to 40 inches while the XTL-48 expands from 48 to 79 inches, which means they can collectively handle most window and door sizes. The XTL-26 costs about $140, and the XTL-48 costs about $240. Stabila also introduced the GoPack case, which can hold both XTL levels plus a third level up to 48 inches long. In addition, the soft case has two roomy pockets that can carry related items, such as a pocket laser and a laser distance meter. It costs about $50. stabila.com

6. HIGH-PERFORMANCE HOLE SAWS

Diablo's new hole-saw system is all about efficiency. It includes 32 hole saws with diameters ranging from ⅝ inch to 6 inches, all of which cut 2⅜ inches deep instead of the usual 1⅝ inches deep. One quick-change "Snap-Lock" mandrel fits all. You simply snap the hole saws onto the mandrel, and remove them by pulling the mandrel's collar and sliding them off. To eject plugs, you pull the saw off the mandrel and push it back on at an angle so the pilot bit forces the plug out. The hole saws cost about $8 to $41, and a mandrel with a pilot bit costs $18. diablotools.com

Milwaukee's new Hole Dozer hole saws come in 56 diameters ranging from 9/16 inch to 6 inches. For added durability, their "Rip Guard" teeth have more steel behind the cutting edge than usual and contain 8% cobalt. In fact, if you break any of these teeth, Milwaukee will replace the hole saw. Two "Plug Jack" access slots allow you to pry out plugs with a screwdriver. Milwaukee quick-change mandrels are also available. Prices run about $8 and up for the individual hole saws; there are also five kits, which cost from $50 to $270. milwaukeetool.com

7. QUICK-CHARGE 5-AMP-HOUR BATTERY

The wave of 4-amp-hour and larger batteries that has been hitting the market lately has been great for extending the runtime of our cordless tools between charges. But the downside to their higher capacity is that they can take forever to charge. For instance, the 18-volt, 4-amp-hour batteries supplied with the Bosch model DDH181X-01L drill/driver kit that I reviewed in the October 2014 issue took a stunning one hour and 59 minutes to fully recharge. The 4-amp-hour batteries that powered the Milwaukee 18-volt, 7¼-inch M18 Fuel circular saw reviewed in the January 2015 issue took almost 1½ hours to recharge.

Makita's new 5-amp-hour 18V LXT batteries, on the other hand, promise to fully recharge in just 45 minutes when you use Makita's standard 18V LXT chargers. They're compatible with all the tools in Makita's 18V LXT and 18V Compact platform that are equipped with "Star Protection Computer Controls" to protect against overloading, overheating, and overdischarging. The batteries (model BL1850) are initially being included in three 18V LXT hammer-drill and impact-driver kits (models XPH07T, XT252T, and XT257T), but they can also be purchased separately for about $125. makitatools.com

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8. QUICK-MOUNT BED EXTENDER

Erickson's Big Bed load extender effectively adds 4 feet to the length of your pickup bed, is 48 ½ inches wide, has an adjustable mast for matching your bed height, and supports up to 400 pounds of distributed weight. It appears to be a godsend for hauling long materials and ladders. Drop a piece of plywood on it, and it can double as a portable workbench or cut station. To install it, you simply slide it into any standard 2-inch by 2-inch trailer-hitch receiver and secure it with a pin and a clip. The Big Bed weighs 35.13 pounds and measures 52 inches by 2 ½ inches by 7 inches when collapsed, for easy storage and transport. It costs $200, complete with a clip-on red flag. ericksonmfg.com

9. COMPACT CORDLESS BRAD NAILER

Grex is still putting the finishing touches on its new C1850 cordless 2-inch, 18-gauge brad nailer, which is scheduled to hit the market in April or May. But a prototype was lined up in the Grex booth right next to competing models from Senco, DeWalt, and Paslode, and the Grex was significantly smaller. I learned that the tool will be powered by two AAA batteries and a disposable fuel cell, but Grex tells me that its fuel cell won't emit the usual unpleasant odor each time you fire and will have an unlimited shelf life. Early testing indicates that the tool will fire 10,000 or more nails per set of batteries and about 1,300 to 1,400 nails per fuel cell. Suggested retail will be about $500. grexusa.com

10. MODULAR JOBSITE RADIO

Modular tool organizers—including DeWalt's heavy-duty ToughSystem boxes that can be ganged together or rolled around with a two-wheeled dolly called a DS Carrier—were reviewed in the September 2013 issue of *JLC*. In DeWalt's STAFDA booth, I was treated to a sneak preview of ToughSystem Music, which is tentatively scheduled to hit the market in June. It's an AM/FM radio that's shaped like a ToughSystem box so it can stack and ride with the other boxes, and it has Bluetooth connectivity and a 3.5-mm auxiliary input so it can stream audio content wirelessly or directly from smartphones and other mobile devices. It also charges DeWalt's 12V Max to 20V Max batteries and packs a USB charger. ToughSystem Music is still in the final stages of development, so we can only show a photo of ToughSystem components that it will complement, but DeWalt says it will be the best sounding jobsite music player on the market. I'm told that deluxe features will include 5 ¼-inch and 6 ½-inch subwoofers, a digital sound processor, and protection against dust and water jets. It will cost about $230. dewalt.com

11. STICKY FINISH NAILERS

This March, Cadex is rolling out three intriguing new pneumatic nailers for trim carpenters: an 18-gauge model (V2/18.50) that will shoot ½-inch to 2-inch regular and slight-head brads, a 21-gauge model (V2.21.55) that will shoot ½-inch to 2 3/16-inch pins and slight-head brads, and a 23-gauge model (V2.23.55) that will shoot ½-inch to 2 3/16-inch pins and slight-head brads. All three will feature anti-dry-fire lockout, an improved safety, no-mar rubber tips, a blowgun for clearing sawdust, a belt hook, and a swivel coupler. Also, like Festool power tools, each nailer will come with a modular Systainer case. But what really piqued my interest was the sticky, no-slip silicone paint that Cadex developed to finish these tools. It not only eliminated the need for a rubber grip, but it's also supposed to be cooler to the touch in the summer and warmer in the winter. According to Cadex, the V2/18.50 will cost about $230, the V2/21.55 about $350, and the V2/23.55 about $330. cadextools.com

12. MINI LASER DISTANCE METER

I tested 13 laser distance meters for the January 2013 issue of *JLC* and have been closely following the field ever since. One important new trend is the appearance of the simple ultracompact. Bosch's new GLM 15, for instance, is only 1 3/8 inches wide by 7/8 inch thick by 3 7/8 inches long. It has just one button, can typically measure lengths from about 6 inches to 50 feet, is accurate to 1/8 inch, displays fractions down to 1/16 inch, can take a continuous reading when moving toward or away from a target, does not have a backlit display, and costs $50.

That's admirable, but my new favorite is the Leica Disto E7100i displayed at the show. It costs $150, but is almost as compact, has a typical measuring range of 6 inches to 200 feet, is accurate to 1/16 inch, displays fractions down to 1/32 inch, can take a continuous reading, and does have a backlit display, which is a blessing. It also calculates square feet, and pairs via Bluetooth Smart to compatible iOS and Android devices so you can use it with the free Leico Disto sketch app. A removable belt hook and a carrying case are included. leica-geosystems.us

13. POCKET BLOW GUN

I own a thumb-lever blow gun that I bought at a local hardware store, which makes it easy to use my compressor to blow sawdust off work areas, equipment, and myself when I need to clean up. At almost 6 inches long, though, it takes up too much space in my toolbox and toolbelt. The new pushbutton Coilhose Redi-Burst Pocket Blow Gun is a couple of inches shorter (once you install a male plug), so it tucks into smaller spaces. It's also comfortable in the hand. It includes an OSHA-compliant safety tip that handles most applications for contractors, plus a conical rubber tip that won't mar a finish and is supposed to be used at a maximum air pressure of 30 psi. The blower also accepts other tips. You provide your own ¼-inch NPT male plug at the air inlet. List price is about $12. coilhose.com

14. LIGHTED BACKPACK

A bunch of new jobsite backpacks appeared at the show, but the dual-compartment, 53-pocket CLC model L255 was the only one I saw that helps light your way. Joining CLC's Tech Gear tool-storage line, it features a built-in LED light at the top that offers three levels of brightness and is powered by two AAA batteries. You can aim the light at your work area or into the backpack. The backpack

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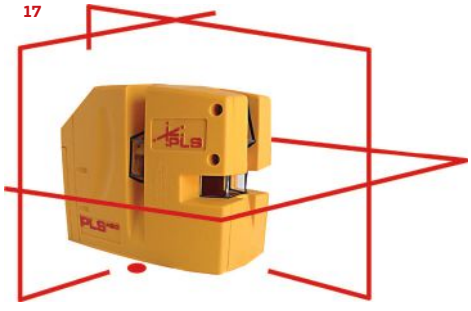

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has top handles, padded shoulder straps, back padding, and large molded-PVC pads on the bottom. It costs $110. goclc.com

15. FASTER CONCEALED DECK FASTENING

Hidden decking fasteners will only get more popular as they become faster and easier to install. The Camo Hidden Deck Fastening System features a choice of five jigs that collectively allow you to use a drill/driver or an impact driver to sink proprietary screws at the perfect angle and depth through the edges of any treated-lumber, hardwood, cedar, composite, or PVC decking. Thankfully, though, you can now quickly drive 2 ⅜-inch Camo screws while standing up by using the new Camo Edge Pro collated autofeed screw gun. Propelled by a Milwaukee corded drill, it's designed primarily for installing treated-wood decking without gaps to allow for shrinkage, but can also be used with other types of decking along with spacers. It costs $380. camofasteners.com

16. VERSATILE LED WORK LIGHT

The new Bosch 12V Max LED Flashlight (model FL12) is just one of many thoughtful work lights that have flooded the market lately. Sold as a bare tool, it can be powered by Bosch's 12V Max 1.5-Ah, 2-Ah, or 4-Ah batteries and delivers up to 330 lumens of illumination, which is enough to light up a work space. At the brightest level, the light runs for about six hours with the 2-Ah battery and 12 hours with the 4-Ah one. You can use the on/off button to dim the light and extend the runtime. The light pivots 200 degrees in its stand and has a ¼-inch tripod socket, two powerful magnets, a carabiner, and a nail hook so you can position it in a variety of ways. It costs $59. boschtools.com

17. FOUNDATION-TO-FINISH LASER

Pacific Laser System's new PLS 480 laser projects one level and two vertical reference lines and can plumb up and down. It's designed to establish plumb, level, and square from foundation to finish. The Basic PLS 480 kit includes a floor base, wall bracket, and case, and costs about $460. The PLS 480 system adds a beam detector and a new adapter that anchors the laser to a tripod or a batter board, and costs about $600. plslaser.com

18. RAPID-FIRE ROOFING NAILER

Senco says its new 1 ¾-inch RoofPro 445XP coil roofing nailer can drive an outrageous 12 nails per second while consuming 5% less air than its predecessor, thanks to an innovative firing valve and feed system. The 5.2-pound nailer also has a bimetal driver blade for improved durability and allows you to access all wear parts from the top of the tool so you can do your own repairs on the fly. Other features include a depth-of-drive thumbwheel, a swivel plug, and an adjustable and removable shingle guide. The nailer costs about $230. senco.com

Bruce Greenlaw, a contributing editor to JLC, *manages the* JLC Toolbox *department.*

Building Outdoor Cabinets

Use exterior-grade panel products and stainless-steel hardware to construct a kitchen with plenty of storage

BY GARY STRIEGLER

Photos: Gary Striegler and Jon Howland

To stand up to the weather, most of the outdoor kitchens I've built were made from masonry and steel studs. Typically, their storage was limited to open space behind stainless steel door units mounted in masonry openings; some also had prefabricated stainless drawer units. That worked well for those particular jobs, but when compared with an average indoor kitchen, storage was almost nonexistent.

When a friend asked me to build his outdoor kitchen, I wanted to make the cabinetry as functional as that in his indoor kitchen—and with doors and drawers. Building cabinets for the outdoors involves many of the same processes I use for indoor work, but also requires attention to the effects of water and moisture. This means using water-resistant materials and stainless steel fasteners and hardware, as well as addressing water infiltration and drainage.

PLANNING

Before we cut any material, I worked with my friend to finalize the design. The plan was to fit the cabinets between the posts on the


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existing deck. To help us visualize the kitchen's footprint, I laid out some rippings of wood on the deck. Next we made a story pole to lay out the locations of the cabinet sides and the appliances **(1)**.

Most of my indoor cabinets have face-frame construction and frame-and-panel doors. On an exterior project, though, the face-frame and door joinery would be exposed to the weather, so European-style, frameless cabinets and doors made from single slabs made more sense for this application.

In the end, I blended methods from both styles and was able to employ many of my tried and true construction methods to build the boxes for this project. I used pocket-hole construction with stainless steel screws from Kreg Tools (kregtool.com) for almost all the joinery in the cabinets.

I also used Extira (extira.com), a material I've used for years, always with great results. It's an exterior-grade panel product with excellent moisture, rot, and termite resistance that's available in dimensions up to 4 feet by 16 feet and in ½-, ⅝-, ¾-, 1-, and 1 ¼-inch thicknesses. It's used by sign makers because it stands up to the weather and takes a keen edge when milled. It is hard; at the end of this project, the carbide router bit I used was noticeably dulled. Compared with MDF, Extira is a bit heavier, more rigid, and more costly—about two to three times more—but for outdoor jobs, the many benefits of the product outweigh the extra expense.

MATERIALS AND CONSTRUCTION

For added strength I made the cabinet backs out of ¾-inch-thick Extira and pocket-screwed them into the sides. I also installed horizontal stretcher rails at the top of the box, front and back. For the wider cabinets, I built an L-shaped front stretcher from two pieces of Extira screwed together. The fit for doors and drawers is much more demanding with European cabinets, so I made sure all dimensions were accurate and was careful to mill all the parts square.

Because the cabinets would be outside and exposed to the weather, I sloped the bottoms ⅛ inch downward from the back to the front; that way, if any water got in, it would flow toward the front. I also cut the bottom pieces of the boxes about ⅛ inch short of the cabinet front so water would have a way to drain out **(2)**.

Knowing that Extira is a flammable product, I contacted the grill

1. After laying temporary strips on the deck to indicate cabinet locations, the author made a story stick to lay out appliance locations and cabinet partitions.

2. The bottoms of the cabinet boxes were sloped down from back to front to shed water. Also the bottoms were cut 1/8 inch shy of the cabinet-box sides to allow water to drip out.

3. The author screwed together a template frame to guide his router during panel cutting. The screws could be removed to adjust the template for panels of different sizes.

4. For routing the raised-panel design, a router was mounted with a bearing above the panel-cutting bit. A block of wood mounted to the base kept the router flat on the template.

and burner manufacturer for clearance recommendations. The company sells a liner to set grills in, and because most of the heat from the burner rises—instead of migrating to surrounding cabinetry—we needed to provide only a ¼-inch space around the burner.

Once I laid out the appliance locations and dimensions, I divided up the remaining cabinet space for a large, two-can trash drawer at one end and for a bank of large drawers. The next step was to make a cut list for the cabinet sides, the only repetitive parts in the project.

I cross-cut the Extira sheets to their finished height using a track saw and ripped the more manageable pieces on a table saw to their finished depth. Next I numbered them to match the story-pole layout, so I could determine how to mill each piece. The milling included drilling for adjustable shelves, notching for toe-kicks, routing a raised-panel design in the cabinet side on each end of the run, and cutting a dado to accept the bottoms.

Most of the milling was straightforward. I used a Kreg jig to drill the shelf pins, cut the notches for the toe-kick using a table saw, and made the dadoes using a straight-edge jig and a router.

Cutting a raised-panel design in the cabinet sides was a bit more involved. I used a Whiteside panel bit (whitesiderouterbits.com) fitted with a bearing above the cutter and a template frame to guide the cut. Because of the depth of cut for the panel, I had to use 1¼-inch-thick material for the frame **(3)**. With thinner material, the bit would have hit the Extira before the bearing made contact with my template.

Later in the construction process, when I routed the door and drawer fronts with the raised-panel profile, it was easy to unscrew the template frame to adjust its size. For all the pieces, I kept the rout about 2½ inches in from the edge. I attached a block of wood the same thickness as the template to one edge of the router base to help keep the router base riding flat on my template—sort of like training wheels for the router **(4)**.

It took several passes around the template to get a final, clean panel cut. Cutting Extira creates a lot of dust, so I used a vacuum cleaner between passes. Even in windy outdoor conditions, it's a good idea to wear to wear a dust mask.


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With all the sides cut and milled, I started at the trash-can end of the cabinet run and cut the first cabinet bottom and set of stretcher rails, then drilled for pocket screws. Because none of the pocket screws would be visible in the finished cabinetry, I adjusted my Foreman to drill to a depth that would let me drive 1 ¼-inch screws into the side panel without coming out the face.

Working from one end to the other, I assembled the cabinet run section by section, first fitting each bottom piece, then adding the back, then the stretcher rails. For cabinet sides with double dadoes, I through-nailed the bottoms in place, then secured them with extra screws **(5)**. The first part of the assembly was done with the cabinets on their backs, then I stood them up to screw in the back pieces.

The manufacturer specified that the grill cabinet hold at least 300 pounds, so I added a vertical divider in the center of the cabinet in the toe space and glued and screwed extra cleats to the cabinet side pieces **(6)**.

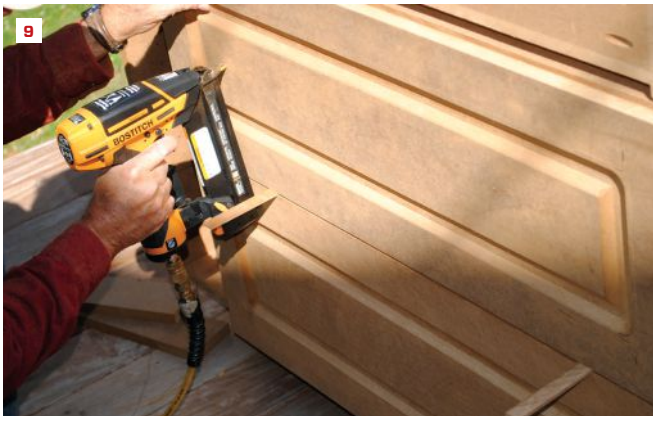
When both runs of the kitchen were built, I matched them up in the corner and shimmed them to level. I screwed cleats to the deck boards, then screwed the cabinets to the cleats **(7)**. The cabinets were also screwed to the deck posts.

DOORS AND DRAWERS

The project was starting to take shape, but a lot of the most challenging work was still to come: building and installing the doors and drawers. Building frameless cabinets made a lot of sense for this outdoor kitchen, but it also meant working with much tighter tolerances. Using overlay doors and drawer fronts on face-frame cabinets allows for a bit of wiggle room; not so with frameless cabinets where tolerances and reveals are more exact.

I planned that the height of my doors and trash-can drawer would be within ⅜ inch of the top of the cabinet so their top edges would be well-protected by the overhang of the stone countertop. I fit the fronts of all the drawers to tight tolerances. (After the cabinets were painted, I added stick-on weather stripping to the top edges to keep out water.)

All the hardware I used was stainless steel Sugatsune from Custom Service Hardware (cshardware.com). The full-extension



5. Cabinet bottoms were nailed in place, then more securely fastened with pocket screws.

6. An added intermediate support in the toe space and cleats glued and screwed to each side piece reinforce the cabinet that will hold the heavy grill.

7. To secure the cabinets in place, the author first screwed cleats to the decking, then screwed through the cabinet side pieces and into the cleats. The cabinet boxes were also screwed to the deck posts.

8. While the drawer slides were being mounted to the cabinet box, temporary 1/2-inch-thick shims were used to hold them off the box bottom.

9. Small brads held the drawer fronts in place. The author used shims when fitting the drawers in a bank.

Sugatsune drawer slides require ½ inch of clearance on each side, but they have some built-in forgiveness if the drawer is on the narrow side. The drawers would have to hold a lot of weight, so I made the boxes with ¾-inch-thick sides and ½-inch-thick bottoms that slide into a dado routed into each side piece.

I used a 5/16-inch-radius router bit to ease both edges of the drawer-side top pieces and one edge of the front and back pieces. For extra strength I used nails and pocket screws to assemble the drawer boxes. The pocket screws through the back pieces will never be seen unless someone removes the drawers, and the pocket screws through the front pieces would be covered by the finish drawer fronts.

To install the drawer boxes, I first attached the slides to the cabinet side, spacing them off the bottom with a ½-inch-thick temporary shim **(8)**. (At first I forgot the front had to be raised up an extra ¼ inch since the cabinet bottom slopes up from front to back.)

The part of the drawer slide that attaches to the cabinet side has elongated horizontal screw slots for in and out adjustments. After driving in two screws, I pulled the slides out and screwed them to the box using the vertically elongated screw slots, which allow for up and down adjustments. I didn't install all the screws yet; I would do that after the finish drawer fronts were installed.

You could use blocks and shims to hold the boxes in place while attaching the slides to the drawer boxes, but I think it's easier to have a helper hold things. Once the slides were screwed in place, I made sure the drawer boxes slid in and out freely. I've learned that it's a waste of time to make any permanent adjustments until the fronts are attached.

The drawer fronts were cut to leave 3/16-inch-wide reveals between each other and between the doors beside them. At first, I cut them a little tight; you can always trim a little off later, but it's really hard to add wood back on.

After fitting the fronts, I routed them with the same panel profile used on the cabinet ends. I set the drawer fronts in place and shot a couple of 18-gauge brads through the fronts **(9)** to hold them in place until I could use pocket screws to attach them permanently from the back side **(10)**.

For the bank of stacked drawers, I worked from the bottom to the top, using temporary shims between the fronts to gauge the reveals.

10. When the drawer fronts were in place, screws were used to attach them from the back.

11. The author routed V-grooves in sheets of Extira panels, a weather- and insect-resistant product, for the finish back of the outdoor kitchen cabinets.

12. Made from Extira, the outdoor cabinets are ready for painting—inside and out—and for the installation of stone countertops.

When I'm building face-frame cabinets, all the door hinges are the same. Frameless cabinets, however, take two types of hinges: full overlay and half overlay. At the beginning and end of a cabinet run, I used full-overlay hinges to cover the full edge of the cabinet box; and in locations where two doors or a door and drawers met, I used half-overlay hinges.

Similar to how I made the finish drawer fronts, I cut the door slabs a little tight, routed in the panel profile, then drilled them for the hinges. Both types of hinges called for the same setback from the edge, but just to make sure everything would work as planned, I drilled a test hole in a piece of scrap first.

Hanging the doors was also a two-man operation. I marked the setback to the back of the hinge and put one screw in each mounting plate, then mounted the doors to test the fit before adding the second screw for each hinge. I had to trim a few of the doors on the table saw to get the right spacing. When everything fit perfectly, we sanded all the door and drawer edges, then nailed on the toe-kick on the bottom of each cabinet run.

I wanted to dress up the back side of the cabinets, too. My solution was to rout vertical V-grooves into ¾-inch-thick Extira panels, using a straightedge and a trim router **(11)**. To support the paneling at the outside corners, I added blocking. The crew that framed the deck did a great job keeping the posts plumb, so it didn't take much work to fit each panel between them.

I wanted the V-grooves to be spaced about 4½ inches apart and have the look of a full piece at each end, so layout was critical. The friend I worked with showed me a wonderful DeWalt construction app (dewalt.cengage.com/mobilepro). In a few minutes, using the app, he had a layout that worked exactly without any adjustments to the V-grooves as we got closer to the edge.

We finished up the panels just as it was getting dark on the second day of hard work **(12)**. Before I headed home, everything was ready for the painters, who would do some sanding to ease some of the sharp edges, then paint the interior and exterior of all the cabinets. The stone contractor would come next to finish the countertops.

Gary Striegler is a contractor in Fayetteville, Ark., and the owner of Craftsman Builders. craftsmanbuildersnwa.com

BY LAUREN HUNTER

Entry-Level Thermal Imaging

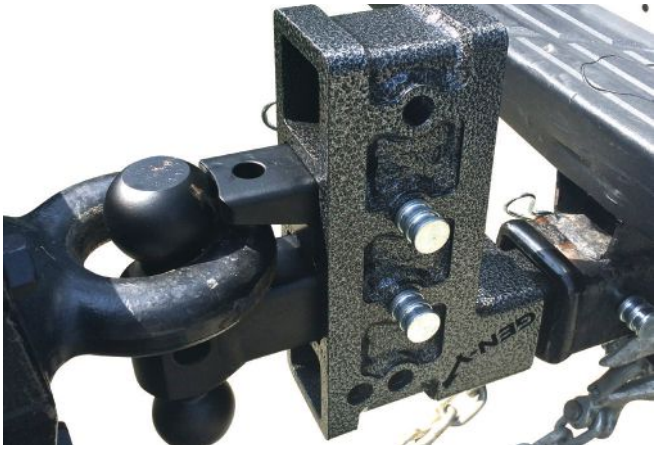
A single-spot IR thermometer with a thermal camera's power, Flir's compact TG165 offers emissivity adjustment and a 24:1 distance-to-spot ratio. It operates between -13°F and 716°F and helps users check seals, spot areas of missing insulation, pinpoint electrical hotspots, and locate water leaks or clogs. It costs $500. flir.com

Elegant Hardware

A sleek, arching design is the hallmark of Top Knob's Tango series in the Mercer hardware collection. Because the hardware lets users see through to the cabinetry underneath, each visible edge is carefully polished, according to the maker. The series comprises two sizes of knobs and pulls, available in five finishes. Prices vary from $5 to $7 per piece. topknobs.com

Carpet, Cleaner

Already hardwearing and soil-resistant, Mohawk's SmartStrand carpet now offers SmartStrand Forever Clean with Nanoloc—an added nanoparticle layer of protection designed to lock out spills and make the carpet even easier to clean. Mohawk says that carpets with Nanoloc release soil at three times the rate of other carpets. mohawkflooring.com



Let's Get Hitched

At 15,000 pounds, Geny Industries' new GH-524 hitch offers a higher capacity for 2-inch hitches, with the versatility and ease offered by the maker's Versa-Ball connection and pintle lock for hook-up to any trailer. Constructed of heavy-duty steel, sandblasted, and coated with a durable silver-vein powder coat, the GH-524 costs $260. genyhitch.com

Keep It Trim
Known for its clean, smooth finish, Fypon is expanding its product line to include two dozen pieces in the Classic Woodgrain collection. Components such as crown, casing, baseboard, and more feature a woodgrain texture suitable for painting or staining. The PVC material is moisture- and pest-resistant. A sandstone finish is also forthcoming. Check with dealers for pricing. fypon.com

Water Watcher
Wireless waterproof sensors placed in the home monitor appliances and plumbing fixtures for the LeakSmart system. When a leak or temperature variance is detected, the sensors alert homeowners through a smartphone app. The system includes sensors, a system hub, the app, and a patented automatic water shut-off valve for less than $1,000, and can integrate with a variety of smart home platforms. getleaksmart.com

Decorative Post Caps, No Pre-Drilling
Coming to the U.S. from Denmark, four of Kokille's post-cap designs feature an integrated nail for quick and easy installation with no pre-drilling. Available in aluminum, copper, or brass depending on the design, the post caps protect cut post ends, while adding a decorative detail. Pricing ranges, based on material and size, from $5.75 for an aluminum cap for a 4x4 post to about $36 for a set of two 6x6 post caps in copper. kokille.dk

Self-adhesive Weather Barrier
Grace's Vycor enV-S self-adhered WRB requires no mechanical fasteners for installation, no taping, and no special joint treatments, and is designed to create a watertight and airtight seal around fasteners used for siding and exterior trim. The maker says third-party testing showed enV-S provided energy savings compared with traditional housewrap on northern U.S. homes. Check with distributors for pricing. graceresidential.com

Features for Work and Play

Redesigned for the midsize category, the 2015 Chevrolet Colorado features amenities including Chevy MyLink with an optional built-in 4G LTE Wi-Fi hotspot. Available in four-door extended or crew-cab models, the Colorado has a 7,000-pound trailer rating. A standard two-tier loading feature allows a platform to effectively split the bed into upper and lower sections. MSRP starts at $20,120. chevrolet.com

Laundry Goes High-Tech

The Whirlpool Duet dryer with HybridCare heat-pump technology recirculates its own exhausted heat to reduce energy consumption by up to 53%. Even without generating new heat, the dryer maintains a standard 60-minute drying cycle. The unit is also ventless, making installation easier and more versatile. With new technology comes higher price tags: HybridCare MSRP is $1,800. whirlpool.com

Smart Thermostat With Layers of Data

Carrier is the latest comer to the smart-thermostat world, with Cor, a device that lets users peel back layers of energy-use data. In addition to offering remote access with Wi-Fi connectivity, Cor shows users their energy consumption, comparisons to other Cor users' consumption, energy efficiency tips, and more. The Cor thermostat will cost around $250, and is compatible with most brands of home comfort systems. carrier.com

Versatile Sealant

Titebond Roof Plus Sealant can be used on shingle and tiled roofs, sheet roofing, metal and flashings, edge and ridge tiles, and liquid-applied roofs. The wide working temperature range between 20°F and 100°F enhances the sealant's versatility on a variety of jobsites. The clear formulation blends with most substrates, or can be painted. Pricing will run around $6.50 per 10.1-ounce cartridge. titebond.com

remodeling
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FEATURED SESSIONS

Keynote Presentations by:

Mike Holmes, "America's Most Trusted Contractor" and host of Holmes Makes It Right on HGTV.

Matt Ehrlichman, CEO, Porch.com, a service specific to the home improvement industry. Named by USA Today as Entrepreneur of the Year for 2014.

Regulatory Update: It's been argued that remodelers have never before faced such a tough regulatory environment. Between the lead-paint rule, a step-up in OSHA inspections, and the coming Silica rule, what's a remodeler to do? Here's one option: Hear from, and talk directly to, a senior federal regulatory official.

Remodeling America's Housing: The bi-annual State of the Remodeling Industry report, issued by the Joint Center for Housing Studies at Harvard University, is considered the nation's preeminent examination of remodeling's current state and future prospects. Kermit Baker leads that report, and at RMLC he'll reveal what's in it and what's to come in your profession.

No. 1's: What do some of America's best remodeling sales reps know that you don't? We convene a panel of top salespeople from operations across the country so they can tell you how they do it.

The Boomer Builder Boom: New-home builders and the media may focus on millennials, but for remodelers, it is baby boomers who constitute the biggest growth market. In this presentation by Hanley Wood's Metrostudy division, we'll look at what this group will want from you and what they're willing to spend to grow old in place.

Air to the Throne?: When the green movement began, the focus was on saving energy, but lately it's turned to air quality. In this presentation, experts from the Building Performance Institute reveal the challenges of maintaining air quality in today's homes and the opportunities for remodelers to capitalize on this growing concern.

Social Studies: Word of mouth advertising may lead potential customers to you, but before they call, it's likely they'll check your website and online reputation first. Don't let your digital reputation kill those potential sales. Here's how to put your best face forward.

Business Leaders Panel Discussion: Victoria Downing, President, Remodelers Advantage, will moderate a panel comprised of remodeling industry luminaries selected from the past 30 years of BIG 50 Award Winners.

Weigh In!
Want to test a new tool or share a tool-related testimonial, gripe, or technique? Contact us at JLCTools@hanleywood.com or 707.951.9471

Props for Stabila's Cross-Line Laser

BY SCOTT JACOBSON

I've worked as a carpenter and foreman for Pinsonneault Builders over the past 12 years. Based in Mashpee, Mass., the versatile contractor has a crew of about 30 men and builds custom homes and commercial buildings while also specializing in remodeling and historic preservation. When Stabila introduced the LAX300 compact laser in 2013, we were about to build a 120,000-square-foot hotel. I thought the LAX300 might be the ideal toolbelt laser for the job, so I placed an order with the boss. The laser worked so well and was so popular with the crew that we recently bought two more.

LINES AND DOTS

The LAX300 projects a horizontal line and an intersecting vertical line, plus up and down points that serve as a virtual plumb bob. Both lines fan out 130 degrees from the laser. The vertical line continues out onto ceilings, where it passes through the top plumb point and stops slightly behind the laser. This placement ensures that the line reaches the tops of walls even when the laser is positioned close to them, and it's especially useful for aligning interior wall framing and long runs of suspended-ceiling grid.

According to the specs, the laser has a visible range of up to 60 feet. We can easily see the lines and plumb points in most interiors. Outdoors, the concentrated plumb points are bright enough for most of our plumb-bob applications, but the two lines can be difficult or impossible to find at a reasonable distance or in bright light. You can use laser-enhancement eyeglasses or the included target plate to extend the visible range. The pulsed laser lines also allow you to use a receiver to detect the beam, extending the working range to about 300 feet. Stabila's compatible REC 210 receiver costs about $175. So far, though, we've only used the LAX300 as a simple standalone portable, and have yet to try any accessories. If Stabila would add a bright point where the two lines cross so we could, say, easily check a ridge for level with the naked eye, the visible range of the lines would seldom be an issue for us.

Like most competing lasers, the LAX300 uses a pendulum to self-level. The base of the laser must be within about 4 ½ degrees of level for the pendulum to work. If the inclination is greater, the lines, points, and LED warning light flash to indicate that you're outside the self-leveling range.

The pendulum automatically locks when you switch off the tool, which helps prevent shock damage. To project a sloped line or the two perpendicular lines in any direction, simply leave the slide switch in the off position so the pendulum remains locked, and press the function button on the opposite side of the laser for about two seconds. In this mode, the lines, points, and LED blink rapidly so you don't forget that the pendulum is locked.

According to Stabila, the three AA batteries deliver up to about 20 hours of runtime, which sounds about right. A separate LED on the laser starts to glow amber when about four hours of runtime remain—plenty of time to buy more batteries.

OTHER HIGHLIGHTS

The main body of the LAX300 rotates 360 degrees on its vertical axis within a C-shaped, rubberized outer housing, which can be very helpful for aiming layout lines. This housing has a ¼-20 socket on the bottom for tripods and laser poles, and two powerful V-grooved rare-earth magnets on the back that stick the laser to the included wall bracket or other ferrous objects. We use the magnetic attachment a lot when setting windows.

The bottom of the outer housing is a height-adjustable foot that releases and

EDITED BY BRUCE GREENLAW

When you install the sturdy black plastic framing base (left) and push the laser squarely against the bottom plate, the down plumb point will graze the plate's edge. If the laser's top plumb point hits the corresponding edge of the top plate above, the wall is plumb. The author appreciates the padded case (right).

locks at the flip of a lever. The foot lets you fine-tune the elevation of the horizontal laser line, and extending it gives a clear view of the downward plumb point. The foot also makes it easy to plumb wall framing: Just push the notched tip of the fully extended foot against your metal track or 2-by bottom plate, and the downward plumb point will sideswipe the edge. When the upward point hits the corresponding edge of the top track or plate, the wall is plumb.

Framing contractors bump track or plates with the LAX300 all day, which can punish the adjustable foot. The laser includes a sturdy plastic "framing base" that screws to the ¼-20 socket so you can plumb walls without extending the foot.

The outer housing serves one more important purpose. In the closed position, it shields all the lenses to help prevent breakage and keep them clean. Stabila says it tested the shock-resistance of the LAX300 by dropping it onto concrete from a height of one meter with the pendulum locked, so the laser appears to be internally rugged, too. The laser also has an IP54 rating, indicating that water splashes and dust won't hurt it.

THE BOTTOM LINE

When I plan to use one of our LAX300 lasers, I just slip its padded carrying case onto my toolbelt to keep it safe and accessible, and I'm ready to go. Our crew has used these lasers on residential and commercial jobsites for plumbing walls, gables, and trusses; setting windows and doors; leveling ceilings; and more. They've been rained on, banged up, and exposed to dust, and have fared very well. We wish they had one bright dot on the horizontal line, and we would appreciate a rechargeable version, but I highly recommend this excellent tool.

LAX300 Specs

Functions: crossing level and plumb lines, up and down plumb points
Range: 60 feet visual, 300 feet with receiver (not included)
Cross-line and up-point accuracy: ±3/8 inch at 100 feet
Down-point accuracy: ±1/2 inch at 100 feet
Self-leveling range: ±4.5 degrees
Batteries and runtime: 3 AA, about 20 hours
Weight: 1.3 pounds
Price: $350
Included in kit: batteries, framing base, target plate, wall bracket, pouch
Warranty: 2 years

Scott Jacobson is a residential and commercial carpenter in Mashpee, Mass. He invented the Pneuhook quick-change nailer hook reviewed in the June 2014 issue of JLC.

COMPACT BLOWER

One benefit of buying into a cordless platform is that you can add bare tools at a minimal cost because you already own the batteries and charger. For instance, I recently bought a Makita 18V LXT blower. It can be powered by Makita's 18V 2-Ah, 3-Ah, 4-Ah, or 5-Ah batteries; has a variable-speed trigger along with a dial that sets the maximum air speed to low, medium, or high; and delivers a top speed of 179 miles per hour.

I had no idea how much I would grow to love this tool. Soon after buying it, I used it to clear sawdust from a roof. It worked better than I expected, especially for a compact tool. It isn't as powerful as a large leaf blower, but the nozzle and the variable-speed switch allow you to blow debris exactly where you want it without making a bigger mess. In fact, the trigger gives me so much control that I typically leave the speed dial on "high." I use this tool all the time for blowing off floors, roofs, workbenches, cutting stations, tools, and myself. You can also buy an optional dust bag and turn the blower into a small vacuum. The bare tool (DUB182Z) costs about $60. The kit (DUB182) includes a 3-Ah battery, a charger, and a tool bag and costs about $230.
—Paul Johnson is a remodeling contractor in Portland, Ore.

Photo: Top right, Joel Moore

The Select Step ladder is a step up from a traditional stepladder, and from other transforming ladders. Its legs can be adjusted for use on stairs or other uneven surfaces (far left), and it comes with a versatile, multiposition tool tray (left). Locking handles make it easy to change and secure leg positions (above).

Transforming Ladder Is Tops

BY DOUG MAHONEY

A few years ago, Little Giant released the Select Step, bringing its extending, transforming ladder concept to the stepladder. I've owned one since it came out and have used it on a variety of jobsites where it has received unanimous praise from guys in just about every trade. Everyone loves it and there are a lot of reasons why.

At its most basic, the Select Step is an aluminum stepladder that can be adjusted to a height of approximately 5, 6, 7, or 8 feet. Unlike the awkward pin system on the traditional Little Giant Ladder, the locking mechanisms on the Select Step are simple and user-friendly. One side moves when two locking handles are pressed in and the other side unlocks with the twist of a large handle. The sliding motion is smooth, and it's easy to locate and lock in the different stops up and down the rungs.

The ladder legs can be adjusted to different lengths, which allows you to set the ladder up on stairs, on a ramp, or hard against a wall. One of my electricians really appreciated this feature when he was hanging lights—especially when he was hanging a large pendant in a stairwell.

The Select Step also comes with something called the AirDeck, a multiposition tool tray that can be attached to the ladder's top. In one position it sits horizontally, and in the other, it sticks up from the top of the ladder and acts as a handrail. Even in this vertical position, the platform can be pivoted to horizontal so you still have a place to put your tools. When not in use, the tray clicks into the ladder for easy storage. The great thing is that the AirDeck provides enough tool storage that once you go up the ladder, you may never need to come down. It has 14 different tool holes, a magnetized tray, a spot for a paint can, and two notches that are designed to secure extension cords or air hoses. This is in addition to the standard storage at the top of the ladder itself.

The trade-off of all this functionality is weight. The Little Giant is heavy compared with a 6-foot fiberglass ladder. Because there are four sets of rungs, even when it's compacted to its smallest size, I found it difficult and awkward to carry around on my shoulder. If you need to go up and down a set of stairs multiple times in a day, this ladder gets old pretty quickly.

So it's a great ladder, but not for everything. A regular fiberglass step is going to be better for quick trips to a site or for a fast-paced task such as putting in light bulbs at the end of a job. But if you're setting up to work in one spot for a while, this is the perfect ladder to use.

Select Step Specs
Load rating: IA; 300 pounds
Height: adjusts from 5 to 8 feet (large model available; 6 to 10 feet)
Material: aluminum (also available in fiberglass)
Country of origin: China
Price: $245

Doug Mahoney is a carpenter in Harvard, Mass., and a regular contributor to Tools of the Trade, *where this review originally appeared.*

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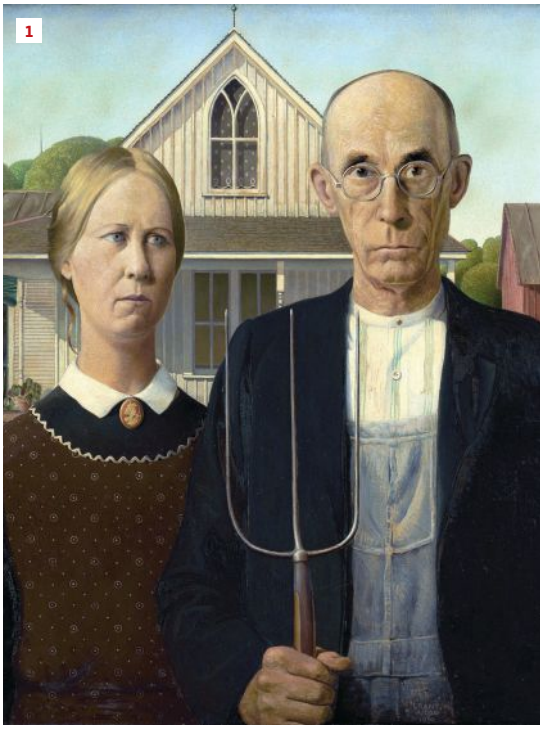
Classifieds

BY JON VARA

1. The couple in *American Gothic* are intended to represent a father and daughter, not husband and wife. The models were the painter's sister, Nan, and their dentist, Dr. Byron McKeeby.

2. The actual window is a bit wider than the version in Wood's painting. He also took the liberty of significantly elongating his sister's neck.

3. Stair code? What's a stair code?



Carpenter Gothic

In August of 1930, Iowa artist Grant Wood went for a drive in the country. Near the village of Eldon, he was struck by a small frame cottage with an oversized Gothic window in the gable end facing the road. (There was also an identical window in the back gable that he probably didn't see.) Wood made a quick sketch on the back of an envelope and later followed up with an oil painting of the kind of people he imagined might live in such a house.

The rest, as they say, is history. Wood's *American Gothic* is instantly familiar to almost everyone, both in the original and in parody versions beyond counting.

But what of the anonymous carpenters who built the house that encloses what must surely be America's best-known window, Gothic or otherwise? Don't they deserve some credit? In fact, the layout of the historic Dibble House—now owned by the Iowa State Historical Society—suggests that they do. The house is small, with a first-floor area of just over 500 square feet. To save space, the carpenters who built it in 1881 (a two-man crew sometimes identified as Busey and Herald) shoehorned the stairway to the second half-story into a rear corner.

According to modern-day Eldon carpenter Jason Snyder—who does repair and maintenance work on the house—the resulting stair is just 18 inches wide and turns left at a landing partway up. "A guy who's 5-foot-5-inches can hit his head," Snyder says. "There's no way to move furniture up those stairs."

Anticipating that difficulty, the original builders seem to have settled on a large gable-end window as a practical, if awkward, solution. The granddaughter of a former owner of the house told historians that the family brought in furniture by hoisting it onto the back-porch roof with a block and tackle, then manhandling it through the Gothic window—which the carpenters had thoughtfully hinged to open like a door.

JLC contributing editor Jon Vara lives in Cabot, Vt.

Photos: 2 & 3 courtesy of the American Gothic House Museum

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