JLC

THE JOURNAL OF LIGHT CONSTRUCTION

July 2016 $4.95

Quality Ductwork

Rooftop Patio Repair

Hanging Interior Doors

jlconline.com hw


DIABLO®
UP YOUR CUTTING GAME
NEW
with Diablo's New
TRACKING POINT™
The Next Generation
7-1/4" Framing Blade
DIABLO®
NEW
TRACKING POINT™
Ideal for Corded & Cordless Saws
More Cuts per Charge
Item#
D0724
www.UpYourCuttingGame.com

Diablo's next generation 7-1/4" 24T Framing Blade with new Tracking Point™ Tooth design delivers maximum life and durability with effortless cutting performance.

UP YOUR CUTTING GAME

UP YOUR CUTTING GAME with TRACKING POINT™ Tooth Design

NEW

5x More Life than Standard Framing Blades

2x More Durable than Standard Framing Blades

www.UpYourCuttingGame.com

5 Standard Framing Blades vs. 1 Diablo Framing Blade with Diablo Tracking Point™

YOU SAVE

$39.90 – $9.97 = $29.93

JULY 2016 / VOL. 34 / NO. 10

JLCONLINE.COM

Contents

FEATURES

DEPARTMENTS

On the cover: Gary Boyer, with Edge Energy, based in Beltsville, Md., tests the draft in a water-heater flue after making modifications to ductwork near the mechanical room. See the story on page 33.

THE JOURNAL OF LIGHT CONSTRUCTION (ISSN 1056-828X), Volume 34, Number 10, is published monthly by Hanley Wood, One Thomas Circle, NW, Suite 600, Washington, DC 20005. Annual subscription rate for qualified readers in the construction trades: $39.95; nonqualified annual subscription rate: $59.95. Publisher reserves the right to determine recipient qualification. Canada Post Registration #40612608/G.S.T. number: R-120931738. Canadian return address: IMEX, PO Box 25542, London, ON N6C 6B2. Periodicals postage paid at Washington, DC, and at additional mailing offices. POSTMASTER: Send address changes to JLC, Box 3530 Northbrook IL 60065-3530.

BPA WORLDWIDE BUSINESS

JLC

JLCONLINE.COM

Group Editorial Director, Residential Construction
John McManus, jmcmanus@hanleywood.com
Editor in Chief, JLC Group Clayton DeKorne, cdekorne@hanleywood.com
Chief Design Director Aubrey Altmann, aaltmann@hanleywood.com
Managing Editor Laurie Elden, lelden@hanleywood.com
Art Director Tina Tabibi, ttabibi@hanleywood.com
Senior Editors Ted Cushman, tcushman@hanleywood.com;
Chris Ermides, cermides@hanleywood.com;
Tim Healey, thealey@hanleywood.com;
Roe Osborn, rosborn@hanleywood.com
Senior Graphic Designer Lita Ledesma, lledesma@hanleywood.com
Chief Editor—Products Lauren Hunter, lhunter@hanleywood.com
Contributing Editors Greg Burnet, Sue Burnet, Michael Byrne, David Frane, Bruce Greenlaw, Dave Holbrook, Joe Stoddard, Jon Vara, Charles Wardell, Andy Wormer

Senior Web Developer Braddock Bull,
bbull@hanleywood.com
Interactive Designer Austin Heller,
aheller@hanleywood.com

Production Director Theresa A. Emerson
Digital Ad Manager Annie Clark
Ad Production Coordinator Bernadette Couture

Group Director, Audience Marketing & Circulation
Christina Lustan
Customer Service Manager Lois Landa
Circulation Promotions Designer Chara Anderson

President, Contractor Group Rick Strachan

HANLEY WOOD MEDIA

President Dave Colford
Executive V.P., Strategic Marketing Services
Tom Rousseau
Senior V.P., Strategic Marketing Services & Consumer Media Jennifer Pearce
Senior V.P., Audience Operations Sarah Welcome
V.P., Product Development Rizwan Ali
V.P., Client Operations Mari Skelnik
Senior Director/Print Production Cathy Underwood

PUBLISHED BY HANLEY WOOD

Chief Executive Officer Peter Goldstone
Vice Chairman Frank Anton
Chief Financial Officer Matthew Flynn
President, Media Dave Colford
President, Digital Andrew Reid
President, Marketing Jeanne Milbrath
President, Metrostudy Christopher Veator
Senior V.P., Marketing Sheila Harris
V.P., Corporate Accounts Ryan Flom
Senior V.P., Corporate Development & General Counsel Mike Bender
V.P., Business Planning & Analysis Ron Kraft
V.P., Corporate Controller Keith Rosenbloom

Editorial & Advertising Offices:
The Journal of Light Construction,
186 Allen Brook Lane, Williston, VT 05495,
802.879.3335, Fax: 802.879.9384

Cortex for PVC Trim now 50% Faster!

The Cortex® Hidden Fastening System for PVC trim just got better!

Continuous improvement. It's important to you. It's important to us.
The Cortex Hidden Fastening System for PVC Trim is now even faster and easier:

- **Cortex Collated Plugs**
  The fastest, easiest way to install Cortex plugs
- **The TORX® ttap® Drive System**
  No fastener strip-out, easily removed
- **The Dual Lead Fastener Thread**
  Installs 50% faster than traditional trim fasteners

Now with Cortex Collated Plugs!

www.fastenmaster.com 800·518·3569

FastenMaster Hidden Fastening Systems
Pride in Craftsmanship

JLC

INFORMATION DIRECTORY

CONTACT INFORMATION

jlconline.com; 802.879.3335
JLC
186 Allen Brook Lane
Williston, VT 05495

EDITORIAL

We welcome letters and article submissions from our readers. Contact us by mail at the address above, **Attn:** Editorial Dept., or via email at jlc-editorial@hanleywood.com. Keep copies of all original materials.

SUBSCRIPTION SERVICES

For help with your **JLC** subscription, contact us:
Online: jlconline.com/cs
Email: jlc@omeda.com
Phone: 888.269.8410
Mail: JLC, PO Box 3530, Northbrook IL 60065-3530
You can subscribe online at: jlconline.com/subscribe
Subscription rates for qualified readers:
1 year/ $39.95; 2 years/$64.95.
Canada, International: add $15/ year for surface delivery. Sales tax will be added to total due if required by your state law.

JLC BACK ISSUES

JLC subscribers have free access to every issue of **JLC** since 1986. Enable your free access at jlconline.com/register. Copies of individual back issues can be purchased for $4.95 each, plus $5 shipping per order. Call 888.269.8410 for availability.

ARTICLE REPRINTS

For custom reprints of **JLC** articles, call Wright's Media, 877.652.5295; hanleywood@wrightsmedia.com

JLC UPDATE EMAIL NEWSLETTER

JLC Update, our email newsletter, is free to **JLC** readers. Each issue contains industry news and the latest tips on building materials, techniques, tools, and technology. Subscribe online at jlcupdate.jlconline.com

For list rentals: The Information Refinery, Brian Clotworthy, 800.529.9020, brian@inforefinery.com

Privacy of mailing list: We rent our subscriber list to reputable companies. If you do not wish to receive promotional materials from other companies, please call us, toll-free, at 888.269.8410.

JLC

SALES OFFICES

HEADQUARTERS

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

Trow Meier Vice President, Sales, Remodeling & Distribution Groups
773.824.2417 Fax: 773.824.2540
tmeier@hanleywood.com

NORTHEAST/MID-ATLANTIC

Jamie Volpe Senior Strategic Account Director
(Including CT, DC, DE, MA, MD, ME, NH, NJ, NY, PA, RI, VA, VT, WV)
203.397.1231 Fax: 203.397.1168
jvolpe@hanleywood.com

MIDWEST/ SOUTHEAST

Clare O'Dower Strategic Account Manager
(Including AL, FL, GA, IL, KY, MI, NC, OH, SC, TN)
202.372.5665 Fax: 773.824.2401
codower@hanleywood.com

MIDWEST/SOUTH CENTRAL

Kay Ross-Baker Strategic Account Manager
(Including AR, IA, IL, IN, KS, LA, MN, MO, MS, ND, NE, OK, SD, TX, WI)
773.824.2576 Fax: 773.824.2401
krossbaker@hanleywood.com

WEST COAST

Carol Weinman Senior Strategic Account Director
(Including AZ, CA, CO, ID, MT, NM, NV, OR, UT, WA, WY)
831.373.6125 Fax: 831.373.6069
cweinman@hanleywood.com

NEW ENGLAND/MID-ATLANTIC REGIONAL EDITIONS

Phil Guerra Account Manager
516.586.4797 Fax: 202.452.1126
pguerra@hanleywood.com

CANADA

John Magner York Media Services
416.598.0101
Fax: 416.598.9191
jmagner@yorkmedia.net

CLASSIFIED ADVERTISING

Maura Jacob Account Manager
678.451.8627
mjacob@hanleywood.com

"TEN TIPS FOR IMPROVING CASH FLOW," BY MELANIE HODGDON (JUN/16)

HFmark (online, 6/5/16): A contractor should always be invested in his jobs! California contractor license law implies a maximum $2,500 per job should be laid out by the contractor upfront. When a contractor is not invested, and the going gets tough, the contractor gets going. The worst thing a client can do is keep the contractor paid up to date. Clients should always retain 10% plus the $2,500, until the job has been thoroughly inspected by an independent qualified inspector, followed by the Inspector of Jurisdiction. If a contractor can't be that invested, he shouldn't be doing the work.

A $25,000 job means an ongoing investment of $5,000. If you're doing $25,000 jobs, holding $5,000 shouldn't be a problem. It should be sitting in an account waiting for the next job. The only way to keep our industry clean is to keep our work ethic clean. The only way to do that is make sure none of us abandons jobsites or cuts corners because of money issues.

Shawn McCadden responds (online, 6/8/16): Truthfully, that sounds like the biased opinion from a homeowner. I'll keep it simple: Delta Airlines won't let you pay after you have landed. Smart business owners get the customer to finance the job. The opinion expressed by HFmark seems to categorize all contractors as not trustworthy. When I had my remodeling business, many customers paid us in full before we started and asked us to keep their house key in case they had us come back. Reputation gives a contractor the ability to be trusted and to be paid in advance of delivery.

Photo: Ira Nerenberg

Ira Nerenberg used either Resisto or Soprema flexible flashing to seal the wall transition at grade. This photo shows the water barrier going over the footing and at least 12 inches up the ICF vertical face.

"THIN-STONE VENEER OVER RIGID FOAM," BY IRA NERENBERG (MAY/16)

ThingOfBeauty (email, 5/17/16): Great article. How did you handle the transition to grade? Also, do you have photos of the weeps at the bottom of the wall? We find those the most challenging areas to manage while making things look like real stone.

Ira Nerenberg responds: The photo at left shows the peel-and-stick flashing we used everywhere that grade intersects a vertical wall component.

As far as weeps are concerned, the mason installed a rope weep between stone joints and behind the stone, in front of the scratch mortar coat. He cut the rope off flush with the stone, so it can't be seen. So far, it seems to be working.

Crremodeling (online, 5/15/16): Nice article, but I was looking to install stone directly on the foam.

Ira Nerenberg responds: After much research, I determined that installing stone directly on foam is a recipe for failure. The research done on this by the Foam Sheathing Coalition became part of New York State residential building code and energy conservation code, which is very specific about requiring fasteners for furring or lath to support the cladding. Foam doesn't have the capacity to support the weight of the stone or anything else that is applied to it without the proper fastening.

This month, we look at two ways to enter the building trades: First, we get the perspective of a remodeler's son who is immune to any social stigma attached to the trades. Then we take a walk through a union-training facility in Chicago for a glimpse into a thriving apprenticeship program.

Why I Want to Be a Carpenter

BY CARTER SILVA

I have been interested in carpentry for as long as I can remember. Lucky for me, my dad, Manny Silva, is a good carpenter and started teaching me about carpentry when I was very young. As I've gotten older and more responsible, he has slowly been teaching me the hands-on part of building as well the business part.

Mentors. One big help is that my dad has taken me to carpentry shows such as JLC Live where I have met many important carpenters in the business. One of those carpenters, Gary Katz, has been especially supportive. Gary believes in me and encourages me whenever I see him. When I was just 8 years old, Gary helped me write an article for *This is Carpentry* about installing a fence post. A few years later, I wrote a second article for *TIC* on installing clapboard siding.

Why I like carpentry. I'm interested in carpentry for many reasons. The first is that it's very rewarding to see something I've created by using my hands and my mind. Another reason is that carpenters solve problems by being patient and creatively using what they know.

Photo: Diane Carter

But most of all, learning carpentry has been really fun.

Like many kids, I got a set of plastic tools when I was younger, and I followed my dad around, copying him with my tools. One of the first carpentry projects that I remember doing was nailing together small scraps of wood that my dad gave me. He started the nails, and then I lined up the boards and nailed them together.

I have always loved going with my dad to lumberyards, helping him pick out and load material into his truck. You can learn a lot at lumberyards. When I was old enough, he started training me to help with estimates by holding the end of the tape measure and by helping him count the items that he needed. Working around our house, he taught me things like the right way to hold the end of a board when he cuts it, and he also let me help with minor demolition jobs.

As I got older, my dad let me tackle more important tasks, like nailing things together, pulling things apart, digging holes, painting, or anything I could safely do with him nearby, carefully supervising. I've helped tear off a porch, build a fence, skim-coat walls inside, build built-ins, install siding, move dirt and rocks, and more.

Looking toward trade school. I remember my dad and older stepbrother taking me to an open house at a trade school. In the carpentry shop, they were letting visitors bang nails into a wooden post. I took a turn and one of the students wanted to start the $1\frac{1}{2}$-inch roofing nail for me. But I told him that I could do it, and I sank that nail in four shots. He said, "Great job! Can you teach that to some of the kids in this school?"

Right now I'm a 6th grader, and I'm pretty sure I want to go to the trade school in 9th grade. After that, the things I look forward to the most are building and repairing things, and driving trucks and heavy equipment. For now I just want to learn as much as I can, so that one day I can have my own carpentry or trucking business.

Carter Silva is an aspiring carpenter, in North Andover, Mass.

Union Town

BY SUE AND GREG BURNET

Since the days of railroads and slaughterhouses, Chicago has been known as a union town. So when we received an invitation to visit the Chicago Regional Council of Carpenters (CRCC) training facilities, we were intrigued to learn about how a union might work for carpenters in this day and age.

Vince Sticca, director of the Apprentice and Training Program, gave us a tour of the facility in Elk Grove, Ill. The two buildings that make up the center have an impressive 270,000 square feet combined (there's also a facility in Chicago with another 90,000 square feet). Even more impressive were the facility's overall organization and high level of technical sophistication.

THE PROGRAM

Before we delve into some of the cool things we saw, we'll outline the union's program. Potential apprentices must first complete a nine-week pre-apprentice program that includes an OSHA course and first-aid and CPR classes, as well as fundamental tool and safety training. This acts as a trial period to ensure applicants are ready to commit to the apprenticeship program.

The apprenticeship consists of four years of training, after which a carpenter earns a journeyman card. Apprentices must be continuously employed by a union contractor to be enrolled in the program, and throughout the four years, they must attend one full week of classes at a training facility every three months.

Apprentices also select a specialty track for certification. There are currently 11 specialties offered: Construction—Residential/Commercial, Cabinet Making, Flooring, Lathing, Millwright, Pile Driving, Drywall, Siding, Roofing, Insulation, and Concrete Form Construction. Once a specialty is selected, apprentices are essentially locked in. Students are paid by an employer and all the training classes are covered by the union, so the concept of a "perpetual student" with a shifting focus is discouraged. After an apprenticeship has been completed, however, journeymen can return to take continuing education classes in other specialties, the costs of which are still fully covered by the union.

Each weekly segment consists of classroom and hands-on instruction, followed by a final test. If a student doesn't pass the test, he or she must retake the entire segment. This could mean waiting another three months for the segment to be offered again, potentially adding time to the apprenticeship. About 80% of the students do finish their apprenticeship in four years.

The CRCC treats the training facility like a real jobsite. There are no cell phones allowed in the building during training. Safety gear is required to be worn during any activities involving the use of tools or equipment, and tardiness and absenteeism are not tolerated: If students are late, their pay can be docked.

HOW DO I GET IN?

There are 239 training centers across the U.S. and Canada, so the process may vary, but here's how it works in the Illinois region. Only qualified individuals may apply (for a list of basic qualifications, go to carpentersunion.org/programs/apprentice-program), and the first step is to take an aptitude test, which measures basic vocabulary and math skills, reasoning power, and talent for carpentry. Those who pass enter a lottery and are selected at random for enrollment.

To find applicants, the union works with city agencies and schools to create a pipeline for students to enter apprenticeships. It has had a relationship with the Chicago Public Schools (CPS) since the 1960s, and while CPS vo-tech programs have been significantly reduced over the years, the program at Dunbar High School on the city's Southeast side has recently been revitalized. The union also exhibits at industry-related trade shows and works with veteran's groups, including Helmets to Hardhats.

COOL STUFF

The CRCC facility has areas set up for specific hands-on training, including a few where apprentices are trained to install multiple products. In the floor-covering section, for example, we saw students installing hardwood, carpet, vinyl, and laminate. We saw a similar variety of products being installed in the roofing and exterior-wall-sheathing areas. The union's goal is to train members on most, if not all, of

Photo: Sue Burnet


POWERSELECT
precision. unmatched.™
TSC 55 Cordless Tracksaw - Beveled, mitered or straight. Sacrifice the cord, not cut quality.
FESTOOL
Tools for the toughest demands
festoolusa.com

the products and materials currently used in each specialty.

To keep pace with how business is done today, the CRCC incorporates technology found on jobsites into the curriculum. The facility has a number of computer labs for classes where there is a job vault similar to what one might encounter on a commercial project. The CRCC also has CNC machines that students are taught to program, as well as a number of virtual training tools. One that was particularly intriguing was a virtual welding rig, which is used in the beginning stages of training, before an apprentice even picks up a welding gun or stick. Though the machines are expensive, they offer instant visual feedback to the students and save on steel and electricity.

Another training area was like a scene from "Let's Make a Deal"—doors everywhere! That area is used to train and certify students on myriad door hardware options, including newer electronic entry devices. Each door is set up with blanks for mounting a different piece of hardware.

CREATING REAL WORLD CONDITIONS

Training for insulation, specifically spray foam, presents an interesting challenge. Initially, the trainers built walls with a cardboard backing for the students to practice on (the cardboard would be removed and replaced for successive students). This wasn't accurately replicating a jobsite setting, however, so trainers hit upon the idea of insulating the open exterior walls of the facility itself. They said that once all their buildings have been insulated, they may consider offering free insulation to neighboring businesses.

One innovation we had a chance to see is the Infection Control Risk Assessment, or ICRA, area. This portion of the training was born of the healthcare industry's need to control the spread of secondary infections. Before ICRA, contractors working in hospitals often treated these sites like any other jobsite. But a seemingly minor disruption to a wall or ceiling might not only dislodge contaminants, but also spread them through the air and ventilation system, where they could become life-threatening problems, particularly for patients with a suppressed immune system. The union now provides an ICRA certification for this subspecialty. Any union contractor that has been awarded a renovation contract in a healthcare facility can send its carpenters and apprentices through the ICRA program prior to the start of the job. The CRCC has also created an eight-hour program that educates hospital staff on what to expect during a renovation of an occupied healthcare facility, and what they can do to minimize disruption and particularly cross-contamination of areas.

IS IT RIGHT FOR ME?

There is no single answer to this question, but it is worth asking. We came away impressed with the CRCC efforts and facility. You can learn more at the United Brotherhood of Carpenters website (carpenters.org/home.aspx) or by speaking with a local chapter representative.

Sue and Greg Burnet own Toolbelt Productions (toolbeltproductions.com).


prowood
PROFESSIONAL GRADE™
TREATED LUMBER STANDARDS ARE CHANGING.
Choose the right treated lumber for your project.
UC3B
Above Ground Use
prowood PROFESSIONAL GRADE™
Above Ground Use
Not suitable for deck joist or near ground uses
ESR-2240 UC3B
UC4A
Ground Contact/General Use
prowood PROFESSIONAL GRADE™
Ground Contact/General Use
For general above ground, ground contact, and fresh water use
ESR-2240 UC4A
UC4B
Ground Contact/Critical Structural
prowood PROFESSIONAL GRADE™
Ground Contact/Critical Structural
For critical structural, ground contact and fresh water use
ESR-2240 UC4B
Learn more at
ProWoodLumber.com/use

Q I need to gain headroom in an 18-by-32-foot barn with a 12:12-pitch roof. The bottom chord of the roof framing is a 2x8. Can I just add a 2x8 above the existing one and then remove the original without compromising the integrity of the roof?

A Darren Tracy, P.E., owner of West Branch Engineering, in Saratoga Springs, N.Y., responds: The short answer is "Probably." But it's difficult to give you a definitive response without knowing the exact details of the roof. I can offer general guidelines, but my advice would always be to have an engineer do a complete analysis based on the size and spacing of the rafters and crossmembers, how much headroom you need to gain, and whether the space above the crossmembers will be used for storage.

If the crossmember does not have a vertical load applied to it—that is, if the owner doesn't plan to use the space above for storage—then its main function is to keep the barn walls from spreading under the weight of the roof. In that case, it is probably safe to undertake the alteration you describe as long as the new crossmember also fulfills that same function. But a single 2x8 seems pretty flimsy for that span, so my first suggestion would be to make the new crossmember larger than a single 2x8. Without knowing all the details, I would advise making the new crossmember out of multiple 2-bys. In your case, I would use a minimum of two 2x8s.

How high you can safely raise the crossmember would again depend on the details of your roof framing, especially the live loads (snow and wind in your area) that the roof needs to withstand. The lower the cross beams, the more effective they are at resisting spreading. So without reviewing your exact situation, my experience and intuition say to raise the cross beams as little as possible.

If you do plan to use the loft area above the cross beams for storage, again, there are many variables, such as on-center spacing, the material used, the depth of the joists, and the anticipated live load. Double #2 SPF 2x8s at 24 inches on-center could carry a 30-psf live load without breaking. They'd be bouncy to walk on and would fail in deflection, but they might be OK for storing lightweight items. Three 2x8s would be better, but an even better choice would be doubled 2x10s. Increased height is always better than increased thickness for resisting vertical forces.

As far as fastening the crossmembers to the rafters is concerned, there are 30 pages of design criteria for fastening wood in my NFPA National Design Specification handbook. If I were preparing a formal design for an inhabited building, I'd do a thorough engineering analysis. But for modifying a barn roof to increase the headroom slightly (and for storage), I'd install a 2x10 on each side of every rafter. Knowing that the approximate shear value of a 16d common nail is 75 pounds, I'd try to put at least 10 nails in each face. I'd also use a pair of twist straps like the Simpson TS22 to attach the rafters to the cross beams.

When installing the new raised crossmembers, first make sure walls haven't spread and bowed out over time. If they have, try to draw them back in before proceeding with the alteration. Attach a cable and turnbuckle in the area of the bow and make it taut. Then remove the old 2x8 crossmembers to allow the wall to be cranked back into plumb. Finally, fasten in the new pieces and add steel straps to reinforce the rafter-plate connection.

Raising a Crossmember in a Roof

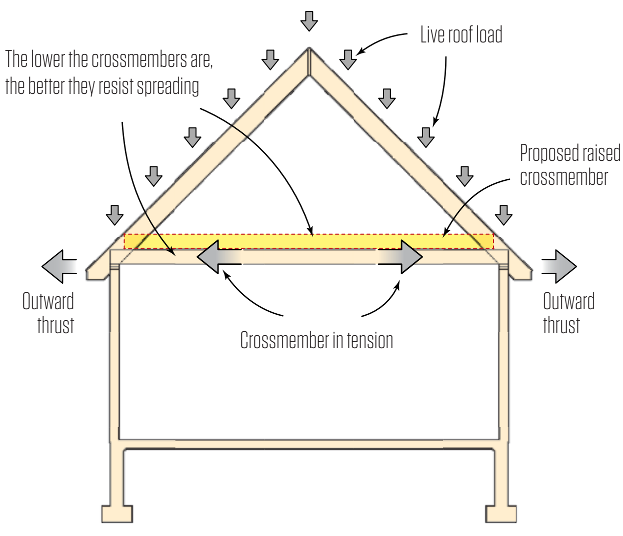


Illustration: Tim Healey

Q I'm replacing an exterior vertical door casing that has rotted at the bottom, but the header casing is still in good shape. Can I replace the vertical casing with PVC and not replace the header trim?

A Greg Burnet, a window and siding contractor based in Chicago and a presenter at JLC Live, responds: Though there's no issue with mixing wood and PVC trim, I can think of a few reasons for replacing all the exterior trim while you are at it.

First, if the door doesn't have a nailing fin, removing all the trim can give you access to the space between the jambs and the framing. On the doors and windows I encounter, this rough-opening space is rarely air-sealed or insulated properly. If you have access to that space, you should inject low-expanding spray foam designed specifically for use around windows and doors to insulate and create an effective air barrier around the door.

The second reason to remove all the trim is to make sure that the window or door is properly flashed. If there's no flexible flashing bridging the gap between the jamb and opening, I'd suggest installing 4- or 6-inch-wide peel-and-stick flashing tape on both the sides and head of the door. Use either butyl or acrylic tape (asphalt-based tapes should be avoided if they'll be in direct contact with PVC). Install the tape shingle-style, lapping it onto the jambs and rolling it to ensure a good bond.

With the door air-sealed and flashed, you can preassemble the new door trim. Preassembly makes for a faster installation, but more importantly, you can achieve tight, flush joints that can be reinforced mechanically with fasteners. Tight joints are important to the long-term success of an assembly, especially on an exterior. Trim joints that open up not only look bad but are also potential paths for water to enter the structure. With this in mind, replacing all the trim in your situation lets you glue the new PVC trim together with the proper cement. Once cured, that bond is usually stronger than the material itself, and the joints should stay tight for many years.

For fastening trim, I've had good luck with the Cortex system. The concealed fasteners look better and don't require messy fillers or sanding, which speeds the installation. Also, be sure to install a rigid metal head flashing above the head trim.


Primed for the toughest jobs.
Excellent hide and exceptional coverage has made KILZ® Primer the choice of professionals for over 40 years. Primer for doing things right.
KILZ.com
KILZ® GET STARTED
KILZ® 2
LATEX
primer | seal

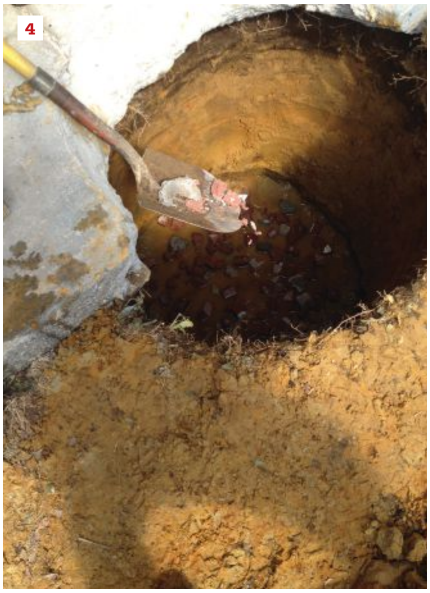
PERFECT FINISHES COME FROM THE RIGHT START.

Duckback wood stain beautifies and transforms wood structures as no other brand can, giving them a distinct and warm glow. Get results that everybody will notice.

SUPERDECK® WOOD STAINS

- Choose from transparent, semi-transparent and solid-color coatings
- Superior protection and water repellency
- Maximum UV protection
- Easy to use

1-800-825-5382 • WWW.SUPERDECK.COM



The new footings will straddle the existing slab, so part of it needs to be removed to allow access to excavate the holes. First, the author traces the footing's perimeter onto the slab **(1)** and removes the concrete using a jackhammer and sledge **(2)**. Then he digs the footing hole to its required depth **(3)**. Because of the high water table, the hole had to be pumped as it was dug. In the bottom of the hole, a layer of crushed stone will support the footing and keep the pump clear of the soil **(4)**.

Photos by John Simmons

Wide-Base Footings on A Wet Site

BY EMANUEL SILVA

On a recent job, I needed to demolish and rebuild the failing structure holding up a family-room addition. The support beams were rotten and the columns were in bad shape. Before I could proceed, I had to lift and support everything with house jacks and temporary beams. Then I took out all the old columns and dug out the seven original footings, which were much too shallow to offer adequate support for the structure above. At that point, I was almost ready to dig new footing holes. But first I needed to figure out how to handle the site's high water table.

RISING WATERS

To find the best solution, I arranged a jobsite meeting with my local building inspector, who had also run a successful foundation company in the past and was familiar with the local soil conditions. He told me to dig a few test holes the day before the meeting so we could see how much water seeped into each hole. As I dug them, I hit water about 3 feet down, and with the help of a pump, I finished digging to 4 feet, the required depth for footings in the area.

I protected the holes with plywood overnight, and when we met the next day, there was close to 16 inches of water in each hole. Drawing on his experience as a foundation contractor, he suggested a strategy for installing the footings: Use wide-base forms, and before setting the forms in place, pump out the water and add a few inches of crushed stone to the bottom of each hole. Then drop in the form and continue pumping water from the hole while filling the

With the base cut to the right size, a cardboard form is screwed to it **(5)**. The form height is measured from the beam above **(6)** and marked with a length of flashing tape **(7)**. A measuring tape and level position the form precisely in the hole **(8)**.

forms with a stiff concrete mix to a level above the water table. With the pump keeping the water out of the hole, the bottom of the footing could set properly without being weakened by the excess water. Then it would just be a matter of filling the forms the rest of the way, backfilling the holes as I went.

LAYOUT FOR THE FOOTINGS

Before I started laying out the footings, I gathered the materials that I'd need for them. For each one, I used a 28-inch-diameter Bigfoot base with a 12-inch-diameter Sonotube form secured to it. Each form required nine 80-pound bags of concrete, and I cut three 3-foot lengths of 1/2-inch rebar to reinforce each footing.

I started with the center footing of the seven that I needed to install. To locate the footing exactly, I first found the center point both in length and width of the beam overhead, and then drove a screw at that point. To the screw, I attached a length of masonry twine with a washer tied to the lower end to act as a plumb line. The washer added weight to the string to keep it from wandering back and forth.

I positioned the Bigfoot form below the center point with the twine hanging inside the form. To center the form, I measured the distance from the rim of the footing to the string and moved the footing until the measurements were the same in every direction. Then I traced the circumference of the form on the original concrete slab to give me an exact location for the hole **(1)**.

THE BIG DIG

Having some of the hole locations straddle the existing slab complicated the digging process. I started the holes by digging next to the slab and undermining the soil below it. Once I'd removed the soil to about a foot below the slab, I scored the outline of the base with a jackhammer, and then broke through it a little at a time, alternating between the jackhammer and a sledge **(2)**.

After breaking through the slab, I continued digging down into the clay and sandy soil **(3)**. The digging was pretty painless, but once I got down about 3 feet, water began to seep into the hole, making it tougher to dig. I dug down few inches, pumped out the water, dug a little deeper and pumped again. I continued alternately digging and pumping until I reached the required depth of 4 feet.

The bottom of the hole was tightly compacted clay and sand, but with all that water, the soil wasn't stable enough to support the footings. To remedy the problem, I added a layer of crushed stone to set the form on, as recommended by the inspector **(4)**. The stone would also elevate the pump, helping to keep it from sucking up loose soil and getting clogged.

With the excavation requiring so much attention, I realized that I'd have to dig and pour the footings one at a time to make sure the footings were installed properly. This took a lot longer than if I'd dug them all first and poured them in one shot.

BUILDING AND POSITIONING THE FORMS

Before digging each hole, I prepared the wide-base form along with the tube for the column above the base. Bigfoot forms come with graduated ring sizes to fit different diameters of tubes. After cutting the

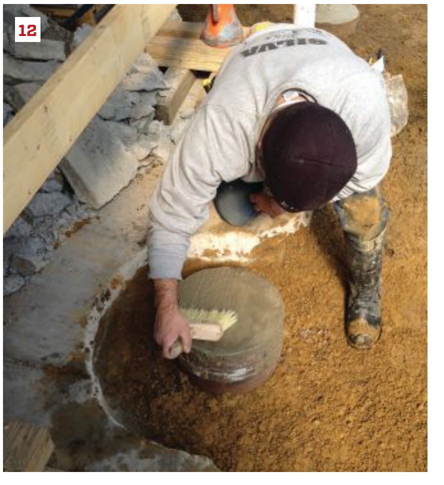
form down to the required ring size for the 12-inch tube, I fastened a section of tube to the base with screws **(5)** and set the assembly into the hole.

To keep all the footings at a uniform height, I had established a set distance from the bottom of the beam overhead to the top of the footing. I measured down and marked the height of the footing on the side of the tube **(6)**. I measured from the top of the tube and marked that distance at several other places around the tube. Then using a length of flashing tape, I drew a line to connect the marks and carefully cut the tube with a razor knife **(7)**.

POUR AND BACKFILL

The next step was repositioning the footing before the pour. I adjusted the location, using a level to plumb the tube. As before, I measured to make sure the masonry twine was in the exact center of the tube **(8)**. I also double-checked that the top of the tube was at the correct distance from the beam above.

On some of the holes, the water didn't seem to seep in as fast, so I was able to drop the pump inside the form to pump out the water while I mixed the batches of concrete. Following the inspector's advice, I mixed a stiffer concrete batch for the bottom section of the footing that would be in contact with the crushed stone and wet soil. Before shoveling in the first batch of concrete, I backfilled around the form to keep it in position while I filled the form with concrete **(9)**. As the pour progressed **(10)**, I added about a foot of soil at a time, tamping it down with a length of 2-by as I went.



A backfill layer keeps the form in place for the pour **(9)**. The form is pumped dry and concrete is placed **(10)**. When the concrete is near the top of the form, three pieces of rebar are added to strengthen each footing **(11)**. After the form is filled and the hole backfilled, the top of the footing is brushed even **(12)**.

Once the level of concrete reached above the water table, I used a looser mix, pouring the rest of the footing as I backfilled around the form. Before adding each new layer of concrete and fill, I checked my reference marks to make sure the form had not shifted.

As the concrete neared the top of the form, I realized that the top of the footing would end up being much lower than the existing slab, creating a place for water and debris to collect and shortening the life of the wooden posts I planned to install to replace the original columns. The owner was eventually going to replace the slab, but I wasn't sure when that would happen, so I decided to raise the height of the footings by adding on a short extension of tube. Lengthening the form would put the top of the footing high enough to avoid any problems.

Before pouring in the final lift of concrete, I sank three pieces of 1/2-inch rebar into the wet concrete to help strengthen the footing **(11)**. I kept the rebar 6 inches from the top of the footing so that it wouldn't interfere with the anchors for attaching the metal post bases.

I continued to fill the footing form to the top, letting the concrete overflow the edges a bit. I screeded the excess concrete even with the top of the form and let the water rise to the top of the footing. While the concrete was still wet, I brushed the top of the footing with a masonry brush, smoothing it and giving it a broom texture. Then I let the concrete in all seven footings cure for seven days before asking them to support the weight of the porch.

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


GOES ON FAST. MOVE ON FASTER.
THE HOME DEPOT
PRO
More saving. More doing.
WE'RE POURING MORE INTO PAINT WITH GLIDDEN® AND BEHR®.
FREE FACTORY TINTING AND COLOR MATCHING
SHIP DIRECTLY TO JOB SITE
UP TO 20% SAVINGS THROUGH PRO XTRA PAINT REWARDS
Homedepot.com/ProXtra
BEHR PRO i100
BEHR PRO i300
BEHR PRO e600
Glidden SPEEDWALL
MAGNUM
©2016 Home Depot Product Authority, LLC. All rights reserved.

1


2


3


4


PVC Miter-Fold Post Wraps

BY NATHANIEL ELDON

In the last 10 years or so, cellular PVC products have been a game changer for exterior trim. Like most products, PVC trim has advantages and disadvantages. As a carpenter, I don't love the material—I much prefer wood sawdust to plastic sawdust. And so does my wife—especially when I come home after working and the fine, white dust statically clinging to my clothing eventually finds our furniture. But dust notwithstanding, you can't beat PVC for its longevity and stability.

One trick that I picked up a couple of years ago while working with PVC trim is miter-fold post wraps. We do a lot of deck and porch work, so I'm often asked to wrap posts with finish trim. I'd heard of another contractor who was making his own miter-fold wraps, so I decided to give them a try. At first, I didn't know what to expect and went through the requisite trial-and-error period before working out the technique.

Each post wrap is a four-sided assembly made out of PVC sheet stock. Using a router, I cut V-grooves nearly all the way through the material to create matched 45-degree bevels, which then fold up to create 90-degree miters.

Although miter-fold post wraps are available commercially, I find it less expensive and more fun to make my own. One local company, Intex Millwork Solutions, makes them in several sizes, cutting the miter joints on a CNC machine.

WHY MITERS?

In my formative years as a carpenter, I was taught never to miter exterior trim, whether you're turning a corner with a fascia or wrapping a post. Even rot-resistant wood such as cedar will eventually cup and cause the joint to open up. Square-edge joinery was always a better course of action with any type of wood.

But with PVC, mitered joints seem to be a better choice. Because PVC doesn't cup or shrink much across its width like wood does, and because of the greater surface area of a mitered joint and the molecular bond of the glue, PVC miter joints stay together. And they're also less visible than square-edge joints.

Photos by Nathaniel Eldon


Custom beauty.
Off-the-shelf easy.
CPTZ
CBTZ
CJTZ
Simpson Strong-Tie® concealed connectors make it easier than ever to show off the natural beauty of wood post and beam connections. Whether you're building a custom outdoor wood structure or exposing interior framing, our off-the-shelf line of concealed connectors is fast and easy to install, and load rated for structural reliability.
To learn more, call (800) 999-5099 and visit **strongtie.com/concealed**.
SIMPSON
Strong-Tie
©2016 Simpson Strong-Tie Company Inc. CONCEALED16-C

LAYING OUT THE POST WRAP

On the project shown here, I wrapped nominal 4x4 porch posts to create a finished dimension of about 5 inches square. Instead of using thinner 3/8- or 1/2-inch stock and packing out the post, as I have done when finishing larger posts, I opted to use 1-by PVC material and apply it directly to the 4x4. I aimed to make the inside dimension of each side of the wraps 3 5/8 inches. (In hindsight, I should have made that dimension 3 3/4 inches. I ended up having to do a bit of on-site planing of the yellow-pine posts to remove some dimensional irregularities).

Knowing that the distance between the groove edges had to be 3 5/8 inches (the inside dimension of each side) and that the PVC stock was 3/4 inch thick, I could easily calculate the outside dimension of each side. That worked out to be 3 5/8 inches plus 1 1/2 inches (the width of a groove cut in 3/4-inch stock using a 90-degree V-grooving bit), or 5 1/8 inches. So I laid out the grooves to be cut at 5 1/8 inches on-center.

I make the cuts by running a router against a straightedge. To lay out the position for my straightedge, I first took into account the width of my router base. The 2.25 HP Bosch router that I use has a 6-inch base **(1)**. Then, I simply added half the width of the base, or 3 inches. This put the straightedge layouts at 3 inches, 8 1/8 inches, 13 1/4 inches, 18 3/8 inches, and 23 1/2 inches. I noted these numbers so that I could lay out the rest of the sheets that I'd need to make all six post wraps.

ROUTER SET UP

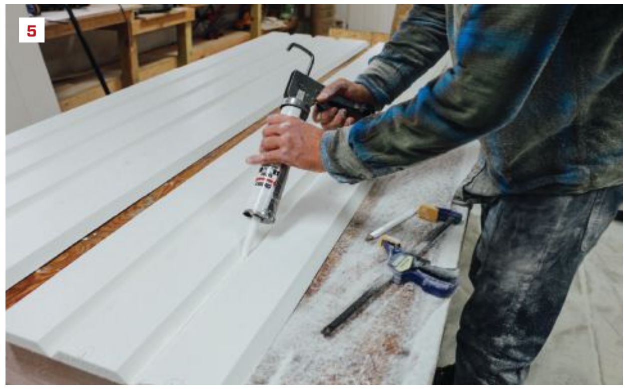
As mentioned above, I make the grooves for the miter folds using a 90-degree V-grooving bit. If you are going to make your own post wraps using a router bit, I recommend getting a large V-grooving bit with a 1/2-inch shank. The heavier shanks are much safer to use, and the cutter is large enough to make miter-folds in material up to 1 inch thick.

Before I start cutting the post wraps, I always check the depth of the router bit using some scrap of the material that I'll be working with **(2)**. Setting the depth of the cut exactly right is critical. The objective is to cut almost—but not completely—through the stock, creating a joint that is flexible enough to be folded by hand. I generally leave less than 1/16 inch of material. Held up to the light, the bottom of the groove is translucent. Once I've set the depth of the bit, I label and stow away the test scrap with the hope that I'll be able to find it the next time I have a similar job using that stock thickness.

CUTTING THE GROOVES

Routing PVC is dust-intensive, so I always wear protective glasses, and if I'm cutting a large number of sheets, I also don a dust mask—and sometimes even a Tyvek suit to keep my clothes dust-free and my wife happy.

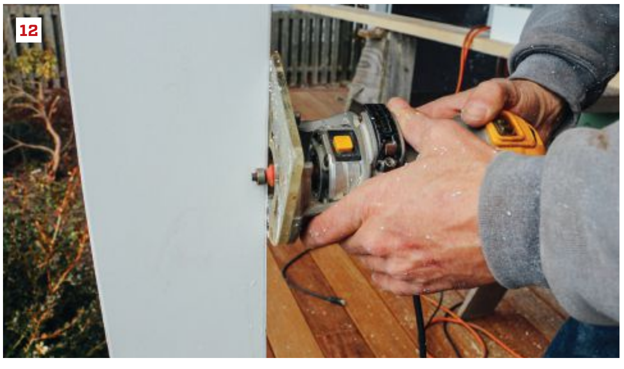
Once the router is dialed-in and the first sheet is laid out, I clamp the straightedge on the layout. Router bits always rotate clockwise, so keep the straightedge to the left of the router when cutting **(3)**. That way, the direction of the rotation pushes the router base




9


10


11


12

against the straightedge and keeps the router from walking away from the straightedge.

As I make a pass with the router, I make sure that dust doesn't build up between the router base and the straightedge. Any buildup can push the router away from the straightedge, leaving you with a groove and a miter joint that is not straight and true.

As with most carpentry projects, this process goes much more quickly and smoothly with someone there to help. I was lucky to have one of my carpenters, Justin Cline, available to give me a hand with setting the straightedge, tending the router cord, and sweeping off the dust between passes.

THREE-SIDED WRAPS

After I've cut the grooves, I carefully sweep the dust off the grooved sheets to get them ready for glue. Because we needed to wrap posts that were already in place, the most successful strategy was to install three-sided wraps, leaving the final side loose to be installed later. We sliced the sheets into sections of three sides by running a razor knife down the base of the appropriate groove **(4)**.

To glue the wraps together, I use Christy's Red Hot adhesive in caulking tubes. I squeeze out a bead of adhesive in the second and third grooves of my three-side sections **(5)**. Then I wait a couple of minutes. The adhesive actually heats up the PVC and makes the material in the groove more pliable.

After letting the glue warm up, I fold one side up to make the first miter joint, starting in the middle of the wrap **(6)**. The material sometimes makes cracking sounds, but it should stay together as long as I've made the groove the correct depth. After folding up the opposite side to make the second miter joint, I clamp the three-sided sections together using plywood blocks on the inside of the wrap to hold the assembly square **(7)**.

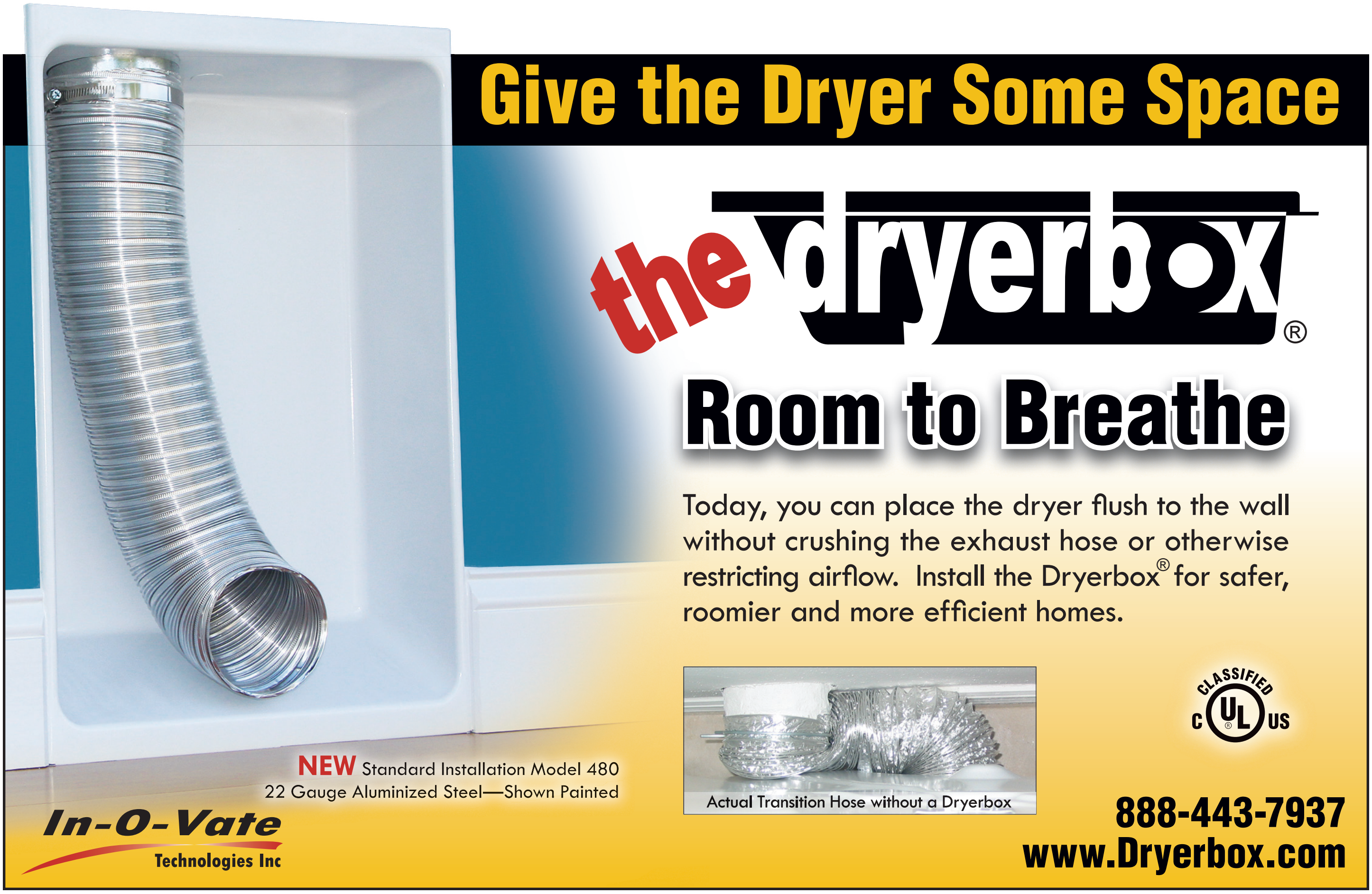
On that cold and nasty February day, we fabricated the wraps for all six posts in my warm shop and let them cure overnight. The next day, we broke down the clamp assemblies and ran a sharp chisel along the inside of the miters to clean off any excess adhesive that had oozed out. Cline cleaned up the exposed miters with a block plane to remove the small bit of material that was left by the router when the grooves were cut **(8)**.

INSTALLATION

Once the weather decided to cooperate, we headed to the jobsite to install the wraps. I started by sliding the three-sided assemblies onto all the wood posts. I'd covered the beam that supported the porch roof in PVC, making the bottom part $5\frac{1}{2}$ inches wide, which let the post wraps fit in nicely below.

I fastened the PVC assemblies to the posts with 15-gauge stainless-steel nails **(9)**. After running beads of adhesive down the exposed miters **(10)**, I fit in the last sides, fastening them with 18-gauge stainless-steel brads **(11)**. To finish up, I eased all the corners with a $\frac{1}{8}$-inch round-over bit in a mini-router **(12)**.

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


Give the Dryer Some Space
the dryerbox®
Room to Breathe
Today, you can place the dryer flush to the wall without crushing the exhaust hose or otherwise restricting airflow. Install the Dryerbox® for safer, roomier and more efficient homes.
NEW Standard Installation Model 480
22 Gauge Aluminized Steel—Shown Painted
Actual Transition Hose without a Dryerbox
CLASSIFIED C UL US
In-O-Vate Technologies Inc
888-443-7937
www.Dryerbox.com


BLUE BEAR®
NEW! Form Release for Wood
800GP
Concrete Form Release
BLUE BEAR is excited to announce 800GP, the latest concrete form release to our 800 series line of releases. Developed specifically for wood and general construction needs, 800GP excels at leaving a quality finish with little dusing on many varieties of wood (HDO, MDO, LDO, waxed forms, raw plywood, etc).
Compatible with:
• Wood
• Metal
• Plastic
• Styrene
• Urethane
• Fiberglass
Key Features:
• Biodegradable
• Highly Concentrated
• Non-staining
• Paintable surface
• Up to 2,500 sq/ft per gallon
BLUE BEAR
800GP
Concrete Form Release
For Wood Forms
And Metal, Plastic, Styrene, Urethane, & Fiberglass Forms
CONCENTRATED FORMULA
• Non-Petroleum Based
• Super Concentrated
• 100% Biodegradable
5 Gal (18.9L) MAKES 55 Gal (207.9L)
For more products and information
Call: 800.538.5069 or visit www.franmar.com
Made in the USA
Franmar®

BY MELANIE HODGDON

Unholy Trinity

One of my clients called recently to share a frustrating experience involving a customer and an architect, and I was reminded why many companies are moving to a design/build model. The scene sounded much like stories I've heard from other contractors; in this instance, my client (let's call her Jane) had actually introduced her customer to the architect, who was a relative newcomer to the area and someone Jane's company had not yet done business with.

Her tale is a tragedy in three acts.

ACT I

Initial conversation about general scope of work and budget range takes place.

- Customer is excited that her vision seems doable.
- Jane is excited about the project, which will nicely fill her schedule.
- Architect is not yet in the picture.

ACT II

Jane, the customer, and the architect meet.

- Architect begins to offer ideas, options, and recommendations (without tying these to costs).
- Customer gets excited and emotionally invested in the new ideas (without realizing the effect on the budget).
- Jane sees where things are headed and attempts to slow the process down by bringing up the unpleasant reality that the new stuff would increase the cost of the project, but she feels like she is raining on both the customer's and the architect's parades.

> Is it the contractor's job to manage the customer's expectations while educating them about cost considerations? Absolutely.

ACT III

The customer angrily pulls the plug on the project.

- Customer feels betrayed when she realizes that she can't afford what she's now emotionally invested in, and she blames Jane for bursting her bubble.
- Architect is frustrated that the project won't be produced but at least walks away with a fee.
- Jane is frustrated and disappointed that her relationship with the customer has gone south and that she's lost the job (which had already been put in the schedule), and wonders what she could have done to better manage the customer's expectations.

THREE DIFFERENT OBJECTIVES

So what happened? Let's look at what each party is hoping to get out of the experience.

Customer. The customer is trying to have her dream realized at the lowest possible cost. She hopes to get everything she wants (and more!) for a budget figure based on wishing.

Customers are highly susceptible to ideas offered by "experts" like architects and designers and can't be expected to know whether or to what degree changes will increase the budget. They don't have a clue about what things cost outside of what they may see on HGTV. To them, moving an already-framed window 4 inches to the right seems as simple as swapping out an ivory toilet for a white one. No biggie, right?

Architect. The architect is trying not only to meet the customer's stated requirements, but also to add flair, style, utility, and (often) evidence of his or her personal involvement in the project. Architects are artists and their ability to see opportunities can make a ho-hum project into something special.

Is it their job to talk about specific costs when introducing new concepts and additions? Not really. Many haven't a clue about what things cost. In fact, based on anecdotal accounts from my clients, I've concluded that any cost quotes from architects to customers are more in the line of, "Well, they should certainly be able to do this for $x per square foot," using numbers that are shot from the hip and that only succeed at setting the customer's expectations.

Contractor. The contractor wants to produce the job to meet the customer's stated requirements while also meeting code, using durable and reliable materials, making a target profit on the job, and fitting it nicely into the schedule. Is it the contractor's job to manage the customer's expectations while educating them about cost considerations? Absolutely. Sad but true, there's nobody else whose objectives include keeping everybody abreast of reality.

MANAGING EXPECTATIONS

Architects cannot be permitted to align themselves with the customer to the detriment of the contractor. That means you, the contractor, need to partner with your architects and train them to present the concept of "there's no free lunch" when offering new plans to customers—especially when you're not present in the meeting. This relieves you from being the bubble-bursting spoilsport and wet blanket. After all, it's hard enough to tell your customers how much that turret will cost without also being the one to break it to them that turrets add cost.

Melanie Hodgdon is owner of Business Systems Management (melaniehodgdon.com).

BY GARY BOYER

Dangerous Interactions

With the air-handler fan on, the author checks draft pressure in a water-heater flue. Having modified the ductwork earlier to solve air-pressure problems in the mechanical room, he's confirming that the water heater now drafts properly with a cold start. (Note: The device clipped to his shirt is a personal carbon monoxide detector—a smart precaution for anyone doing this type of work.)

Photos by Edge Energy

The company I work for, Edge Energy, does weatherization, home-performance contracting, renewable-energy contracting, and energy-code-compliance verification. As an energy auditor and the Director of Building Services for the company, I'm involved in the whole range of our projects. I'm certified as an energy auditor by the Building Performance Institute (BPI), and as a Home Energy Rating System (HERS) rater by the Residential Energy Services Network (RESNET). I conduct energy audits on existing homes, make recommendations for improvements, and manage the related weatherization work. I also manage more extensive insulation and air-sealing projects on new construction and home rehabs. (We often do that kind of work before passing customers to our solar division, to help get the homes closer to "net zero" when the alternative generation comes on line.) In addition, I'm responsible for our energy-code-compliance testing, and I certify new homes for Energy Star labeling. With this wide range of work in various stages of construction, I've been exposed to concerns with comfort, moisture, health and safety, and heating and cooling in both existing and new homes.

One of the trickiest problems for a non-specialist to grasp involves the interaction between combustion appliances and the heating and cooling ductwork in a home. In this story, I'll take a look at two examples where it took a little detective work to get to the bottom of a water-heater backdrafting problem. In one case, I was called in to troubleshoot by an HVAC contractor we work with, and in the other, I went to the house to conduct an audit for a homeowner who wanted help solving comfort issues and lowering energy bills.

In both cases, I immediately suspected that the air-conditioning ducts were the cause of the backdrafting problem; but in one case, there turned out to be another culprit.

CASE ONE: PROCESS OF ELIMINATION

When the HVAC contractor described this backdrafting water-heater situation to me over the phone, I was pretty sure I knew what I would find at the house. The basement had been recently remodeled, and there was a large return grille in the finished space

In the example shown at left, the author suspected a return air grille in the mechanical-room wall of backdrafting a water heater. But blocking the return with tape (top) had little effect. Measuring the pressure and airflow at the grille with an exhaust-fan flow meter (center), he found that the flows were appropriate. Next, he checked the room air pressure near the water heater itself, using a manometer (bottom; the probe going out the window allows a comparison between indoor and outdoor pressures). The pressure in the mechanical room was negative, causing a backdraft—until an exhaust fan in the kitchen upstairs was turned off.

connecting through the wall of the mechanical room, with a large, short run of duct straight to the air handler. I expected to find out, as I have in other, similar cases, that the oversized return was depressurizing the basement enough to backdraft the water heater.

To find out, I started by conducting a standard "worst-case" depressurization test. We measured the air pressures throughout the house. If a room had positive pressure, we closed the door to shut it off from the rest of the space. If it had negative pressure, we left the doors open. We turned on every fan that could create a negative pressure in the house: dryers, bath exhaust fans, and the recently installed kitchen downdraft vent. Under those conditions, the air pressure in the mechanical room dropped to -3.8 pascals (Pa)—and sure enough, the water heater began to backdraft.

Next, I tried to eliminate my chosen suspect: the return grille (see photos, left). I taped off the grille with 6-inch-wide tape from Energy Conservatory, expecting the problem to go away (this is the tape we commonly use for airtightness testing—it holds well enough, but you can pull it off without damaging paint).

But I was wrong. Basically, nothing happened: The water heater continued to backdraft, and the pressure in the mechanical room increased by only about 0.2 Pa.

So next I asked the HVAC contractor to go upstairs to the kitchen and turn off the downdraft fan on the range. "Don't tell me before you do it," I said. "Just do it, and I'll watch the manometer."

Sure enough, a minute or two later, the manometer reading changed to about -0.6 Pa. Of the -3.8 Pa depressurization, about -3.2 Pa was caused by the kitchen fan.

Still, I was glad I had gone to the trouble of investigating all possible causes, even if some turned out to be dead ends. The obvious solution when you have a backdrafting problem is to replace the natural-draft appliance with a power-vented unit. And in the end, that's what I recommended. But it was worth it to look more closely. If the duct return grille had been to blame, the problem could have been fixed by just reducing the size of the return in the basement, and perhaps increasing the size of the upstairs returns, which would have been a less expensive fix.

CASE TWO: OUT OF BALANCE

My second example was part of a typical home-performance job. The customers called us because they were uncomfortable in the house, and they wanted to add some attic insulation. But the first principle of home performance is "do no harm." So as always, I did a routine walk-through of the house to find out whether insulation and air-sealing could cause any kind of health or safety issue—or in particular, create a combustion safety situation.

And in fact, a worst-case depressurization test of the mechanical room did induce obvious backdrafting of the water heater. The photo on the facing page shows me using a smoke pencil to reveal the backdrafting, but it was also evident when I held a mirror next to the flue, and the moist exhaust fogged up the glass. In fact, I could feel the gas like a hot breeze against my face without any equipment at all.

In this case, the air-conditioning return

Here, the author checks another water heater under “worst-case” conditions and finds the unit backdrafting into the house (top left). In this case, ductwork was indeed the culprit. The air conditioner had not one, but two return grilles creating suction in the space (above): one outside the mechanical room door, and a larger one actually inside the mechanical room. In addition, the air filter for the unit was housed in a wide-open slot. Taping over the larger return grille and the filter slot (left) brought the pressures back into balance so that weatherization work could safely proceed.

ducts and grilles—the usual suspects—did turn out to be the root of the problem.

Because the supply registers in the house weren’t delivering enough heating and cooling (especially at the furthest reaches of the duct runs), the homeowners had sealed up the supply ducts in their basement with tape and mastic. But they didn’t know enough to seal up the return ductwork also—they didn’t realize that by sealing only the supply ducts, they were changing the air pressure in the mechanical room and creating a negative pressure that would affect the water-heater combustion vent.

It’s not clear who added a whole return grille to the system right in the mechanical room, when the return outside the mechanical room door would have been sufficient. But in combination, the two return vents created a suction that completely overpowered the natural draft in the water-heater flue.

It’s interesting that I was able to address these issues with materials that were actually sitting in the mechanical room, just a few feet from the problem. The homeowners still had some good-quality foil tape on hand and some mastic. I taped up the slot for the air filter with that tape—I find this to be a practical way to seal that component, and it’s easy enough for homeowners to change the tape every few months when they change the filters. (You can even write the date on the tape with a felt marker as a reminder to change the filter when it’s time.)

I had taped over the return grille with Energy Conservatory tape as part of my pressure testing, and I advised the homeowners to make that fix permanent with the same tape and mastic they had used on their ducts (and to seal the return ducts too).

This still leaves the homeowners with supply ductwork installed in the 1940s that doesn’t deliver enough heat or cooling to their rooms. I recommended an Aeroseal job: a thorough cleaning, followed by sealing the entire duct system with latex aerosol blown into the ducts. This provides air-quality benefits as well as energy savings, and it’s pretty much the only way to seal this home’s duct system, which is mostly inaccessible. But an Aeroseal franchise would charge a couple thousand dollars to do the job, and this customer may choose to apply only envelope air-sealing and insulation upgrades.

Gary Boyer is Director of Builder Services/Energy Auditor at Edge Energy, in Beltsville, Md.

BY TED CUSHMAN

Photos by Tad Garbacik

Testing House Tightness With a Duct Blaster

As a HERS rater working in western New York, Matt Bowers is well acquainted with blower-door testing. Since he started working for Airtight Services (Marion, N.Y.) in 2009, Bowers has tested a lot of houses for air leakage—some of them for Energy Star verification and others just to meet the New York state building code.

But Bowers is also a certified Passive House consultant, and when he started to design his own house, he made up his mind to shoot for Passive House certification—and the Passive House standard for airtightness is much more restrictive than the Energy Star standard or the building code. The Energy Star standard in effect in New York state requires a house to test at 3 air changes per hour at 50 pascals (3 ACH50); the New York building code, when Bowers started his house, allowed 7 ACH50, he said, although the state's new code, which takes effect this summer, will match Energy Star's 3 ACH50 limit. But the Passive House airtightness spec is 0.6 ACH50—five times tighter than the new code or Energy Star. So Bowers knew that building an airtight shell was going to be a critical issue for his Passive House project.

On the phone with *JLC,* Bowers described the air barrier and superinsulation strategy for his 2,800-square-foot house. "It's a double-stud-wall assembly," Bowers explained. "The interior 2x4 stud wall is load-bearing, and that wall frame is sheathed with the Zip System. Then we have 8 inches of cellulose, and another 2x4 insulated wall over that. So the overall thickness of the insulated wall is 16 inches, and the air barrier in that double wall assembly is the Zip sheathing on the exterior side of the interior load-bearing wall." The exterior 2x4 wall's drainage plane is ProClima Solitex Mento membrane, which allows the dense-pack-cellulose insulation in the wall to dry readily to the exterior. Meanwhile, the airtight Zip sheathing is located well toward the conditioned interior of the house, largely eliminating any risk of vapor condensation on the Zip face in winter.

Following the advice of the Passive House community, Bowers decided to test his enclosure for airtightness at various stages of construction, starting when the interior load-bearing wall was complete, but before windows or doors were installed. "That way, if we got a large jump in blower-door numbers between one test and the next, we would know where to look," he explained. If the house got leakier after he installed the windows, for example, he would know that the windows, the way they were installed, or both, were the source of the new leaks. And if the wall itself turned out to have leaks early on, Bowers would find out while the structure was still accessible for repair.

But for his first tests, with the door and window openings sheathed over and no doors or windows installed, Bowers had only one opening for placing his test fan: a basement window hole that was too small to hold a standard blower door. That's when Bowers decided to use a Duct Blaster fan instead. "So for our first couple of tests, we taped the Duct Blaster to a sheet of rigid foam insulation over the basement window hole, and the foam board was foamed in place with the one-part fire-rated foam," said Bowers.

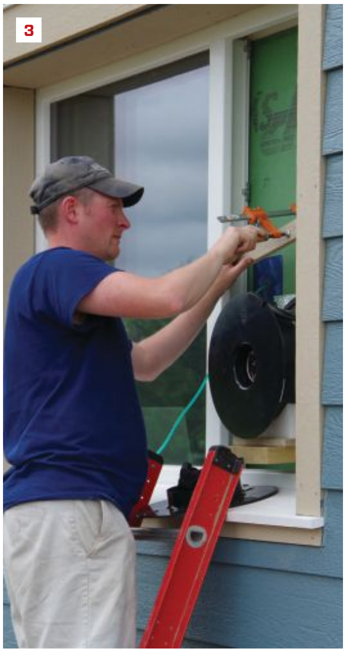
As the job progressed, Bowers installed a window in the basement opening, along with the rest of the home's doors and windows. But the operating doors in the main walls were too large for a standard Minneapolis Blower Door's telescoping framework. So Bowers stuck with the Duct Blaster, crafting a custom testing assembly from a scrap piece of Zip sheathing and some other handy materials. He made his Duct Blaster frame to fit a window unit that he had installed in six places, so that he would have a choice of test fan locations.

On his first test, Bowers was hoping to score well below 0.6 ACH50. But his results far exceeded those expectations. "The first test came back at .15 ACH50," he said, "and to be honest with you, I thought it might be a mistake. I was concerned that we had set the test up wrong, because I had never done a blower-door test with a Duct Blaster. So I talked to Energy Conservatory, which

1

2

3



Matt Bowers tapes off the air inlet for a Zehnder energy-recovery ventilator as he prepares to test the house for airtightness (1). Here he applies foam weatherstripping to the airtight membrane face of his custom blower window assembly, made with a scrap of Zip sheathing (2). The mounting ring for the Duct Blaster fan is already attached to the Zip frame, as is a D handle for pulling the rig tight and clamping it in place over an installed window. A small Pro Clima gasket is attached to the face of the assembly to allow air-pressure lines to be easily fed through and sealed in place, and Velcro strips are attached to the door that will serve to hold the manometer during testing. Bowers clamps the blower window rig in place in preparation for a house pressurization test (3). For a depressurization test, the rig is flipped around and clamped against the outside face of the window frame, working from inside (see photo, page 37).

4

5

For confirmation, Bowers runs a standard blower-door depressurization test using a Minneapolis Blower Door instead of a Duct Blaster **(4)**. The blower door was too small for the door frame, so Bowers extended the door shroud using painter's tape. Because of the very low airflow required to pressurize the very airtight house to the standard 50 pascals, Bowers equipped the fan with the D ring (available by special order). To meet the Passive House airtightness spec, Bowers needed airflow to be 250 CFM50 or less; 1,940 CFM50 would qualify the house for the Energy Star label. A closeup of the manometer shows the blower-door-test data: about 50 CFM50, 38 times tighter than Energy Star **(5)**.

supplied the device, just to be sure that everything was set up right. And they verified that the setup was correct."

That first successful test didn't leave Bowers with a punch list—everything seemed to be fine. He ran another test after installing windows and doors, and again after installing air ducts and lines through the envelope for the Zehnder energy-recovery ventilator and a pair of Mitsubishi heat pumps. "And it was funny," said Bowers, "but—everything I had read said, 'Your tightest blower door is going to be the first one that you do, when there are no holes in the system.' But not us—the more holes we made, the tighter it got." Bowers gives credit to the project general contractor, builder Tad Garbacik: "I would not have been able to achieve these results without him."

As the house nears completion, Bowers is continuing to test. In June, he ran another Duct Blaster test, as well as a standard blower-door test (using extra tape to fit the blower door into the building's oversized door). At 50 pascals of pressure, airflows measured from 50 to 65 CFM—about $2\frac{1}{2}$ square inches of equivalent air leakage area, Bowers calculated. It's hardly worth worrying about, but Bowers said there were a few things to keep an eye on: "We've got temporary holes for temporary power outside. We've got plumbing that hasn't been finished yet. We've got windows that need to be opened and the frames need to be wiped clean because of construction dust." Still, with results this good, Bowers is into the zone where the test apparatus itself may be responsible for most of the air leakage. "Making sure that the compression on the gasket was tight to the window, and everything was taped and sealed," he said, "that's where we actually spent most of our time."

Ted Cushman is a senior editor at JLC.


DEWALT

Habitat for Humanity®

Be part of

Habitat for Humanity's 2017 Home Builders Blitz

June 5-9, 2017

Every year, builders nationwide come together to build, renovate and repair hundreds of Habitat homes across the country. Habitat homeowners pay an affordable mortgage and, thanks to the commitment of builders throughout the week, can build the strength, stability and independence they need to create a better life for themselves and their families.

#HomeBuildersBlitz
habitat.org/homebuildersblitz


GIVE YOUR BUSINESS MORE HORSEPOWER.
Get the most powerful training tool in the business.
JLC's Digital Field Guide is the most comprehensive, trusted skill training and best practices resource for pros in the residential and light construction industry. Give your business the boost it needs—more projects. More profit. Add the JLC Digital Field Guide to your toolbox today. Subscribe to the JLC Digital Field Guide today. jlconline.com/how-to
JLC
FIELD GUIDE

Repairing Stone Patios Over Living Space

Thorough waterproofing is essential for a leak-free job

BY DOUG HORGAN

Photos by Doug Horgan/BOWA

Low-slope roofs present a particular problem for drainage and waterproofing, especially when they intersect with an upper-story wall. If the roof is not just a roof, but also a walkable deck, the problems can be compounded. And a heavy stone or tile patio that is also the roof over an occupied space may be the trickiest problem of all.

In a previous issue, I discussed a case where we had to diagnose a leaking patio roof ("A Leaking Patio Above Living Space," Jun/16). But in that example, my company didn't have to repair or rebuild the patio; instead, the owners opted to cover the whole area with a new enclosed room covered by a conventional roof.

In this story, I'll look at a couple of other examples, where leaking rooftop patio surfaces had to be completely removed, re-waterproofed, and re-paved. The jobs included removing and replacing the masonry or stucco wall coverings at the bases of the adjacent walls. Along the way, our crews had to rebuild the waterproofing details at the intersections of the patios and the walls, replacing old, leaking systems with a more effective method.

In the example shown under repair in the photo above (and also on page 49), the original patio had flagstones set in a mortar bed on top of an 8-inch reinforced concrete slab, which in turn was supported by basement foundation walls at the ends, and steel I-beam girders in the middle. In the example shown on pages 45 through 48, the slab was supported by a steel structural frame and corrugated steel pan forms—again, topped by a mortar bed and flagstones.

In each case, the slab continued all the way to the home's framed walls, and the masonry cladding for the house walls rested on top of the slabs; then the mortar bed and flagstones were laid butting up against the masonry wall claddings.

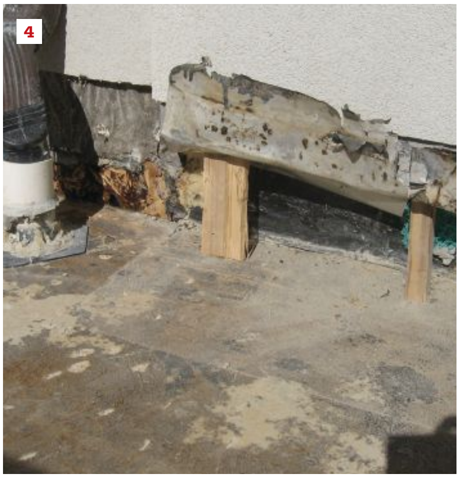
At those complicated intersections, the waterproofing and flashing details require considerable thought, careful planning, and careful execution. The drawing on page 48 and the photo above show our preferred way to handle this condition, and reflect how we repaired each of these wall-to-roof intersections. But that's not what we originally found when we tore each example apart.

With the stone pavers removed, the crew conducts a test for leaks, focusing on the critical locations where the patio meets the house wall. They build a low dam using strips of foam caulked to the existing waterproofing, and flood the roof edge **(1)**. After observing leaks at the wall joint, the crew strips away a portion of stucco and the lowest course of concrete masonry to reveal the flashing and waterproofing, supporting the block wall with pieces of 2x4 **(2, 3)**. The joint where the rubber roofing met the masonry is seen to be compromised, and aluminum flashing behind the block is corroded and leaky **(4)**.


1


2


3


4

INVESTIGATION

In both cases, the leaks weren't the only reason for us to be there: The homeowners wanted to replace their stone or concrete-paver patios anyway. But there was evidence of leaking in the rooms below each of the patios (in one case, a ground-level garden room, and in the other case, a garage and occupied room in the home's walk-out basement level). So we also had to figure out the cause of the leaks, and fix it.

In the case shown on this page, we removed the stone patio, mortar, and dimple-sheet drainage board (which left little circles all over the bitumen-sheet waterproofing). We could not see weeps or flashings in the masonry veneer on the walls, so we tested the intersection of the wall and terrace with water: We built a little dam near the wall, gluing strips of foam insulation to the roof membrane with adhesive caulking. Then we added water with a garden hose to create a shallow pool by the wall, and checked for leaks below the roof. Sure enough, water began to drip from the ceiling in the room below.

Next, masons removed the lowest 12 inches or so of masonry (4-inch block with a stucco veneer) and temporarily supported the block walls with short pieces of 2x4. The previous contractors had applied waterproofing to the flat concrete sub-deck,

To create a waterproof seal, the crew applies Henry 790-11 Hot Rubberized Asphalt across the entire deck, continuing the asphalt coating up onto the wall. Before applying the coating, workers first make a fillet of flexible caulking at the joint to ease the corner and relieve strain **(1)**. Next, they roll the hot asphalt onto the wall and the deck edge **(2)**. A layer of reinforcing fabric is set over the hot material, then a second layer of coating is applied, embedding the fabric into the rubberized membrane **(3)**.

then a piece of coil stock flashing was placed on top and bent up the wall. Housewrap on the wall was tucked behind this flashing instead of in front as it should have been, but that probably didn't matter—because water was free to run across the waterproofing and into the wall underneath the aluminum flashing. Also, aluminum flashing will corrode in contact with masonry. That process was well underway in exposed areas.

STARTING OVER

Our next task was to re-waterproof the concrete deck. We removed the old waterproofing and applied a "cant strip" of flexible sealant in the inside corner of the wall for strain relief.

Next, the crew applied Henry's recommended primer, then two coats of the hot rubber, with a layer of polyester reinforcing fabric laid down between coats. This product makes a thick, heavy coating. A couple of commercial contractors I know think it's the most reliable waterproofing on the market, and we haven't had any issues on the few jobs where we've used it.

Different waterproofing materials have different recommended methods for plane changes, corners, and other details; we always download the instructions and refer to them as we work. But generic details can't cover every situation that we may find in the field, particularly in a repair situation.


8


9


10

Railing post bases are a common source of leaks in a rooftop patio. One typical practice that can create a leak point is to drill holes and set anchor bolts after waterproofing is applied, penetrating the waterproofing. The author's preferred method is to set the bolt in the concrete before waterproofing **(8)**. Next, the metal-post base plate is connected to the bolts. **(9)**. A coat of primer is applied to the metal and the concrete, and finally the reinforced rubberized asphalt is applied over the post base for a robust waterproof seal **(10)**.

So we usually have to make judgment calls on a case-by-case basis, relying on our experience and the expertise of our subs. For the jobs discussed here, a lot of the design and all the repair work was provided by Ev-Air Tight, Shoemaker Inc. (Riverdale, Md.), one of our trusted trade partners.

POST DETAIL

Railing mounts are a typical trouble spot on a masonry patio. For a patio on grade, railing companies often come to the job after pavers are installed and drill holes through the pavers into the concrete, then cement the rail-post bolts into the holes. That's not a problem if there's nothing under the patio but ground. But if they do that on a waterproof roof deck, it will make a hole in the waterproofing, and there will be a leak into the space below.

When you need to preserve effective waterproofing, one good approach is to mount the railing posts before doing the waterproofing, or at least set pins for mounting the posts. That's what we did in this case (see photos, right): The crew set stainless steel bolts into the concrete, then mounted the post bases in place, before applying Henry primer and two coats of rubber to the deck.


11


12

13

The rubberized asphalt membrane is applied hot, and splashes or drips will stick to anything and are a hassle to clean up. At left, the crew has protected the masonry rail posts with poly **(11)**. Over the reinforced membrane, the crew lays a dimpled plastic drainage sheet with filter faces, then builds up a mortar bed reinforced with galvanized wire mesh **(12)**. Finally, they set new stone pavers into the wet mortar **(13)**.

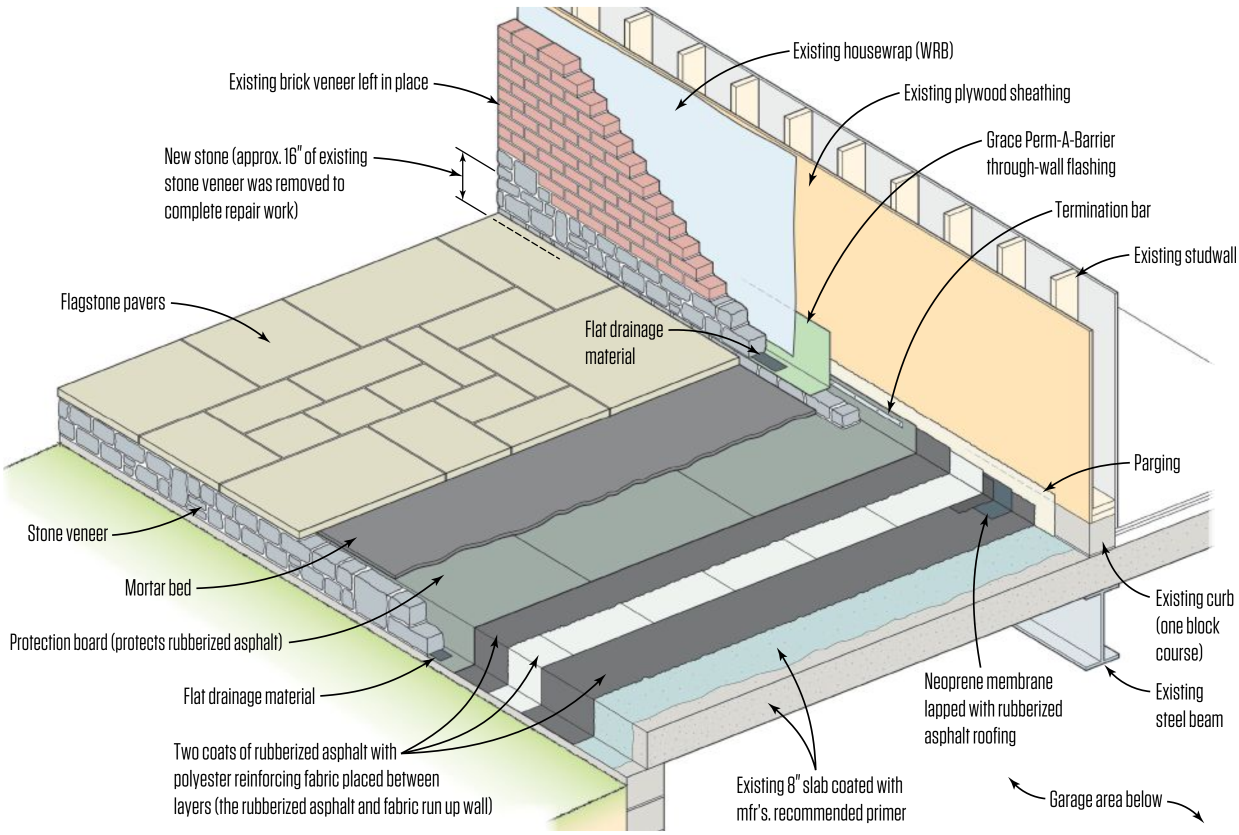
MORTAR BED AND PAVERS

Before setting the new limestone pavers in mortar, the crew rolled out a dimple-sheet drainboard with a filter facing. Many different vendors supply a suitable product for this application; we typically use MiraDrain from Carlisle Coatings and Waterproofing (carlisleccw.com), because it's easy to find in our area.

This material creates a drainage space below the stone, giving water free-flowing access to leave the assembly. That reduces the risk of freeze-thaw damage in the stone and mortar, and reduces pressure on the waterproofing. With free drainage, only a tiny amount of water can accumulate on top of the waterproofing, so there is never much head pressure to push water through any flaw.

Next, the masons placed a setting bed of dry-pack mortar, embedding a galvanized wire reinforcing mesh in the center of the mortar bed. Then they mixed a batch of thin, more-fluid mortar, spread that thinly over the dry-pack, and set their pavers in place. Dry-pack forms a strong base, and the more-liquid mortar serves to bond the stone to the dry-pack bed.

Patio Waterproofing Over Basement Garage



Protection at the transition. In the author's preferred detail, fiber-reinforced rubberized asphalt membrane extends from the slab up onto the wall sheathing, with neoprene rubber flashing embedded in the hot asphalt at the corner. Protection board on the patio also extends up the wall and is secured with a mechanically fastened termination bar. After the base course of masonry is set, a through-wall flashing and weeps are applied to direct moisture from the wall masonry out to daylight.

A BEST-PRACTICE DETAIL

Our company has multiple crews working in the field on a wide range of building and remodeling projects. As a large company, one of our challenges is to create a common knowledge base across all of our crews, so that the whole company can benefit from the lessons each crew has learned on the job. Building and sharing that knowledge base is a big part of my job at BOWA.

The drawing above depicts the typical solution that we've developed over time for masonry paver decks over living space, based on the recommendations of materials suppliers combined with our own experience on site.

The joint between the wall and the concrete slab is the critical point. Ideally, we address that situation with the dual-flashed assembly shown above. The reinforced fluid-applied waterproofing adhered to the concrete slab extends all the way to the pre-primed wall and laps up onto the wall, secured with a termination bar that will hold the material even if adhesion fails. Dimpled drain board or a fiber protection board—or both—improves drainage and protects the waterproofing.

A base course of wall masonry is laid on the waterproofed slab. Next, a through-wall flashing membrane is applied to the top of that base course and lapped up onto the wall. The wall's weather-resistive barrier (WRB) is lapped down over the flashing. Then more courses of masonry are laid, with weeps provided for drainage above the through-wall flashing.

With this assembly, water in the wall cladding is directed out of the wall onto the surface of the patio. The waterproofing beneath the patio, extending up onto the wall, provides a second line of defense.

The photos above show the retrofit sequence for a grade-level patio over a basement and garage space. Hot-applied rubberized asphalt is applied to the concrete deck and lapped up onto the primed plywood wall sheathing **(14)**. A course of protection board is laid over the waterproofing **(15)**. Flashing membrane is applied to the wall as a backing for the new stonework **(16)**, then a base course of stone is set against the flashed wall (see photo, page 43). Another through-wall flashing is installed before upper courses of stone are laid (leaving weeps that allow the wall to drain). Finally, new pavers are set into a fresh mortar bed **(17)**.

PITCH AND PROTECTION

In the example shown above (and in the photo on page 43), the patio is located at grade, but it's not sitting on the ground—it's over occupied space. The room at the back of the patio is built over a basement-level garage, which extends past the room on both sides, so there is a 10-foot patio over the garage on either side. Like our earlier example, this patio was leaking into the space below because of ineffective waterproofing and flashing at the patio-to-wall juncture.

So our replacement of the flagstone patio, again, had to include a reworking of that intersection. In photo 14 above, the crew has taped back the housewrap, primed the plywood wall, and applied rubberized asphalt to the slab and up the wall. Next, they laid down sheets of fibrous protection board, which allowed the masons to rebuild the wall masonry without getting themselves covered in the soft, sticky asphalt, and then to pave the patio without damaging the waterproofing.

The masonry detail at the wall base includes two layers of fully adhered flashing. Before the base course of stone was set, masons applied a peel-and-stick membrane to the wall, lapping it onto the hot-applied asphalt. After setting the base course, they installed a through-flashing membrane over that course, lapping up under the WRB.

This relatively small patio had a good pitch, and so we decided it would be safe to omit the layer of dimpled drainage sheet. So in this case, the masons installed their mortar bed directly on the protection board.

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

Hanging Pre-Hung Interior Doors
Stay organized and keep a production mind-set

BY JOHN SPIER

Interior doors are often taken for granted, but they are crucial to the overall quality of a home. Well-installed doors open and close smoothly and stay open when you want them to—and should be able to withstand the occasional teenage or matrimonial slam!

CHECK THE FRAMING

Interior door installation starts with the framing. Rough openings need to be the right size, in the right place, and framed with good stock. Each opening should be plumb, level, and in plane with itself and the surrounding wall. Trimmers need to be square in the opening and securely nailed, as well as exactly flush with the adjacent king studs to keep the wall thickness consistent. You can always hang a door in a bad opening, but it will take longer, and trimming the door neatly will be a challenge.

Good house plans call out the sizes of all interior doors, and some provide a schedule of rough openings. I always check the plans carefully, verifying that each door will fit with enough room left for trim, light switches, structural columns, and other details. I also verify that the opening height works with any special issues (such as the radiant subflooring heating used in the project shown here).

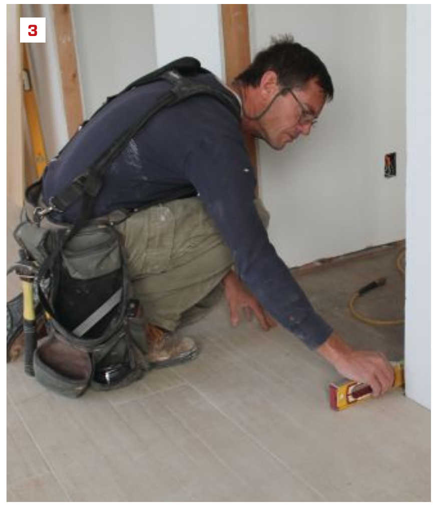
After the house is framed and all systems are roughed in—but before wall finishes are installed—I check every opening with a long level. Often, framing lumber will have bowed or twisted, or a plate will have shifted, or I'll find some other problem that I can fix now to save myself trouble later. While I'm doing this, I also label every opening with the door's nominal size and handing. For the benefit of the sub-tradespeople, I mark the hinge side and draw an arc on the floor to indicate swing direction.

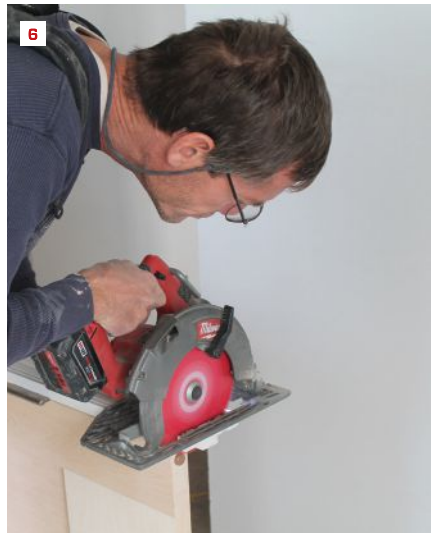
ORDERING DOORS

The order for pre-hung doors starts with a master list. I give each door in the house a number or letter, and to avoid mix-ups, I also include its location in the house. I generally start by listing general specifications: slab type and finish, jamb material, style and thickness, hardware, and so on. Often, individual doors will have specific differences, so the general spec will be followed by "except where noted." Then each door is listed with information about it: size (height and width), handing, hardware prep, and any differences from the standard specs. Some suppliers will send a sales rep out to make the list for you, but I prefer to make my own.

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

Photos by Rick Luck





Check the rough openings

Start each door with a final check of the opening, making sure that the door will fit and that there's nothing unusual to contend with. If door location within the opening is critical—to center it in a space, for example, or to align it with another component—note what its exact position needs to be. If there are other doors nearby, check the overall level of the floor to make sure the head jambs all line up **(1)**. Next, check the floor across the doorway for level **(2)** and under each jamb to make sure the opening is perpendicular to the floor **(3)**. If the floor is sloped or stepped, adjust the jamb cuts for the best fit.

Measure and cut the jambs

Jamb-leg length is strictly a function of the door-slab height and the clearance that's needed above the floor or threshold. In most houses, the height of the jambs rarely varies. Ideally, leave 1/2 to 1 inch of clearance between the top jamb and the header framing to allow for settling and to let the casing bridge slight differences between the jamb and wall finish.

During the initial steps of cutting and fitting, keep in place the temporary fasteners that hold the door slab in its jamb. To cut the jamb legs, roll the unit onto one edge. Then measure the jamb leg **(4)**, mark it **(5)**, and cut it to length **(6)**. Flip the unit onto its other edge and repeat the process. Check to be sure that the hinge screws haven't come through the back of the jamb; they can quickly ruin a finished floor.

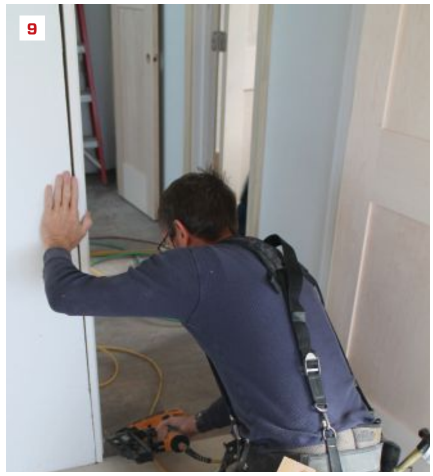
Level the door slab in the jamb

With the door slab still secured in its jamb, stand the unit up in the opening and make sure the head jamb is perfectly level **(7)**. If it's not level, set the door down again and trim the appropriate jamb. When the bubble is dead center, release the temporary fasteners holding the door in its jamb, and set the unit in the rough opening. Unless you've noted differently, center the door in the opening and secure the hinge jamb just above the top hinge with a couple of shims and nails **(8)**.

To anchor the assembly in the opening, shoot a single nail through the jamb at each of the other three corners **(9)**. Then shim and nail the rest of the hinge jamb. Rather than using a level to plumb the slab, insert shims behind the bottom of the hinge jamb just below the hinge **(10)**. Adjust the shims until the margin between the door slab and head jamb is perfect across the top **(11)**. If the head jamb is level, then the door should be plumb, but double-check it with a long level. When you're happy with the fit, drive a couple of additional nails to secure the bottom of the hinge jamb. Then shim and nail just above the middle hinge to make sure the jamb stays straight.

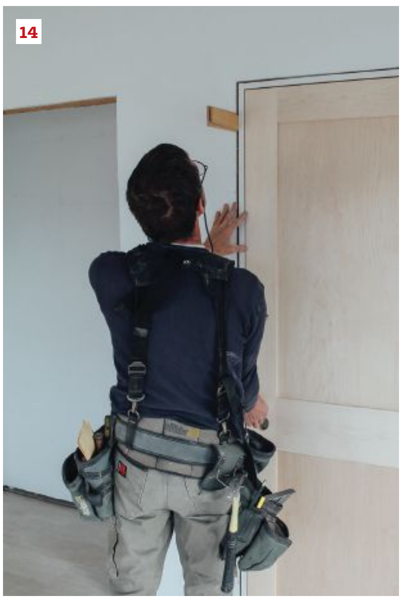

7

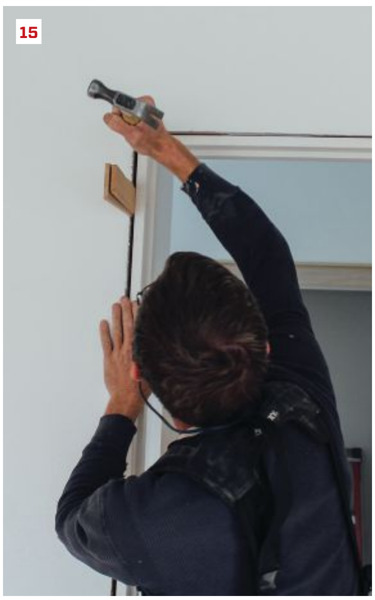
8


9


10


11





Fine-tune the rest of the fit

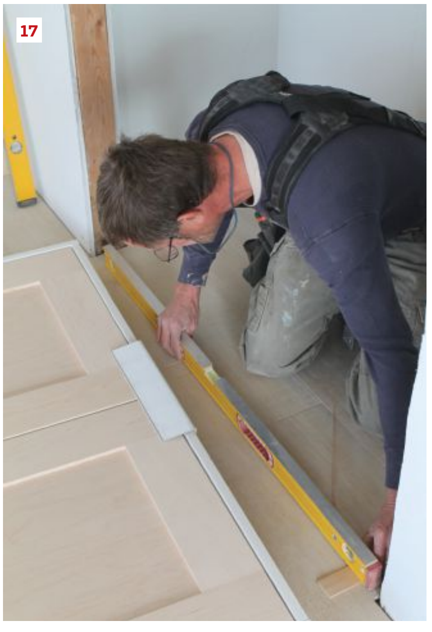
When the hinge jamb is straight and secure, turn your attention to the strike jamb. Starting at the bottom, adjust the jamb in or out to keep an even space between the door slab and the jamb **(12)**. Once that space is even, insert shims between the jamb and the framing close to the floor, and snug them in place before nailing through them. At the top of the strike jamb, insert shims just below the head jamb **(13)**.

Next, check to make sure the door is hitting the stop evenly **(14)**. If it's not, give the jamb a gentle tap until it's perfectly even **(15)** before securing the top with additional nails. Finally, shim and secure the middle of the latch jam just above the striker location. When finished, the door should open and close smoothly, show a perfect margin all the way around, and hit the stop evenly with a satisfying solid clunk.

To make shims, rip stacks of shingles into 2-inch to 3-inch widths. Insert the same number of shims from each side, except to make up for twisted framing. When each door is hung, cut the shims flush with a utility knife or multi-tool **(16)**.

Double doors: Cut and set up

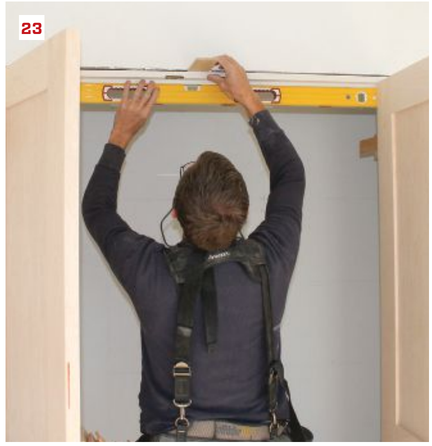
Double doors are trickier to hang than single doors, but the basic process is the same. With the double door shown here, the floor was out of level. Placing a shim under the level showed how much had to be added to the jamb leg to make the head jamb level **(17)**. That amount was added to the measurement of the longer leg **(18)** and then both jamb legs were cut **(19)**. As with a single door, the unit was set in the opening—this time with the temporary fasteners removed—and the head jamb checked to make sure it was level **(20)**.

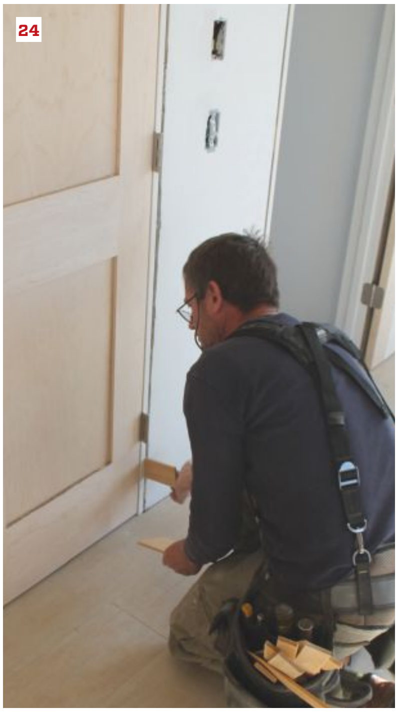

17


18

19


20





Double doors: Tweaking the fit

To hang double doors, instead of starting with a set of shims on one side, swing the doors open and shoot a single 2 1/2-inch 15-gauge finish nail through the jambs at each of the four corners **(21)**. These nails hold everything loosely in place and let you adjust the jambs as needed. Next, shim the top of each side jamb, centering it in the opening **(22)**. Shoot only one nail through the shims—it's important to be able to shift the jambs slightly to align the door. At this point, shim and nail the top jamb, using the edge of a level to get the jamb perfectly straight **(23)**. Don't nail through the head-jamb shims though; those shims will be removed later after casing is installed on one side. Then, the header framing can't push on the door jamb if it settles in the future.

With the top of the frame secure, shim and adjust the side jambs **(24)**, making sure that the gap between the doors and head jamb is even; the top corners of the doors are level with each other; the center gap between the doors is even **(25)**; and the door slabs are in the same plane when fully closed. This last part is done by tapping all four corners in or out slightly with a block **(26)**. Once everything is aligned properly, shim and nail the rest of the jamb securely.


Make a Splash
Our new stainless-steel screw for composite decks.
Simpson Strong-Tie now offers a stainless steel screw that provides better options for building decks in corrosive environments. With no predrilling needed, Deck Drive® DCU Composite SS screws are easy to install, finish clean and perform in all types of composite materials. Offered in Types 305 and 316 stainless steel as well as the original 11 carbon steel colors, the DCU helps protect your workmanship and your customer's investment, even when the project is next to a pool or lake or along the ocean.
The DCU is the go-to screw for composite deck construction. To learn more, call (800) 999-5099 or visit strongtie.com/dcucomposite.
SIMPSON
Strong-Tie
®
Photograph is for dramatization purposes only and screws should not be submerged in water. ©2016 Simpson Strong-Tie Company Inc. DCUSS16-D

A Path to Safer Balconies

These tricky cantilevered structures demand careful framing and waterproofing details

BY CHARLES BICKFORD

Photo: Lenny Gillis

On June 15, 2015, a group of 13 students in Berkeley, Calif., fell five stories when the balcony they were standing on suddenly collapsed. Six were killed, seven were critically injured, and the incident became the latest example of the often-fatal consequences of poor building practices. The 4-foot-5-inch by 8-foot-10-inch balcony wasn't overloaded; it was designed to support combined live and dead loads of more than 100 lb. per square foot (the code requirement at the time it was built). Subsequent investigations revealed a number of problems, however, including a leaky walking surface and a non-ventilated deck soffit that trapped water inside the deck frame, causing the engineered (but not pressure-treated) wood framing to rot.

It's a sobering lesson for any builder who thinks a balcony is basically a cantilevered deck. Unlike a deck, which is supported by a ledger and a system of posts, beams, and footings, a framed balcony's sole support derives from joists or beams that cantilever from the exterior wall. Its stability and longevity rely on the strength of the cantilever and a careful detailing of the exterior to protect the house and deck framing from water damage.

CODE PROBLEM

As building-code educator Glenn Mathewson notes, codes specify requirements for balcony framing and railings, but they don't address the precise and often unique combinations of potential problems that balconies pose. "For example, when a balcony is designed to be waterproof and the joists are enclosed by a soffit below," he explains, "it is considered by code to be a roof assembly, and because roofs are not meant to leak, there is no code requirement to use pressure-treated lumber."

According to city officials who investigated the Berkeley tragedy, that was one of the factors that led to the collapse. Plans for the balcony called for a 2-inch concrete topping slab over waterproofing and a double layer of OSB sheathing supported by cantilevered 1¾-inch by 11⅞-inch LVL joists, which were untreated. Investigators say that when the Library Gardens apartment complex was built in 2006, the balcony design met all of the requirements of the California Building Code. Of particular note, the balcony joists didn't have to be made of a "durable or preservative-treated material," because they were separated from the walking surface by an impervious moisture barrier (an exemption that has since been removed from the current Berkeley Housing Code).

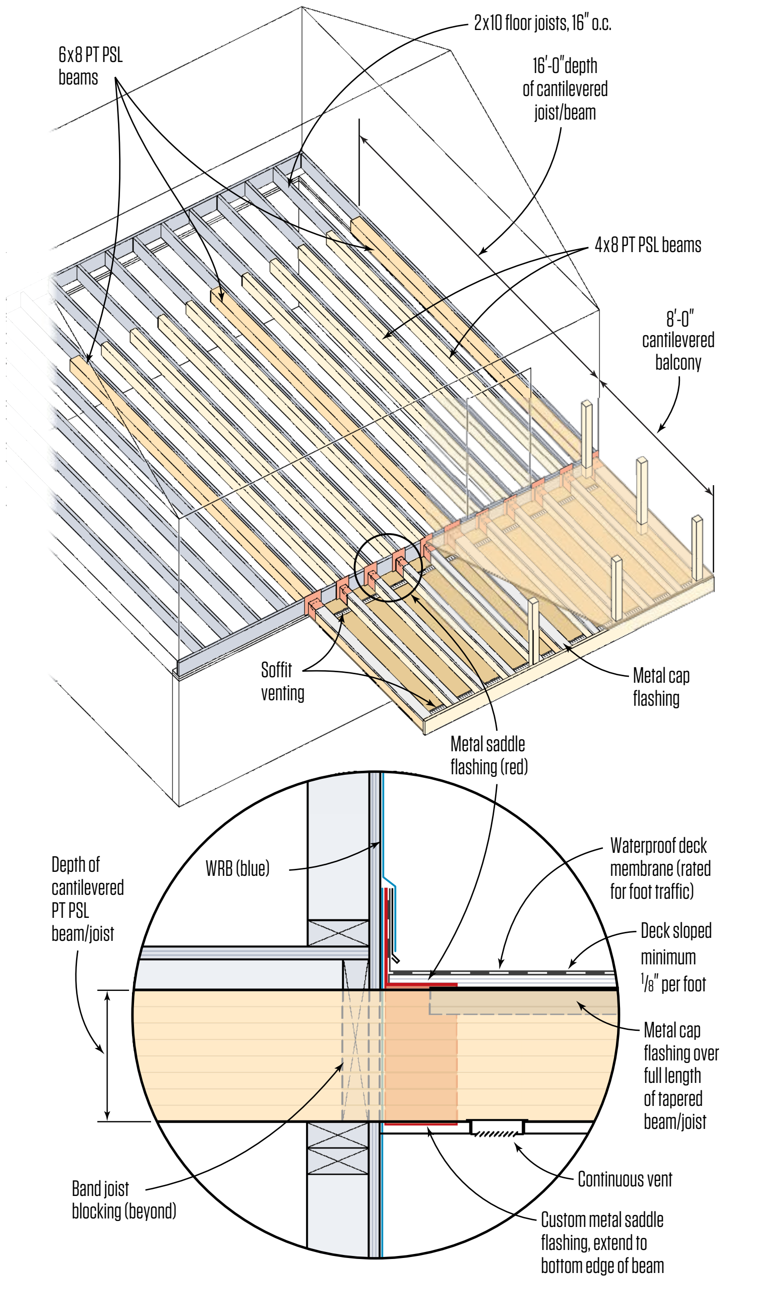
ENGINEERED CONNECTION

Most balcony designs originate with architects or engineers, and one of their rules of thumb for cantilevered balcony joists is that the exterior length of the joist must be supported by a double length inside the building envelope. This 2:1 backspan to cantilever ratio is incorporated in Table R502.3.3(2) in the 2015 IRC, which specifies joist sizing based on the desired cantilever span, ground snow loads, and joist spacing. Following this prescriptive path, 12-foot-long 2x10s spaced 16 inches on-center would be needed to frame a 48-inch-wide balcony built in an area with 50-psf ground snow loads. Not addressed by the code are connection, insulation, and flashing details.

To achieve wider balconies, Patrick Jean-Phillip Burger, a licensed architect, builder, and building inspector, in Hayward, Calif., suggests incorporating 6x8 beams of PT Douglas fir or Wolmanized Parallel-Strand Lumber (PSL) at the perimeter and mid-span of the design. Burger says using the wider beams along with 4x8 PT joists 16 inches on-center and sistered to the interior floor system allows for an 8-foot-wide balcony. To prevent water damage to the framing, he emphasizes careful flashing at the beam-wall intersection, and if the framing is enclosed, he makes sure that the assembly is well ventilated (see "Flashing a Cantilevered Balcony," right).

Flashing and drainage. In multifamily construction, balconies are often stacked vertically and built with an enclosed waterproof deck so that the upper balconies shelter

Flashing a Cantilevered Balcony



Careful flashing is a critical component in any balcony design. Here, each beam is protected with metal saddle and cap flashing, which in turn is integrated with the WRB on the wall and the floor's waterproofing membrane. Continuous soffit vents underneath allow air to flow through the assembly, and promote drying if the waterproof deck should ever leak.

Illustration: Tim Healey

Structural steel can be used to frame wider balconies **(1)**. On this project, four MC-10-22 steel beams were bolted to the interior joists on 8-foot centers **(2)**. Pressure-treated 2x12s were used for the perimeter and infill joists, as well as for the ledger bolted to the house's rim joist. Adjacent joists and the rim beam were bolted to the steel **(3)**. Note: Unlike a deck's 36-inch-minimum railing height, a balcony's railing is required by code to be a minimum of 42 inches high **(4)**.

the balconies on the floors beneath them. The joist bays are typically enclosed with an exterior grade of plywood that's painted or covered with stucco to act as a finished ceiling for the balcony beneath. The problem with this type of assembly is that if the walking surface leaks, there's no way for the framing to dry out.

In the Berkeley collapse, this proved to be a critical flaw. Reports indicate that although the balcony joists were covered with a waterproof membrane, the builders apparently neglected to include the necessary drainage board above the backerboard, which made the joists vulnerable to water that seeped through perforations in the membrane caused by fasteners. Making matters worse, the concrete walking surface was apparently not sloped away from the building as specified, which allowed water to collect and find its way through the concrete and the backerboard to the joists. Had the balcony deck not been enclosed, or had there been ventilation, it's possible that the framing would not have rotted. And had there been a way to inspect the framing, the problem may have been discovered prior to the fatal accident.

"The failure to adequately ventilate an enclosed deck can create a breeding ground for fungal growth," says Burger. So he recommends a belt-and-suspenders approach, which is to install continuous strip vents to ventilate each of the framed cavities, as shown in the illustration on the facing page.

On residential balconies that aren't enclosed, simply installing gapped water-resistant decking boards is an effective way to shed water, as long as the structure is adequately detailed and flashed at the exterior wall. The framing should also be sloped away from the house to maintain proper drainage. This can be done by adding tapered rips to the tops of the joists to create a 1/4-inch-per-foot slope. An alternative sloping technique used by some builders is to start with wider stock and rip tapers along the length of the joists.

Photos: Lenny Gillis

STEEL REINFORCEMENTS

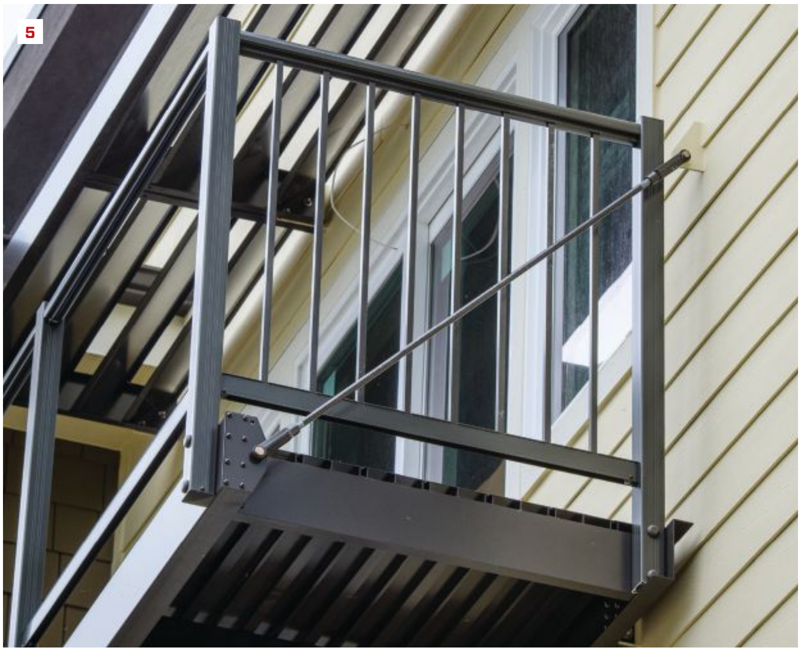
Cantilevered wood framing can be reinforced with steel, an approach used by Lenny Gillis, of Colony Home Improvements, while building a cantilevered balcony as part of an extensive remodel in Wellesley, Mass. While the project's architect had initially specified pressure-treated 2x12s as the cantilever support, Gillis thought that was a bad idea. "The 2x12s were supposed to be sistered to the interior engineered I-joists, but in my experience, PT tends to twist when it's used inside a structure," Gillis explains. "In addition, we couldn't get the lengths we needed to satisfy the required amount of cantilever."

At the time of the build (2009), pressure-treated LVLs were hard to find, so Gillis decided to use steel C-channel beams. After packing out the webs of the 14-inch-deep I-joists, he and his crew bolted four MC-10-22 steel beams to the interior joists **(1, 2, 3, 4)**. Cantilevered at the 2:1 ratio specified by his engineer, the beams were installed on 8-foot centers. Gillis then ran pressure-treated 2x12s as perimeter and infill joists from a ledger bolted to the house's rim joist. Adjacent joists and the rim beam were bolted to the steel. As to the cost, Gillis says, "I can see the cost-saving advantages of using PT LVLs, but they would fail long before the MC10s would fail."

INNOVATIVE SOLUTIONS

To prevent moisture problems, some companies offer prefabricated aluminum balconies and balcony components. American Structures and Designs' innovative system (americanstructures.com) also incorporates a pair of support or sag rods that run between the deck's outer rim and the structure wall just above the railing **(5)**. The rods and a sub-fascia ledger can be lag-bolted or through-bolted into the interior framing. Though each balcony is engineered, all designs are based on standardized frame components that are bolted together on site, and include aluminum decking and railing posts. Owner Mark Weissenbuhler says

5



6

Other options. This prefabricated aluminum balcony from American Structures and Designs has integral diagonal support rods that connect to brackets that are through-bolted to the house framing **(5)**. Another choice is a component system from Wahoo Decks. This option begins with a balcony that's framed with pairs of cantilevered LVL beams, as shown above **(6)**.

Wahoo Deck's Dry Joist EZ—a 2-inch-high aluminum joist system with an interlocking design—spans the distance between the LVL beams **(7)**. The system can span up to 8 feet, depending on floor loads. Any standard decking can be attached to the aluminum joists; water that makes its way into the deck's interior drains to the outer edge **(8)**.

that one advantage to this system is its ledger, which isn't continuous but rather is made up of individual brackets. "The ledger actually sits 1/2 inch off the building wall to allow the water to flow freely behind our balcony."

Another company that offers prefabricated aluminum balconies is Wahoo Decks (wahoodecks.com). While its Wahoo Complete pre-fab balconies are designed for multifamily construction, residential builders may want to look into the company's Dry Joist EZ product. This is a component system of extruded interlocking aluminum joists that creates a waterproof surface **(6, 7, 8)**. As a bonus, Dry Joist EZ framing is compatible with Wahoo's waterproof aluminum decking system to create a finished ceiling below the deck.

Citing the custom nature of their businesses, neither company would quote a precise square-foot cost, but stressed that the savings from reduced installation times compensated for the higher material costs. With both of these products, the buyer is responsible for engineering the framing and for providing adequate flashing details.

BUILD AS IF YOU OWN IT

Glenn Mathewson thinks cantilevered balconies are a bad idea. Unlike other structural details in a house, there is no redundancy in the balcony's resistance to gravity—when it's bad, it fails and fails disastrously.

But balconies are also a desirable architectural feature for some homes—and almost a requirement for many multifamily projects. So the idea isn't to shy away from something that's tricky to build. "It's up to the architect or engineer to design a structure that won't fail," says Mathewson. But it's up to you to build it with careful engineering and conscientious detailing, and always with the realization that your clients' lives rest squarely in your hands.

Charles Bickford is a freelance writer and architectural photographer, in Ivoryton, Conn. This article originally appeared in Professional Deck Builder.

BY LAUREN HUNTER

1

2

3

4

1. Designer-Created Paint Line
Kilz is helping designers move one step closer to their dreams of an HGTV-style home, with its premium interior paint collection, Magnolia Home by Joanna Gaines. All 25 shades, personally designed by Gaines (of the popular show *Fixer Upper*), are formulated to provide the stain-blocking and mildew resistance Kilz is known for, along with coverage, hide, and touch-up that remodelers will appreciate. Pricing will range from $40 to $50 per gallon depending on sheen; matte, eggshell, and satin are available. magnoliamarket.com

2. Metallic Wall Accent
Make a metallic statement with Armstrong's Metallaire panels. Originally created to give the effect of a vintage tin ceiling, the panels are easily adaptable as backsplash and feature wall coverings. Panels measure 24 inches square and install with adhesives in wall and backsplash applications; 24-by-48-inch sizes are available for nail-up installation. Choose from chrome, copper, brass, lacquered steel, and white finishes. Average per-square-foot pricing varies from about $5 for white to about $10 for copper finishes. Starting prices for backsplash panels average $13.50 per square foot. armstrong.com/metallaire

3. Work at the Right Height
Husky has improved workbench ergonomics with an adjustable-height bench-top on the 52-inch 10-drawer Mobile Workbench. A removable crank handle raises and lowers the 1-inch-thick wood top to anywhere between 38 and 48 inches above the floor. In addition to 10 storage drawers of varying depths, the unit has storage space under the bench-top. Heavy, 21-gauge-steel construction can support 1,000 pounds on large, 5-by-2-inch casters that make the workstation easy to move even when fully loaded. Priced at $350. homedepot.com

4. Shock-Absorbing Hammer Tacker
"Anti-Vibe" technology in the new Anti-Vibe Hammer Tacker from Bostitch helps reduce shock and vibration transmitted to the user. Other features include an anti-jam mechanism that reduces misfires; a bottom-load magazine that's easy to load with one hand; a slip-resistant grip; and a die-cast aluminum housing that offers both durability and light weight. Priced at $33. bostitch.com

5. Caught in the Downdraft

Best Range Hoods aims to improve on downdraft kitchen ventilation with its Cattura model. As effective as an island hood and quieter than other downdrafts, according to the manufacturer, the thin, retractable unit has dual inlet ports to capture emissions; LED task lights; and technology that detects excessive heat and adjusts fan speed accordingly. Cattura's filters are dishwasher-safe. Retail price is $1,800. bestrangehoods.com

6. Smart Home Appliance Suite

Builders interested in upping their connected-home game can turn to GE's additions to the If This Then That (IFTTT) platform. The new offerings double GE's presence to six channels, and make GE the first appliance manufacturer to have its entire suite on the platform. IFTTT lets users create "recipes" of if-then functions within apps or with other Internet of Things devices, such as smart thermostats or lighting; for example, a recipe could say, "if I turn on the wall oven, then turn on the air conditioner," or "if there's 10 minutes left on the drying cycle, then blink my living room lights." The IFTTT app is free; appliance prices vary. geappliances.com/ge/connected-appliances

7. Two-in-One Containment Tape

Designed for sealing off spaces for restoration, remodeling, and abatement, Shurtape's DS 154 double-sided containment tape has the same painter's tape adhesive used on FrogTape on the wall side, while the opposite side uses a specially formulated adhesive to secure poly sheeting, tarps, and other coverings in both wet and dry environments. The two-in-one design results in full-surface contact and an airtight hold even under negative pressure. Check with dealers for pricing. shurtape.com

8. Portable Stucco Pump

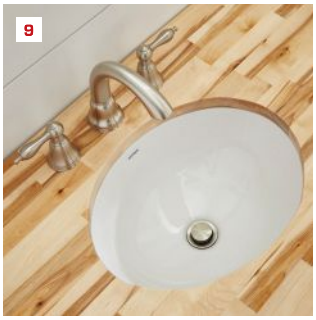
Use one pump start-to-finish for stucco and EIFS applications with Graco's new ToughTek S340e Portable Stucco Pump. It has a 20-gallon hopper and uses piston pump technology to deliver abrasive materials with a steady flow, even with long hose lengths. For EIFS, the S340e handles base and finish coats; for stucco, it handles scratch, brown, and finish coats, as well as air/water-resistive barrier materials. A compact design improves access for spraying in tight areas, and variable speed controls dial-in the exact flow rate. The pump plugs into a standard 120V wall outlet or may be used with a 5.5 kW generator. graco.com/stucco

5

6

7

8



9

10

11

12

9. Undercounter Lavatory Sinks

Two new undercounter sinks have been added to Gerber's lavatory product line. Luxoval sinks include a 16-inch-diameter round model and an oval model measuring 17 5/8 by 14 5/8 inches; both have 7-inch bowl depths. The small dimensions suit small spaces. Both sinks have a slotted front overflow and are available in a white finish. Priced starting at $100. gerberonline.com

10. Compact Electric Water Heaters

For whole-house hot water on demand, Bosch Thermotechnology offers the wall-mountable Tronic 5000C and 6000C electric water heaters. According to Bosch, the compact and lightweight units deliver 97% thermal efficiency with minimal standby loss; modulating elements help to ensure a constant output temperature. For cold climates, the Tronic 6000C model WH17 is recommended for point-of-use only. Other Tronic models (6000C WH 27 and 5000C WH36) may be suitable for whole-house use. Tronic C models require hard-wiring. boschheatingandcooling.com

11. Easy-Adjust Woodworking Clamps

Kreg's new Clamping Solutions line features improved "Automaxx Auto-Adjust Technology," which lets users clamp any piece without ever adjusting the clamp itself. Simply squeeze the handles and Automaxx does the rest, holding securely at the desired pressure. A thumbscrew gives control over that pressure. Kreg Clamps and Clamp Systems include the wood project and bench clamps, a bench clamp system and clamp table (shown), auto-adjust bar clamps, and a clamp vise. The Clamp Table is priced at $250 on its own, or $400 with a steel stand. Clamp prices start at $30. kregtool.com

12. Affordable, Durable Truck Boxes

The Defender Series is Weather Guard's latest affordable truck-box solution designed specifically for pros. Four-piece welded construction and C-channel reinforced lids provide durability, while push-button locks, reinforced front panels, and two dual-stage rotary latches with looped sinkers add security. Styles include saddle and cross boxes, all-purpose chests, low-profile, and lo-side and hi-side boxes. Other features include a dual dynamic gas-strut-supported lid and a no-drill mounting kit for use with all but lo-side and hi-side boxes. Boxes are available in clear aluminum and gloss black powder-coat finishes. Prices range from $500 to $730. weatherguard.com

Programmable 18-Volt Hammer Drill

BY BRUCE GREENLAW

When Milwaukee introduced the model 2704 second-generation M18 Fuel brushless hammer-drill last summer, the tool promised to deliver more power, a faster top speed, longer runtime, and better protection against overheating than its predecessor while shaving about 1/3 inch off the length. The model 2706 introduced five months later has the same performance specs as the 2704, but adds a Bluetooth module that can pair the tool with most current iOS or Android smartphones via Milwaukee's free One-Key app, allowing you to customize and keep a virtual eye on the tool. I couldn't resist giving this souped-up new version a test drive to gauge its overall performance and see if the One-Key feature is worth its $50 premium. The feature is also now available on several other M18 Fuel tools, including a drill/driver, an impact driver, and impact wrenches.

STANDALONE PERFORMANCE

According to the specs, the new 2706 delivers a whopping 1,200 inch-pounds of peak torque and a top speed of 2,000 rpm, while the first M18 Fuel hammer drill, launched three years ago, delivered 725 inch-pounds and 1,850 rpm. I initially figured that this extra muscle would drill bigger holes and drive larger fasteners. Yet both operator's manuals say the tools can power auger and spade bits up to 1 1/2 inches and hole saws up to 3 inches in diameter in wood; drill 1/2-inch holes in steel or 5/8-inch holes in masonry; and sink 3/8-inch-diameter wood screws. When I asked Milwaukee why these recommendations didn't change, I was told that the latest M18 Fuel models are designed to complete the same applications faster than the first-generation model, not to drive larger bits and fasteners. That's good to know.

Before trying the One-Key app, I put the tool through my usual trials. Equipped with a 1 1/2-inch spade bit, it raced through 2-by Douglas fir in about 6 to 10 seconds. It also easily bored holes through the material with a 1 1/2-inch Irwin solid-center auger bit. Next, I exceeded Milwaukee's recommendations and tried my old Irwin 1 3/4-inch and 2-inch ship-auger bits just to see what would happen. The tool bored these holes, but it did shut itself off a couple of times to prevent overloading, and I started worrying about wrist-snapping kickback. I also easily drilled a hole through the 2-by with a 4 3/4-inch bimetal hole saw (my biggest), but had the same safety concerns. The tool also easily sank Simpson Strong-Tie's .22-inch by 10-inch Strong-Drive SDWS structural wood screws into an LVL/LSL/PSL sandwich without pilot holes.

According to Milwaukee, equipped with a Milwaukee 1 1/8-inch ship auger and powered by the 5-amp-hour batteries included in the 2706-22 kit that I tested, the tool can drill 112 holes through 2-by Douglas fir in high speed, per charge. I'll take the company's word for that. It took me 1 hour and 48 minutes to recharge a depleted battery with the kit's charger.

ONE-KEY FEATURES

Once I completed my initial workout, I downloaded the free One-Key app with my iPhone 6, created an account, logged in, read the included quick-start guide, and explored all of the app's features. I quickly learned that this app can't be mastered over a cup of coffee or be thoroughly described in a few paragraphs. If you visit milwaukeetool.com/one-key, though, it'll walk you through every feature. You'll also find helpful Milwaukee One-Key tutorials on YouTube.

For starters, One-Key allows you to inventory your tools and equipment so you can efficiently manage purchase information, usage, maintenance, and budgeting from anywhere with an Internet connection. The app can also automatically record when and where it last came within 100 feet of any One-Key compatible tool in your inventory, even with no M18 battery installed. If one of these tools disappears, the app can be set to update its location and alert you when the tool comes within 100 feet of any smartphone that's using the One-Key app (including another contractor's phone). Milwaukee

The One-Key app allows you to use your smartphone to create and save up to four custom performance profiles directly into the tool's memory so you can set the ideal parameters for any drilling or driving application.

2706-22 Specs
Tool weight (with/without side handle): 5.68/5.09 pounds
Length: 7 5/8 inches
Rpm: 0–550/0–2,000
Hammer bpm: 0–32,000
Price: $350 (includes two 5-Ah batteries, charger, side handle, belt clip, bit holder, plastic case)
Warranty: 5 years, tool; 3 years, batteries

tells us that a forthcoming free One-Key update called "Tool Security" will let users lock tools so they will be useless if stolen.

For me, though, the One-Key feature called "Tool Controls" might be the game-changer. To link this to the hammer drill, you need to install a battery on the tool and rotate the application-selector collar to the wireless symbol. Open the app within about 30 to 50 feet of the tool, tap where required to connect to it, tap "Tool Controls," and you're ready to create and save up to four custom performance profiles directly into the tool's memory. Once you do that, you can use any of the four profiles on the job independent of the app by once again rotating the collar to the wireless symbol and then pushing a button at the base of the tool to select mode 1, 2, 3, or 4. You can use the app to change any of these profiles any time. Rotate the collar to the drill, drive, or hammer-drill symbol instead, and the tool works just like the conventional model 2704.

In a nutshell, Tool Controls allows you to set the maximum rpm desired in low and high gear for particular drilling or driving applications, and to reprogram the electronic clutch to change the 13 default clutch settings on the tool's torque-selector collar so you can adjust the torque in smaller increments anywhere within the default torque range. For instance, you can shift all 13 settings to the low end and dial into the perfect setting for sinking small and delicate fasteners. This feature works as advertised, though I wouldn't love using a 5-pound drill to drive lots of small fasteners. You can also set all 13 settings to the same torque level.

Even better, you can reprogram the electronic clutch with the precise sensitivity required to prevent kickbacks when drilling big holes. I tested this feature by starting more holes with my auger bits and hole saws and tipping them slightly until they jammed. After I used the app to incrementally zero in on the ideal torque shutoff level for the task at hand and saved it to the tool, the feature worked perfectly every time for that application.

Finally, you can tap "Hole Saw" in the app and select the diameter of the bimetal hole saw you plan to use and the material you're cutting (aluminum, mild steel, OSB, stainless steel, or wood). The app sets the ideal cutting speed and tells you whether you need to switch your tool to low gear. According to Milwaukee, when hole-sawing mild steel, you get a 25% increase in runtime without sacrificing speed, and you quadruple hole-saw life. To check the speed claim, I drilled 10 holes with a 4-inch bi-metal hole saw through 20-gauge galvanized sheet metal in low gear at the maximum 550 rpm, and then repeated this exercise after using the app to program the tool for the optimal drilling speed for the job, which turned out to be 367 rpm. It's a small sample size, but the programmed slower speed actually drilled the holes more than a second faster on average than the higher speed. More significant for me, though, the Hole Saw option also includes kickback control, which can be useful when powering big hole saws.

Tool Controls also lets you adjust the tool's trigger ramp-up speed, along with the duration and brightness of the LED headlight. You can even set the LED to serve as a flashlight.

THE BOTTOM LINE

As a standalone tool, the new Milwaukee model 2706 is almost identical to model 2704, which means it delivers all the power and speed you need from an 18-volt hammer drill. But the 2706 adds One-Key compatibility, allowing you to use a smartphone to customize its performance, track its location, and more. Unless you manage a big tool crib or do lots of repetitive drilling and driving, many of its features might be overkill. Still, I'd pony up the extra $50 just for One-Key's anti-kickback control. Milwaukee also promises plenty of updates to the app that might prove to be indispensable.

Bruce Greenlaw is a contributing editor to JLC *and* Tools of the Trade.

A Compact, Triggerless Impact Driver

BY CHRIS ERMIDES

Brushless motors are more efficient, durable, and compact, as well as quieter, than brushed motors. Ridgid takes full advantage of this technology in a new, one-of-a-kind tool: an impact driver that fits in the palm of the hand and can be easily tossed into a nail pouch. The 12V R8224K Impact Screwdriver is the size of the battery on my first cordless drill (back in the 1990s—how far tools have come), and it weighs about the same too. It features what Ridgid calls "push-to-drive technology," which means that placing pressure on the screw you're driving engages the tool. And though it doesn't have a trigger, it is variable speed—controlled by the amount of pressure placed on it.

TAKING IT OUT FOR A DRIVE

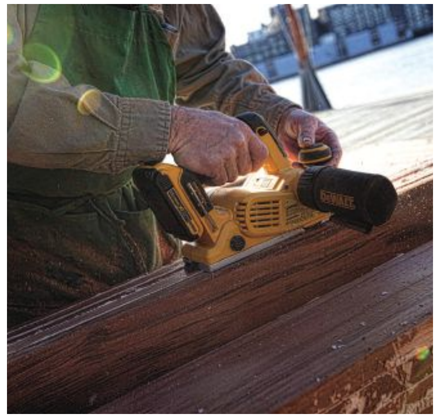
I've been using this little tool for several months and have found it incredibly useful. First, the ergonomics are excellent. It is balanced so no matter how you're holding it—overhead, out to the side, or directly in front of you—it's easy to engage. Longer screws require a fair amount of pressure to keep the bit from skipping out of the screw head, and with this tool—unlike drivers that have a handle and trigger—you're able to focus that necessary pressure directly over the bit and screw. I was also able to toe-screw easily, thanks to the balance and grip.

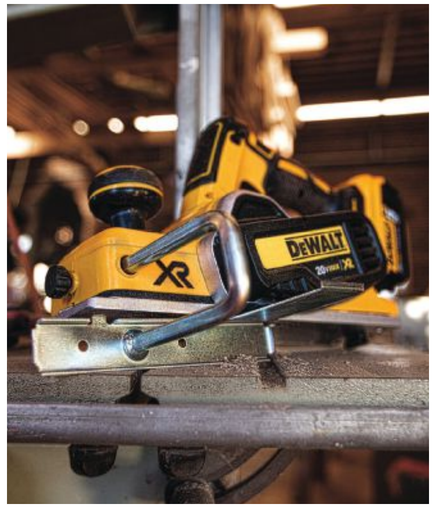
With a no-load speed of 0 to 2,000 rpm and maximum torque of 400 inch-pounds, it's not the fastest or most powerful impact driver I own. But it's not meant to be; its intended use is for screws, not lags or bolts. It did very well driving 2 to 3 inches and was plenty powerful for building toe-kick bases for cabinets and adding 2-by cleats—especially when the angle or space was too compact for a full-sized impact driver. Vibration is barely noticeable, though it does throw out some noise.

I liked the one-handed, quick-load chuck as well as the on/off switch for the LED light (which also engages the onboard battery gauge). The LED light also turns on and off automatically as the tool is engaged and disengaged. The forward and reverse switch is located conveniently for one-handed operation; you can change it without pulling the driver off the screw.

It's hard to criticize a tool that's one-of-a-kind and that performs as well as it claims to. But one thing that's missing is a hand strap. The grip is sure enough to maintain control over it. Still, when I was working on a ladder, I would have liked the added peace of mind that it couldn't slip out of my hand and land on a client's windowsill below. And though with a 1.5-Ah battery, it's not meant to drive hundreds of screws at a stretch, an extra battery would have been nice. The kit includes a bit, a 1.5-Ah battery, a charger, and a carrying case. COO: China; cost: $100.

Chris Ermides is a senior editor at JLC *and* Tools of the Trade.





DeWalt Cordless Planer

Continuing its trend of expanding cordless tool offerings for finish carpenters and woodworkers, DeWalt has entered the cordless planer market. The brushless DCP580B runs on the company's 20V Max lithium ion battery platform. Like other planers in its class, it has a 3 $^{1}/_{4}$-inch-width cutting capacity and features a chamfering groove. It has a rabbet capacity of $^{5}/_{64}$ inch and adjusts in $^{3}/_{32}$-inch increments. Brushless technology allows this cordless version to run at 15,000 RPM, the same as its corded cousin, the DW680K. Two reversible blades make the cut and the tool has onboard key and blade storage. A set of replacement blades costs about $20. The bare tool weighs 6.7 pounds and can be hooked up to DeWalt's universal dust collection system. COO: China; cost: $200 (tool only). —*C.E.*

July Advertising Index

Classifieds

BY MARK LUZIO

It's All About the "D"

I had the privilege to oversee the complete restoration of an 18th-century tavern in Rhode Island. The design for the front entry was a milestone I reached at the end of the third year into the job. We removed the 19th-century door and clapboards, and found a ghost outline of the original clapboard ends and the flashing for the top cornice. This helped define the overall dimensions of the entryway, but none of the original woodwork existed.

Search for details. We knew the entry had been built sometime after 1780, when the tavern was purchased by a master jointer from Newport, R.I. I photographed about 20 entries in the 18th-century section of Newport, and I purchased three design books that a jointer could have had access to at the time.

Of these, my go-to book on all questions of classical proportion has become *The American Vignola,* by William Ware (a Norton Press reprint is available on Amazon and used-book websites for $10 to $15). Vignola was a Renaissance architect who published one of the first books on methods for drawing correctly proportioned classical details, and it was from the Vignola that I learned it's all about the D: the diameter of the column, or in the case of this entryway, the width of the pilaster. Most of the dimensions that define the elements of any classical order derive from a multiple of D.

Doric elements. On the entryway I was restoring, the columns and entablature had to fit into an existing entry height of 110 inches. The D—the width of each Doric pilaster—is 11 inches. This meant that the height of the entablature would be 2D, or 22 inches, and the length of the pilaster 8D, or 88 inches (see illustration at left, which summarizes the Doric proportions as defined in the Vignola). It's important to note these dimensions can be slightly altered. I had to alter the pilaster height slightly to fit a 6-foot 8-inch door, but the overall proportions remain visually intact.

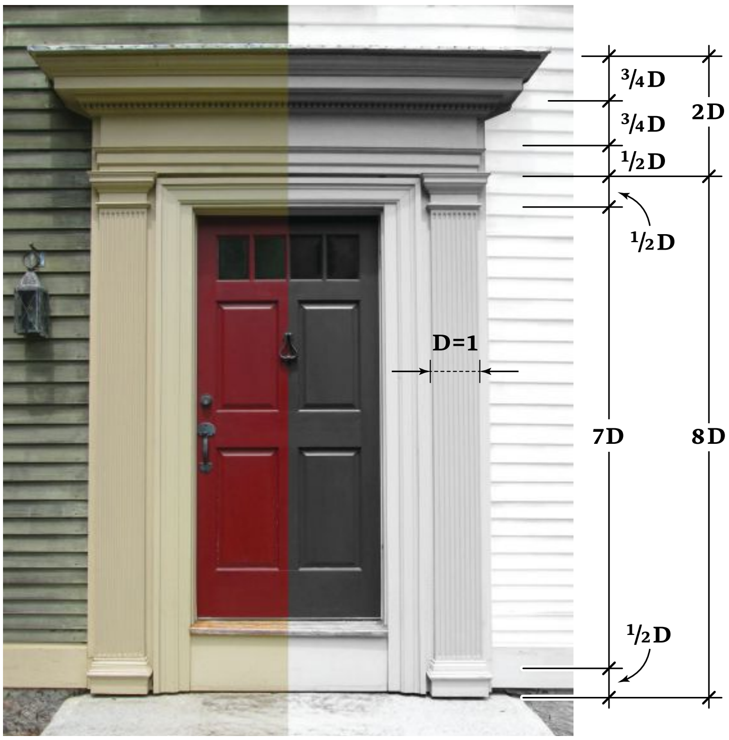
Flutes. I diverged from a strict Doric order on the detailing of the flutes. On a Doric column, there are no spaces between flutes; the flutes come to a point called an *arris.* Instead, I chose to leave a *fillet*—a space between the flutes—because the pilaster is made of wood, not stone, and over time, a fillet wears better.

Fillets are an Ionic invention, and according to the Vignola, an Ionic fillet is about one-fourth the width of the flute. This translates to using a ¾-inch box core router bit to make the flutes and leaving about 3/16 inch between them. The Vignola allows you to avoid the "classic" mistake of having too much space between flutes.

Following the rules in the Vignola, you can create a coherent order that nods to an ancient sense of proportion. When I was putting this entry together, I doubted some of the measurements, but once I stepped back, all the time I spent poring over the Vignola proved worth it.

Mark Luzio owns Postpattern Woodworking in Brooklyn, Conn. For a comparison of all the classical orders, see this article at JLConline.com.

Doric Proportions



The heights of each architectural element within a specific classical order derive from D, the diameter of the column (width of the pilaster). For this Doric entry, column height should be 8D; the entablature 2D. Within the entablature (from top to bottom), the cornice is 3/4D; the frieze 3/4D; the architrave 1/2D.

Photo: Mark Luzio

Pro Plug® System for PVC

VERSATEX Approved Plug Fastening System

1 Pro Plug Tool for PVC
No Cam-out Auto-Stop™ Mechanism to prevent stripped screws

2 Screws
Available in both Epoxy Coated Carbon Steel and Stainless Steel (Grade 305 and Marine Grade 316).
Sizes: 2″ • 2½″ • 2¾″ • 3″

3 Plugs
Made from Versatex® Trimboard, so the color and grain match perfectly.

For more information on where to purchase Pro Plug® System for Versatex® Trimboard, call or email us: 800.596.7747 | info@starbornindustries.com

DU PONT
Tyvek.
NEW TYVEK® PROTEC™
ROOFING UNDERLAYMENTS
WITH INDUSTRY-LEADING WALKABILITY
With its industry-leading walkable surface, the portfolio of Tyvek® Protec™ engineered synthetic underlayments provide you and your crew with a high-performance product and greater confidence on the job. It's an ideal combination of protection and performance for your customer.
EXPERIENCE THE DIFFERENCE
Get your free, 2-square sample roll* at tyvek.com/protec
DU PONT
Tyvek®
Protec™
ROOFING UNDERLAYMENTS
FOR GREATER GOOD™
* Limited-time offer. While supplies last.
Copyright © 2016 DuPont. All rights reserved. The DuPont Oval Logo, DuPont™, For Greater Good™, Tyvek® and Tyvek® Protec™ are trademarks or registered trademarks of E.I. du Pont de Nemours and Company or its affiliates.