May 2022 $4.95

JLC

THE JOURNAL OF LIGHT CONSTRUCTION

Bonus Inside

PROFESSIONAL DECK BUILDER

Better Porch Stairs

High-Performance Roof

Earthquake Resilience

jlconline.com

JLCONLINE.COM

Contents

On the cover: Emanuel Silva of Silva Lightning Builders in North Andover, Mass., installs the stair stringers for a new porch. See the story on page 11 in the *Professional Deck Builder* section. Photo by Emanuel Silva.

FEATURES

DEPARTMENTS

THE JOURNAL OF LIGHT CONSTRUCTION (ISSN 1056-828X), Volume 40, Number 6, is published monthly except combined issues in Jan/Feb, July/Aug, Sept/Oct and Nov/Dec by Zonda Media, 1152 15th St. NW, Suite 850, Washington, DC 20005. Annual subscription rate for qualified readers in the construction trades: $39.95; nonqualified annual subscription rate: $59.95. Frequency of all magazines subject to change without notice. Double issues may be published, which count as 2 issues. Publisher reserves the right to determine recipient qualification. Canada Post Registration #40612608/G.S.T. number: R-120931738. Canadian return address: IMEX, PO Box 25542, London, ON N6C 6B2. Periodicals postage paid at Washington, DC, and at additional mailing offices. POSTMASTER: Send address changes to JLC, Box 3530 Northbrook IL 60065-3530.

A CAPE COD HOME WITH A CALIFORNIA TWIST

Cedar shingle siding in Camarillo? It makes perfect sense with look-alike polymer.

As the vice president of construction operations for multifamily giant IMT Residential, Adam Thomas is a pro's pro at building mega, multi-million-dollar apartment communities.

However, there's one project that nearly "drove me nuts" with design, material specification, and construction details. It's a project Thomas poured everything he knows about best practice in a career spanning over 20 years with top-ranked single-family and multifamily builders.

It's his dream project, the Thomas family forever home.

The 7,300 square-foot project is in Camarillo, Calif, on a piece of land he purchased in 2018. "Building my home was an opportunity to open the floodgates on everything I've learned about building," Thomas says. "You're never going to get it 100 percent perfect, but I think I'm in the high 90s on this one."

CALIFORNIA CAPE COD

There's no mistaking the new Thomas family residence in a neighborhood of Santa Barbara-style Spanish homes. It's classic Cape Cod complete with six dormers and a four-windowed cupola. "Aesthetically, it's in a league all its own," Thomas observes. "I knew I didn't want wood or stucco."

Just one thing. Cape Cod style is defined by cedar shingled siding that's not only a "maintenance nightmare," in Thomas's words, but also doesn't play well in fire-challenged California. As for fiber cement, Thomas wasn't happy with that material for other reasons. "It's a heavy product and hard to work with. Plus, you can't touch the dirt with it. I don't want any concrete showing," he explains.

What to do?

He researched cedar shingle siding alternatives. One material checked all the boxes for aesthetics, workability and durability. It's a proprietary engineered polymer material from AZEK, a leading exterior building materials company. Intrigued, Thomas had a company rep stop by with shingle and trim samples. Once he handled it, the veteran construction chief was sold. Thomas explains why:

- **Aesthetics.** "I liked the cedar detail, it's very authentic. Varying shingle gaps on each panel makes it very cedar-like. The trim assortment is surprisingly comprehensive. The one-piece corner board, for example, is awesome. There's no need to butt-end two trim boards and leave an exposed joint. The siding and trim combination leaves a crisp, clean look.

  "Ground contact doesn't matter. Engineered polymer panels extend down to the grade."
- **Workability.** "Engineered polymer is an installer's dream. First, it's light compared to fiber cement, so it's easy to move around. There's no need for masonry saw blades, breathing masks and vacuums. You work with it just like wood, no special tools required. It cuts so easy and true, it's almost like doing interior finish carpentry. No splitting on routes and cuts."
- **Durability.** "The polymer composition eliminates most water worries like rotting, splitting, peeling, warping and swelling. We're painting the shingles a medium gray. Paint adhesion is terrific because the panels are enhanced with PaintPro technology. All in all, it means near-zero maintenance for a very long time."

"I feel good everything was done right," Thomas adds. "I have thought through all of my details and material choices. This is my forever home and I feel it will stand the test of time."

Learn more about why AZEK shingle siding with PaintPro technology offers an important new residential cladding alternative at **azekexteriors.com**.

Produced by Zonda Media, a Delaware corporation.
marketing.zondahome.com

AZEK® Exteriors

TRIM | SHINGLE SIDING | BOARD AND BATTEN

- Rot-Resistant
- Moisture-Resistant
- Superior Paint Adhesion
- Low-Maintenance

PAINTPRO® TECHNOLOGY

Premium Siding and Trim Engineered to Endure

New AZEK® Trim and Siding with PaintPro® Technology offers the most low-maintenance paintable substrate in the market. Lightweight and durable AZEK trim made from engineered polymer and enhanced with PaintPro® Technology lasts longer than wood but can be cut, drilled and fastened with standard woodworking tools.

CLASS A RATED FLAME SPREAD INDEX

AZEK Trim and Siding with PaintPro® Technology maintains a Class A Flame Spread Rating.

INDUSTRY- LEADING WARRANTIES

We guarantee the performance of our trim, moulding and siding with a Lifetime Limited Warranty that covers rotting, splitting, splintering, swelling, and warping.

ORDER A FREE PAINTPRO® TRIM SAMPLE

JLC

JLCONLINE.COM

Clayton DeKorne, Chief Editor, JLC Group, cdekorne@zondahome.com
Andrew Wormer, Executive Editor, JLC Group, awormer@zondahome.com
Laurie Elden, Managing Editor, lelden@zondahome.com
Tim Healey, Senior Editor, thealey@zondahome.com
Vincent Salandro, Associate Editor, Products, vsalandro@zondahome.com
Melissa Krochmal, Freelance Designer, mkrochmal@zondahome.com

Contributing Editors: Jake Bruton, Mark Clement, Rob Corbo, Ted Cushman, Dave Holbrook, Doug Horgan, Jake Lewandowski, Roe Osborn, Matt Risinger, Emanuel Silva, Gary Striegler, Tim Uhler

Cathy Underwood, Senior Director, Print Production
Margaret M. Coulter, Senior Director, Print Production
Stephanie Fischer, Production Manager, Inside Sales
Christina Lustan, Group Director, Audience Marketing & Circulation

PUBLISHED BY ZONDA MEDIA

Jeff Meyers, Chief Executive Officer
Melissa Billiter, Chief Financial Officer
Andrew Reid, Chief Operating Officer
Jennifer Pearce, Executive V.P., Chief Content Officer
Bridget Forbes, V.P., Digital Strategy and Operations
Jennifer Malkasian, V.P., Audience Development and Analytics
Kurt Nelson, Group V.P., Talent Strategy
Amy Dudley, Executive V.P., National Sales
Tim Sullivan, Senior Managing Principal, Advisory Group

JLC will occasionally write about companies in which its parent organization, Zonda Media, has an investment interest. When it does, the magazine will fully disclose that relationship.

Opinions expressed are those of the authors or persons quoted and not necessarily those of **JLC**.

EDITORIAL AND ADVERTISING OFFICES

1152 15th St. NW, Suite 850
Washington, DC 20005
202.452.0800

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

SUBSCRIPTION SERVICES

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 added if required by your state law.
Frequency of all magazines subject to change without notice. Double issues may be published, which count as 2 issues.

JLC BACK ISSUES

JLC subscribers have free access to every issue of **JLC** since 1986. Enable access at jlconline.com/register.
Back issues: $4.95 each, plus $5 shipping per order.
Call 888.269.8410 for availability.

ARTICLE REPRINTS

Wright's Media
877.652.5295, zonda@wrightsmedia.com

JLC UPDATE EMAIL NEWSLETTER

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

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.

ADVERTISING SALES

Paul Tourbaf, Executive Vice President
847.778.9863, ptourbaf@zondahome.com

Kay Ross-Baker, Vice President
630.707.0811, krossbaker@zondahome.com

John Tatusko, Vice President
617.359.8619, jtatusko@zondahome.com

Carol Weinman, Senior Director of Strategic Accounts
847.778.9861, cweinman@zondahome.com

Mark Rosenbaum, Strategic Account Director
312.802.7002, mrosenbaum@zondahome.com

Patrick Zazzara, Strategic Account Director
571.488.5324, pzazzara@zondahome.com

CANADA

John Magner
York Media Services
416.598.0101
jmagner@yorkmedia.net

JLC INTEL

Georgia-Pacific ForceField WEATHER BARRIER SYSTEM

GET TO YOUR NEXT PROJECT SOONER

Help reduce weather-related delays with an integrated WRB.

Weather can be unpredictable and can quickly throw off a project's timeline when a structure can't withstand the elements. If your building envelope doesn't include an integrated weather-resistive barrier (WRB) for walls and sloped roofs, you may be facing costly delays.

ADDING A CRITICAL LINE OF DEFENSE

Choosing integrated WRB sheathing over traditional building wrap and roofing underlayment may help you achieve a continuous building envelope that could reduce the risk of:

- Water damage
- Air leakage
- Damage due to weather
- Delays to project schedules

A reliable WRB system may offer advanced protection against air and water intrusion, an important first step in building strong roofs and walls that keep multifamily structures dry during construction and beyond.

THE POSITIVE IMPACT ON TIME AND LABOR

An integrated WRB that has the versatility to be used on roofs and walls may eliminate the steps of applying house wrap and roofing underlayment. And fewer steps can help simplify installation for your crew, allowing them to dry-in the entire structure faster. There is less switching between materials and less confusion about what goes where. Plus, one system may reduce the number of trade professionals needed on your jobsites, streamlining the construction process and preventing inefficiencies that result from one trade waiting on another to finish up.

As if the value added to multifamily structures weren't enough, the time and labor savings can provide even more incentive for you to choose a WRB over cheaper methods. Crews may have an easier time installing the system, helping reduce worry about the material tearing or blowing off.

AN INTEGRATED WRB FROM THE PARTNER BUILDERS TRUST

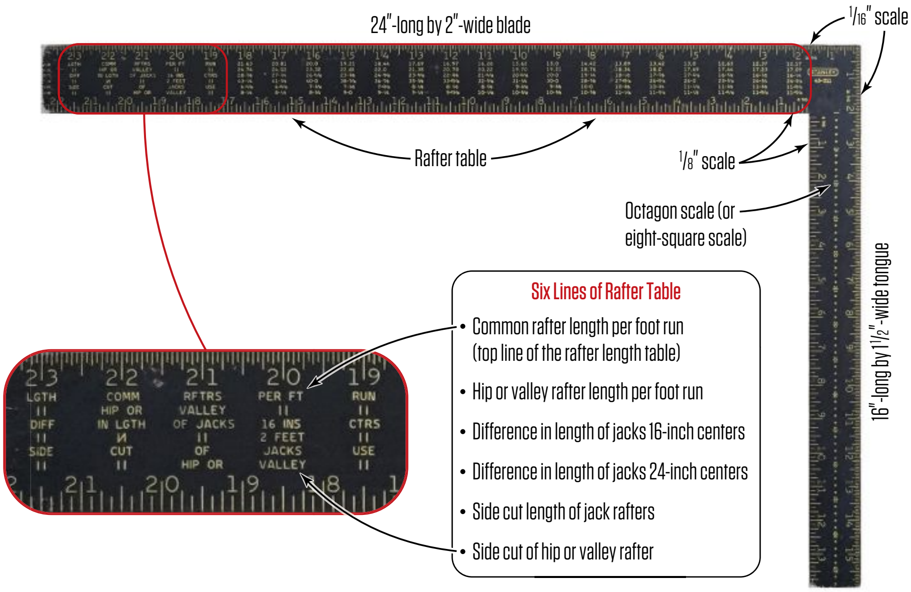
Georgia-Pacific's ForceField Weather Barrier System helps offer advanced protection against air and water intrusion so you can dry-in your structure faster and move on to the next critical path—and your next project—sooner.

To learn how a fellow builder used this high-performance integrated WRB sheathing to find savings beyond the material receipts, check out the Liberty Creek Village case study at **GPForceField.com/LibertyCreek**.


WHEN HIGH
PERFORMANCE IS
MISSION CRITICAL
IF YOUR BUILDING ENVELOPE DOESN'T INCLUDE AN INTEGRATED WRB FROM GEORGIA-PACIFIC, YOU MIGHT AS WELL FACTOR IN COSTLY DELAYS NOW.
ForceField® Weather Barrier System helps keep you on schedule and on budget, providing a versatile WRB for roofs and walls that helps you dry in multifamily structures faster. So you can move on to the next critical path—and your next investment—sooner.
©2022 Georgia-Pacific. All rights reserved. Unless otherwise noted, all trademarks are owned by or licensed to GP Wood Products LLC.
GP Georgia-Pacific
ForceField
WEATHER BARRIER SYSTEM
GET PRODUCTS THAT PERFORM
GPFORCEFIELD.COM/MULTIFAMILY
Georgia-Pacific
ForceField
WEATHER BARRIER

BY JOHN CARROLL

Framing Square Basics: Rafter Layout



The front of a standard framing square is etched with rafter tables on the wide blade and the octagon scale on the narrower tongue.

The real challenge in roof frame layout is not the math; it's visualization. You have to be able to see how the triangle fits the roof you're trying to build. Using quaint language (the framing square) or high-tech calculators that work in feet and inches doesn't help if you don't know how the geometry fits the roof. In a previous article (see "Rafter Square Basics: Foundation Layout," Apr/22), I explained how the brace table etched on a framing square can be used to unlock the geometry needed to quickly and accurately lay out a foundation. In this article, I'll focus on the rafter table on the front of the square, and how the numbers it contains can be used to lay out the rafter cuts needed to frame a roof.

Unlike the brace table, which uses the same isosceles triangle for the first 13 entries and the familiar 3-4-5 triangle for the final entry, the rafter table provides the base, altitude, and hypotenuse for 34 different right triangles, each with angles that are different from all the rest. These triangles are well-camouflaged on the square, but they are there, and learning how to decipher them in the 1970s proved to be a turning point in my own quest to learn how to frame a roof.

Ridge height and common rafter layout. On the first line of the rafter table (length of common rafters per foot run), the base of the triangle for all the entries is 12. The altitude is the number above the table. It's cleverly hidden in the 24-inch scale along the edge of the square. The hypotenuse of the triangle is provided in the decimalized number just under the number indicating the altitude.

For a 6-in-12 pitch roof, then, assume a base of 12 and look under the number 6 to find the hypotenuse, or 13.42 (see annotated framing square, top of facing page). The task now is to expand this little, 6-12-13.42 triangle into a much larger triangle that preserves the angles of the little triangle and fits the roof you are building.

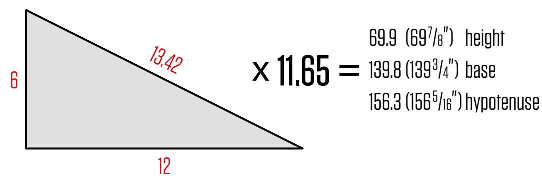
First, establish the size of the base of the large triangle. In the drawing of the 24-foot-wide building ("Ridge Height and Common Rafter Layout") on the facing page, the short point (sometimes called the heel) of the birdsmouth cut of the rafter lands 2 inches in from the inside of the building's 2x6 wall. Opting to have the hypotenuse of the big triangle run along the underside of the rafter means the base of the large triangle equals 139 3/4 inches.

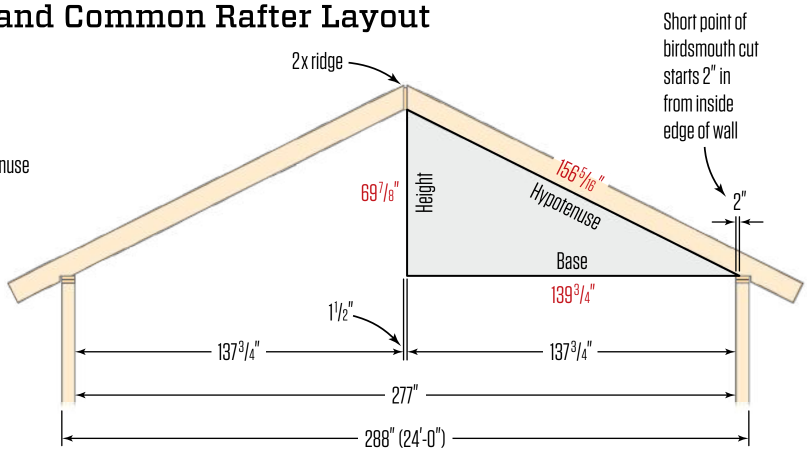
To find how many 12-inch increments there are in 139 3/4, convert 3/4 to .75, then divide 139.75 by 12. This comes to 11.65, which is the common multiplier needed to expand the 6-12-13.42 triangle into the larger, 69.87-139.75-156.34 triangle. This triangle provides the height to the bottom of the ridge, 69.875, which converts to 69 7/8 inches. It also provides the distance between the short points of the ridge

Photos by Matthew Navey; illustrations by Tim Healey

To find the diagonal for a triangle with a rise of 6 and run of 12 (for a roof with a 6-in-12 pitch), look up the first entry beneath the number 6 on the framing square's top scale. A 6-12 right triangle has a diagonal—or hypotenuse—of 13.42.

Ridge Height and Common Rafter Layout





The 6-12-13.42 right triangle can be expanded as shown above to match the building dimensions needed to find the length of the common rafters. For layout purposes, measure the building width from inside edge to inside edge of the wall framing, as shown at right.

cut and the birdsmouth cut of the rafter, 156.343, which converts to 156 5/16 inches.

In this example, note that the building width is measured from the outside of the framing rather than the outside of the sheathing. This is because I frame to match the foundation footprint, then lap the sheathing over the foundation. Because I take rafter measurements along their bottom edge, the most important building measurement is actually the distance between the inside edges of the wall framing.

Converting from sixteenths to decimals and back. Doing the math for this layout, including the decimal to fraction conversions, would have taken me less than 10 minutes in 1976, working longhand on paper. That's a glacial pace today, when these numbers can just be punched into a calculator. But, in the scheme of things, it had little impact on the overall productivity or cost of the job.

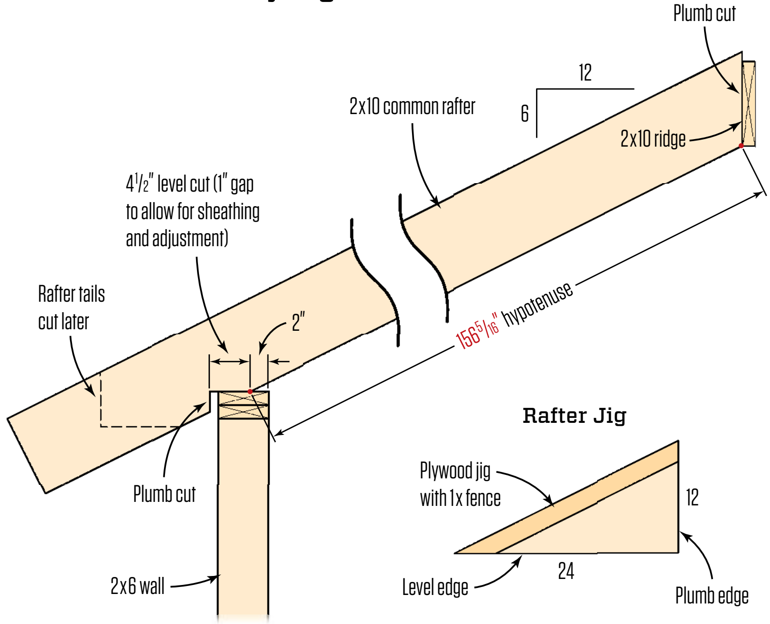
In the mid-1970s, the back of most tape measures had a decimal-equivalent table **(1)**. So, to convert from sixteenths to decimals, I could glance at the back of my

One way to convert decimals to fractions and back again is to refer to a decimal-equivalent table, which was once a common tape measure feature **(1)**. Conversions can also be done with a construction calculator.

tape. After a while, I had committed the decimal equivalents of halves, quarters, and eighths to memory, and I had to consult the table only for sixteenths.

When I had to go the other way and convert from decimals to sixteenths, I couldn't use the conversion table so easily. The decimal inch is usually expressed in hundredths, and there are 6.25 hundredths per sixteenth. So, if the result of my math yielded the number 0.42, for example, I could look at the conversion table and know it was about midway between the entries for 3/8 (0.375) and 7/16 (0.437). I could just pick one or the other and be well within a sixteenth of 0.42 inch, which would be fine for framing.

Laying Out the Cuts



Holding the square with the 6-inch mark on the tongue and the 12-inch mark on the blade lined up with the edge of the lumber (2), scribe the plumb cuts using the 6-inch side and the level cuts with the 12-inch side. For greater accuracy, multiply the sides by 2 and make a plywood rafter jig with a fence, as shown in the illustration above and in the photos on the facing page. You can multipy the sides of the triangle by 1.5, then clamp a fence to the 9-inch mark on the framing-square tongue and 18-inch mark on its blade (3).

The fractions and decimals can alternatively be converted by using division or multiplication. To convert the fraction 7/16 to a decimal, for example, divide the upper number by the lower number: 7 ÷ 16 = 0.4375. To convert the decimal 0.39 to a fraction, multiply it by 16: 0.39 x 16 = 6.24. The result, 6.24, is the number of sixteenths. After rounding this number, I'd know I had 6/16, or 3/8.

LAYING OUT THE CUTS

Laying out the cuts at the top and bottom of a rafter can be a bit confusing at first, but like most layout problems, it becomes much easier once you can visualize how the parts fit together. Because the sloping rafter has to fit the side of the ridge, which is plumb, and the top of the wall, which is level, the angled lines needed for the layout are called plumb and level lines. On this roof, the angles of these lines are the same as the ones in the 6-12-13.42 triangle used to create the larger, 69.87-139.75-156.343 triangle discussed above.

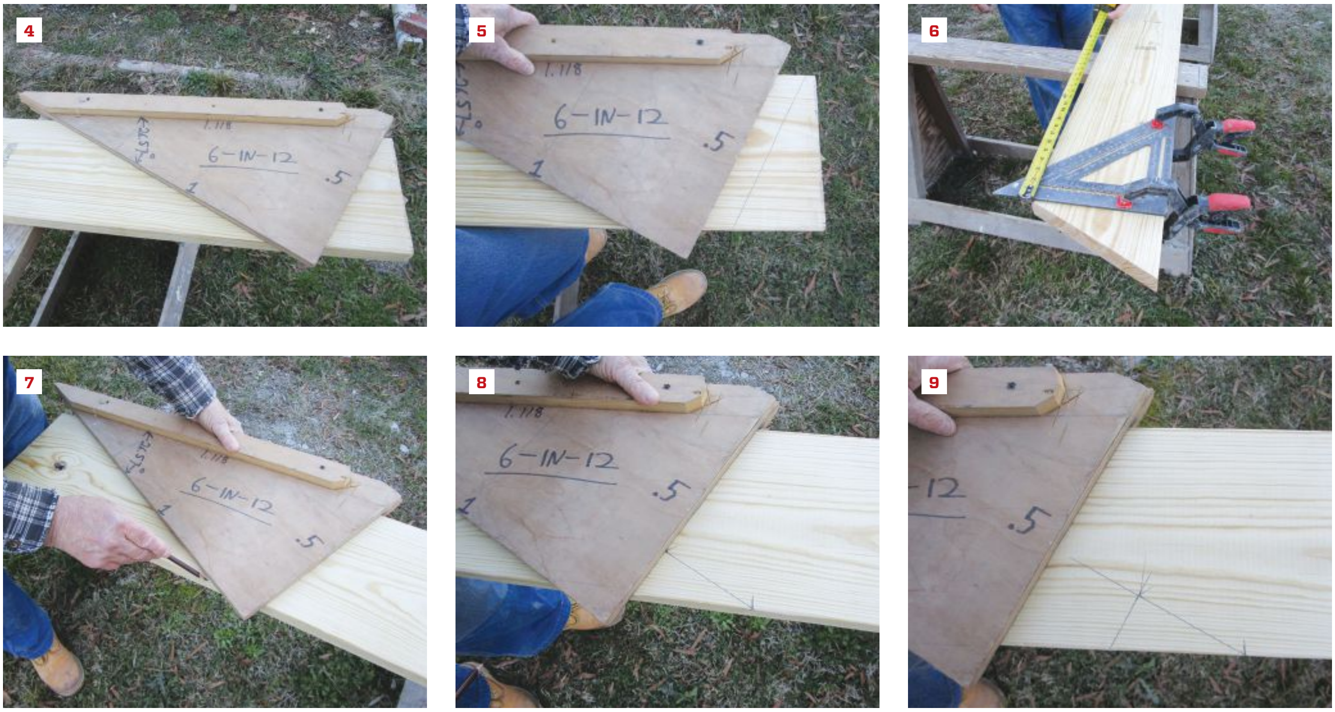
Using a framing square. To accurately lay out the plumb and level lines needed for these cuts, hold the framing square so the numbers representing the pitch align with the edge of the lumber. For this roof, the marks at 6 inches and at 12 inches should align with the edge of the rafter board **(2)**. Scribing along the 6-inch side marks the plumb line; and scribing along the 12-inch side marks the level line.

Holding the framing square precisely, even with two marks, and at the same time scribing a line is a little tricky, so it's helpful to clamp a fence at the marks **(3)**. If you use a fence, here's a handy tip: You can expand the size of the layout triangle by multiplying the 6 and 12 dimensions by 1.5. By placing the fence at the expanded dimensions, 9 and 18, you can mark the lines almost all the way across a 2x10.

Site-built rafter jig. To help lay out the plumb and level lines on wide rafter stock, I like to make a simple plywood jig that I fabricate on site. To make the jig shown here, I start by expanding the 6-12-13.42 triangle by a factor of 2:

2 x 6 = 12
2 x 12 = 24
2 x 13.42 = 26.84

Doubling the size of the 6-12-13.42 triangle makes the jig big enough to reach across the width of a 2x10. Using a square scrap from the end of a sheet of plywood, I measure and mark up 12 inches up from the corner and 24 inches out from the corner. After marking a sloping line that connects those two points, I make a second parallel line 2 inches above the first, then cut the triangular piece along this second line. I complete the jig by attaching a 1x2 fence along the sloping line on both sides of the template **(4)**.



Fabricated from scrap plywood with a true 90-degree corner and carefully measured dimensions to match the roof pitch (4), a rafter jig is an accurate layout tool (5). The author measures the rafter length from the short point of the plumb cut (6) to where the level cut for the birdsmouth begins (7). The long edge of the rafter jig is used to mark the level cut, which for this rafter is 4 1/2 inches long. The short edge of the rafter jig is used to mark the plumb cut of the birdsmouth (8, 9).

To lay out the plumb cut, I hold the jig against the top edge of the board and scribe along the vertical side **(5)**. Next, I measure and mark 156 5/16 inches from the short point of the cut to lay out the location of the birdsmouth cut **(6)**. To provide a surface to hook my tape measure to, I clamp a Swanson Big 12 Speed Square across the board and over the short point of the cut, and hook the tape to the part of the square that extends past the edge of the board.

At the 156 5/16-inch mark, I use the bottom edge of the jig to lay out the level line of the birdsmouth **(7)**. To do this, I keep the jig oriented in the same position, with the fence against the top of the board and the vertical side to the right. I slide the jig until the bottom aligns with the mark, then scribe the level line along the edge. To finish the birdsmouth, I make a mark on the level line that will be slightly beyond the outside of the wall. In this case, I measure and mark 4 1/2 inches along the level line **(8)**. Keeping the jig in the same position, I slide it down the board until the vertical edge aligns with the mark on the level line, then scribe along the vertical edge to mark the plumb line of the birdsmouth **(9)**.

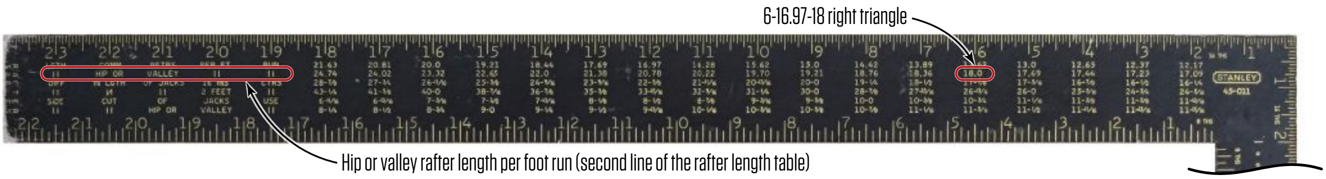
Sometimes, near the end of a board, there isn't enough surface left to hold the fence against. If this happens, you can rotate the jig (or the framing square/fence assembly) 180 degrees and hold the fence against the bottom edge of the board. You can also do this when, on wide material, the vertical edge of the jig or square doesn't reach to the bottom of the rafter board.

After laying out and cutting the birdsmouth, you can lay out the rafter tails for the eaves. I generally wait until I have installed all the rafters, then I lay out the rafter tails in place. I described this process in the *JLC* article "Framing Eaves and Rakes" (Aug/16).

HIP AND VALLEY RAFTERS

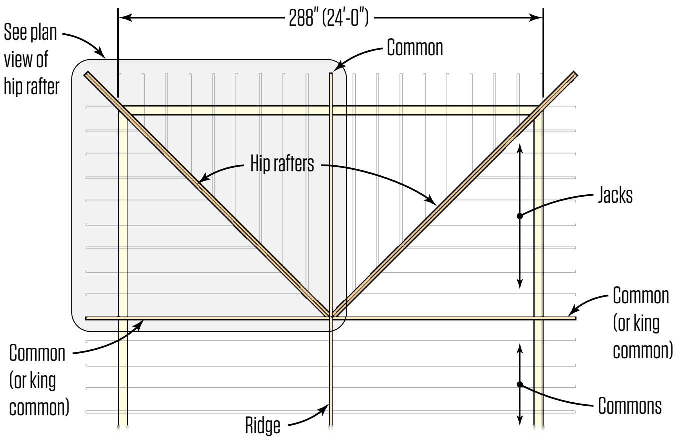
The second line of the rafter table provides the hypotenuses of 17 triangles, which all have as their base the number 16.97. To crack the code for this number, you have to go back to the phrase "per foot run." As indicated above, that phrase means 12 inches. But, since the hip or valley runs diagonally across the layout (in plan view), the base of the little triangle is actually 12 x 1.414 (the diagonal of an isosceles right triangle if the sides equal 1.0), which is 16.97. As with the common rafters, the altitude is in the scale above the table, and the hypotenuse is in the table.

For a 6-in-12 roof, then, the little triangle for a hip or valley is 6-16.97-18. To find the length of a hip or valley to fit the 6-in-12 roof just described, use the same 11.65 multiplier used above to find the length of a common rafter. Both the altitude and the base of this triangle have already been established by the layout of the main roof.



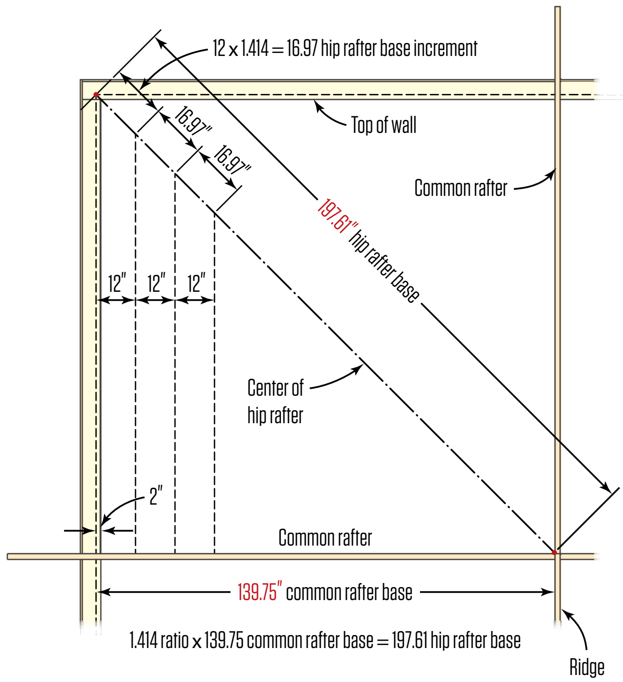
The second line of the rafter table is used to determine the length of a hip (or valley) rafter. The second number under the 6 on the 24-inch scale, or 18, is the hypotenuse of a triangle with a rise (or height) of 6 and a base (or run) of 16.97, rather than 12.

Partial Roof Framing Plan

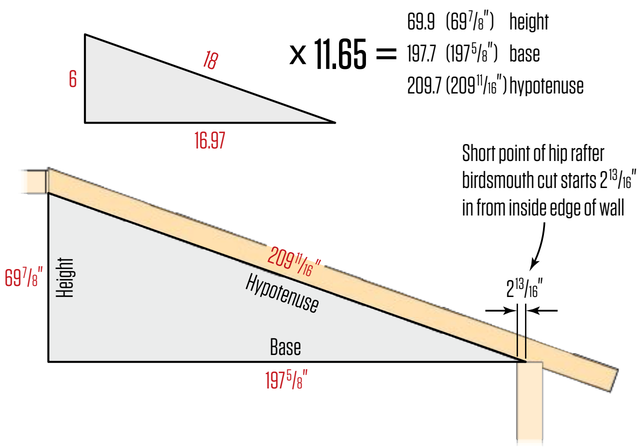


Because hip rafters have longer spans than common rafters, they typically are framed with either engineered lumber or with doubled sawn lumber; in either case, measurements must be made in the middle of the assembly (above). To find the length of the hip rafter base, multiply the common rafter base (139.75) by 1.414. Dimensions can be determined by expanding the triangle dimensions found in the rafter table by the 11.65 multiplier already calculated when determining the length of the common rafters, as shown at right.

Plan View of Hip Rafter



Elevation View



The altitude, which determined the height of the ridge, is fixed at 69.875. The base is 1.414 times the length of the base for the common rafters. The math looks like this: 1.414 x 139.75=197.61.

To double-check the lengths of the altitude and base and to find the only dimension missing—namely the distance between the short points of the ridge cut and the birdsmouth—multiply all three numbers of the little triangle by 11.65. As you can see in the elevation view at right, the altitude and the base check out and the critical dimension for the hip or valley is 209.7 inches, or 209 11/16 inches. This dimension, by the way, has to be measured and marked in the center of the thickness of the hip or valley.

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

With a unique foam-to-gel formula, AdvanTech™ subfloor adhesive delivers a powerful panel-to-joist connection with a fast, easy application — even on wet or frozen wood[1]. And when you combine it with the moisture resistance, strength and fastener-holding power of AdvanTech® subfloor panels, you get a subfloor assembly backed by the industry's only Squeak-Free Guarantee[2]. And that's what makes AdvanTech® products the FLAT OUT BEST™ choice for a quiet, stiff floor.

AdvanTech SUBFLOOR ADHESIVE

See it in action at AdvanTechSFA.com.

[1] Exceeds ASTM D3498. [2] Limitations and restrictions apply. Guarantee for panel-to-joist connection on an AdvanTech™ Subfloor Assembly.
See SqueakFreeGuarantee.com for details. HUB 24215-1 04/22


Discover VERSATEX®
The smarter way forward.
JMS Builders Inc., Westerly, RI
VERSATEX manufactures state-of-the-art cellular PVC building products that install like real wood and are completely impervious to moisture or any environmental impact. When you Discover VERSATEX, you find there is a way to blend architectural beauty with long-lasting, low-maintenance performance. Learn how VERSATEX was discovered by this builder at
www.versatex.com/discover.JoeStanton
www.versatex.com
724.857.1111
VERSATEX®
BUILDING PRODUCTS

BY CLAYTON DEKORNE

Key Trends in the 2022 Cost vs. Value Report

The 35th annual Cost vs. Value report by Zonda (*JLC*'s parent company) shows improvement projects that are on the exterior of the house continuing a multiyear trend of providing the greatest return on investment (ROI) to homeowners. Of the 22 remodeling projects in the report, 11 are exterior replacement projects, and all of these rank within the top 12 projects with the highest ROI. At the top is the replacement of the garage door (at No. 1; see "Cost vs. Value: National Averages," right), new siding (including manufactured stone veneer as an exterior accent at No. 2 and fiber cement at No. 4), and windows (with vinyl replacement windows at No. 5 and wood replacement windows at No. 7). The one exception to the exteriors trend, sitting at No. 3, is the minor kitchen remodel—a modest kitchen face-lift that offers a relatively high return when done prior to the sale of a house. The reason this ranks high stems from the nature of the report.

The Cost vs. Value report (costvsvalue.com) aims to answer a specific question: What value does a particular remodeling project add to the sale price of a home? This is only one kind of value that these projects can provide, but it proves to be an important assessment.

Cost vs. Value: National Averages

Project	2021 National Averages		
	Job Cost	Value at Sale	% Cost Recovered
Garage Door Replacement	$4,041	$3,769	93%
Manufactured Stone Veneer	$11,066	$10,109	91%
Minor Kitchen Remodel	$28,279	$20,125	71%
Siding Replacement (Fiber Cement)	$22,093	$15,090	68%
Window Replacement (Vinyl)	$20,482	$13,822	67%
Siding Replacement (Vinyl)	$18,662	$12,541	67%
Window Replacement (Wood)	$24,388	$16,160	66%
Deck Addition (Wood)	$19,248	$12,464	65%
Entry Door Replacement (Steel)	$2,206	$1,409	64%
Deck Addition (Composite)	$24,677	$15,315	62%
Grand Entrance (Fiberglass)	$10,556	$6,305	60%
Roofing Replacement (Asphalt Shingles)	$31,535	$18,780	60%
Bathroom Remodel Mid-Range	$27,164	$15,990	59%
Universal Design Bathroom	$42,105	$23,869	57%
Major Kitchen Remodel Mid-Range	$80,809	$45,370	56%
Roofing Replacement (Steel)	$51,436	$28,196	55%
Bathroom Remodel Upscale	$82,882	$44,363	54%
Master Suite Addition Mid-Range	$175,473	$93,762	53%
Major Kitchen Remodel Upscale	$158,015	$83,025	53%
Bathroom Addition Mid-Range	$63,986	$33,160	52%
Bathroom Addition Upscale	$114,773	$59,136	52%
Master Suite Addition Upscale	$356,945	$165,359	46%

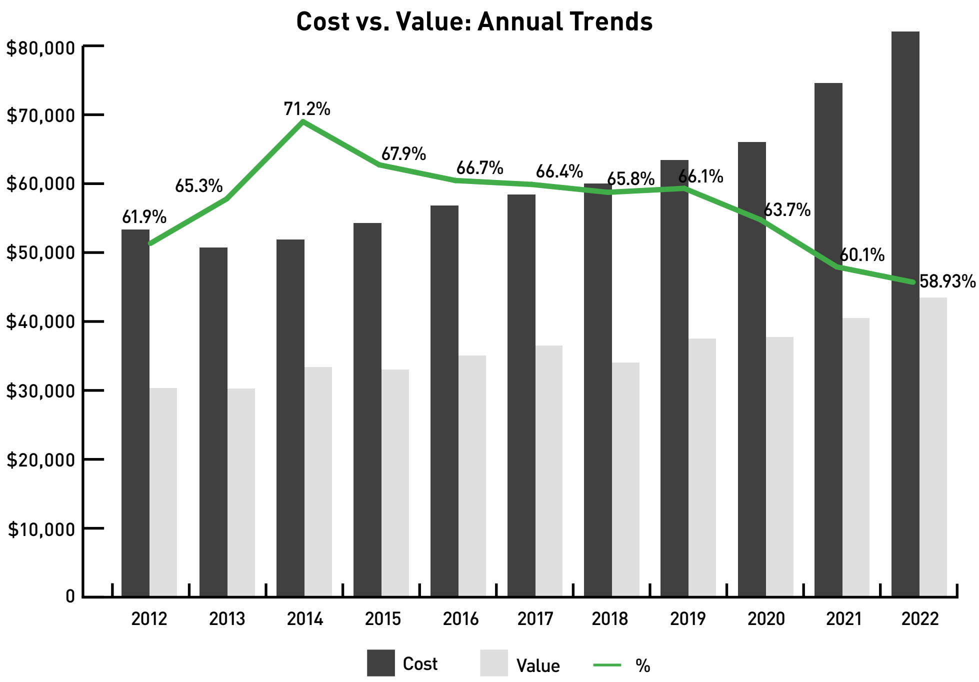
National perspective. Sorted by the highest return on investment, this table ranks all 22 projects in the 2022 Cost vs. Value report.

WHAT SORT OF VALUE?

The value data in the report was derived in prior years from surveys of real estate professionals who were asked to rate the value of the 22 projects in their area. In the past two years, Zonda has revamped the report's methodology, providing an econometric model that overcomes a past difficulty of surveying a sufficient number of real estate professionals in some areas. The new model sifts in a range of other relevant variables, including local GDP, existing home sales, existing home values, changes in existing home sales, and housing starts, among others. What's important to grasp here is that all of these variables (yes, even new housing starts) influence the sale price of existing homes in specific markets, and that is what defines the value side of the calculated ROI.

There is more than one kind of value. Lifestyle enhancement, increased accessibility, and the ability to accommodate a growing family are all reasons homeowners take on remodeling projects, each with its own type of value. Cost vs. Value focuses on another sort—the value that leads to a higher sale price for an existing home. If we begin to think a bit more like a real estate professional, we begin to grasp how to fully understand this value and, correspondingly, the return on investment.

Local markets. "Location, location, location" we all know as the first principle of real estate, and the Cost vs. Value report addresses this by providing data for 150 metro markets and allowing users to drill down to data at the ZIP code level to obtain a more fine-grained



Historical perspective. This chart shows trends based on 15 of the 22 Cost vs. Value projects that have been included in the report since it began in 2002. While values have increased for the last five years, the overall ROI for these 15 projects has fallen, owing to the sharp increase in material costs over the last two years.

view of how costs and values differ among metro areas.

Exterior condition. "Curb appeal" and "first impressions" are strong concepts in real estate because they have a surprisingly big impact on how much money prospective home buyers are willing to pay for a home. Prospective buyers who see a "buttoned up" exterior form the impression that the house is in good shape—or, as we all like to say, "has good bones"—and they proceed to fit all the new information they learn once they walk through the front door around these positive impressions. The reverse case—that is, driving up and seeing a dilapidated garage door or a house in need of a paint job—has the reverse effect: Buyers immediately start to downgrade what they are willing to pay for the house. While these impressions are highly subjective, they tend to influence buyers in remarkably consistent ways. And this tendency goes a long way toward explaining the high ROI on exterior replacement projects.

Discretionary projects. While still delivering a strong return on investment, larger discretionary projects, such as kitchen, bath, and master-suite remodels and additions, tend to have a lower impact on the price of a home. These projects typically involve a large number of products that have strong appeal to the client making the selections but that also tend to be quite individualized without garnering broad appeal. There is no one best cabinet style or color, perfect tile, or fixture design that everyone likes. Certainly, there are design trends that have wide appeal among a range of homeowners. But because of the vast differences in aesthetic tastes, real estate brokers know that one person's elegant new kitchen or bath may be viewed by other prospective buyers as unappealing, overstated, or otherwise in need of a reset.

The minor kitchen remodel ranks high, I believe, because most prospective buyers who are trying on a new home ask: "Can we live with this kitchen until we build back our savings and we can create our dream kitchen?" If the answer is yes, they are much more likely to meet the seller's price, or even bid higher.

HEAVY COSTS

The strong leaning toward exterior replacement projects having the highest return on investment predates the pandemic. It's important to understand that the Cost vs. Value data doesn't track the most popular projects; this is not a design trends report. Costs are based on common projects that are assigned specific dimensions and details in order for the cost information to have teeth in the real world of contracting.

The Cost vs. Value report tracks the ratio of value over cost for 22 common remodeling projects, and in that ratio lies the rub: Across the board, material costs have been increasing for the last decade, and increasing sharply for the past two years. And even while values have also been steadily inching up for the past five years, the high numbers on the bottom of the ratio (cost) bring

Cost vs. Value by Region

	Middle Atlantic	New England	South Atlantic	East North Central	West North Central	East South Central	West South Central	Mountain	Pacific
Garage Door Replacement	92.6%	95.3%	92.1%	93.9%	91.0%	92.7%	92.5%	93.1%	95.1%
Manufactured Stone Veneer	91.0%	89.7%	92.5%	90.1%	93.6%	89.4%	90.2%	91.3%	92.7%
Minor Kitchen Remodel	74.7%	69.3%	68.6%	68.3%	68.3%	70.3%	68.4%	71.7%	77.9%
Siding Replacement (Fiber Cement))	72.2%	70.2%	64.4%	66.7%	63.7%	65.2%	65.4%	69.5%	73.8%
Window Replacement (Vinyl)	67.2%	69.6%	65.4%	68.4%	57.7%	63.5%	59.7%	68.9%	75.5%
Siding Replacement (Vinyl)	71.9%	69.8%	63.7%	68.9%	51.9%	57.4%	59.0%	72.5%	72.1%
Window Replacement (Wood)	69.5%	69.9%	61.3%	67.2%	55.8%	65.0%	58.4%	67.5%	75.8%
Deck Addition (Wood)	65.7%	61.9%	64.5%	62.4%	52.2%	64.4%	59.2%	64.5%	72.0%
Entry Door Replacement (Steel)	67.1%	55.1%	61.7%	64.6%	63.0%	69.1%	64.5%	54.6%	69.9%
Deck Addition (Composite)	63.0%	66.6%	58.6%	60.8%	50.3%	61.0%	53.8%	60.3%	73.2%
Grand Entrance (Fiberglass)	67.9%	57.5%	55.4%	59.6%	51.9%	56.6%	52.1%	52.9%	72.3%
Roofing Replacement (Asphalt shingles)	56.5%	63.6%	58.6%	55.8%	50.3%	58.0%	55.1%	59.5%	69.4%
Bathroom Remodel Mid-Range	56.1%	60.8%	55.1%	58.5%	51.2%	62.7%	56.5%	56.5%	67.5%
Universal Design Bathroom	56.8%	61.8%	53.2%	56.5%	52.0%	54.9%	54.0%	54.7%	63.3%
Major Kitchen Remodel Mid-Range	58.5%	53.8%	53.7%	54.3%	52.8%	56.5%	53.0%	53.7%	64.2%
Roofing Replacement (Steel)	51.1%	58.5%	54.4%	52.4%	48.3%	53.4%	51.5%	57.0%	60.7%
Bathroom Remodel Upscale	51.7%	54.3%	51.1%	53.6%	49.3%	50.1%	52.8%	52.5%	59.5%
Master Suite Addition Mid-Range	53.7%	53.5%	50.7%	51.0%	47.2%	44.0%	51.4%	51.4%	63.4%
Major Kitchen Remodel Upscale	52.2%	52.6%	51.0%	52.3%	50.8%	51.8%	48.0%	51.1%	59.3%
Bathroom Addition Mid-Range	49.6%	49.0%	48.4%	49.4%	49.7%	59.6%	52.2%	49.5%	60.2%
Bathroom Addition Upscale	50.4%	48.7%	48.3%	50.2%	51.0%	48.6%	51.8%	50.5%	59.2%
Master Suite Addition Upscale	48.3%	44.8%	44.0%	45.0%	40.8%	38.2%	44.7%	45.8%	52.9%

Regional perspective. A look at the regional averages (sorted to match the "National Averages" table for highest ROI, on page 15) shows the influence of local market variations on ROI percentages. Overall, the Pacific region outperformed the national average by 7.9%, while the West North Central region came in 5.2% under the national average.

down the overall number, which is the return on investment.

A look at yearly trends (see "Cost vs. Value: Annual Trends," opposite page) shows that project costs have risen consistently since 2014, with sharp increases in costs in the last year brought on by supply-chain disruptions largely created by the pandemic but complicated by global trading tariffs. Mirroring the increase in costs, the value-over-cost ratio as a percentage has steadily declined over the same period, with the sharpest decline in the last decade in 2021—down 3.6%. (Please note the Cost vs. Value report reflects economic changes that occurred the previous year, so this drop reflects 2020 activity.) It's worth noting that despite the sharp cost increases for building materials in 2021, the decline in overall ROI in the 2022 report was a modest 1.2%, confirming the resiliency of robust remodeling markets amid economic concerns and supply-chain challenges.

REGIONAL TRENDS

Of the nine regions, three—Pacific, New England, and Middle Atlantic—outperformed the national average of 61.7% (for all 22 projects), with the Pacific region leading at nearly 8% above the national average. New England was 1.4% higher, and the Middle Atlantic, almost 1% higher. The West North Central region fell below the national average by 5.2%; the West South Central region was under by 2.9%. All other regions were within 2% below the national average.

Clayton DeKorne is editor of JLC.

Q Since steel expands when it rusts and destroys whatever is around it, why doesn't the rebar used to reinforce concrete footings and foundations—which are in contact with ground water—rust and break the concrete into pieces?

A *Foster Lyons, an engineer and building-science consultant, responds:* The short answer is, it does, but it happens so slowly and takes so long that it is insignificant to us. Properly placed rebar typically corrodes at a rate of about 1/10 micrometer per year across the thickness of the material. So, under normal conditions, a #5 bar (5/8-inch diameter) loses 2/10 micrometer from its diameter every year.

To determine if this is a problem, we have to understand the size of a micrometer. Also known as a micron and symbolized by the Greek letter μ, a micrometer is equal to one millionth (1/1,000,000) of a meter. By way of comparison, fine, thin hair is about 30μ in diameter and thick hair, about 130μ. A razor blade is about 0.4μ at its cutting edge, while a sharp knife blade is about 1μ; 5μ at the cutting edge is considered dull.

At a corrosion rate of 0.1μ per year, it will take 31,750 years to reduce the diameter of a #5 rebar from 5/8 inch to 1/2 inch, and 158,750 years to corrode it down to nothing. If Stonehenge had been built with well-placed reinforced concrete instead of natural stone, the concrete would still be totally functional today. So, the real questions are:

- Why does rebar corrode so slowly under typical conditions?
- Why does it sometimes corrode quickly?

The answer to both questions lies in the chemistry inside the concrete. Most of the time, this chemistry is unfavorable for galvanic action of steel, with a pH level that is normally about 13.5. That's quite high; stronger than oven cleaner but not quite as strong as the liquid drain cleaner you might use when your tub drain is clogged with 130μ hairs. The high pH in concrete is caused by a lot of loose calcium, sodium, and potassium ions—usually from the cement—and water, making it a little bit like a solid version of rat poison.

A pH level of 13.5 puts the steel into what's called a neutral state, meaning that the iron doesn't dissolve off into any water solution that may be around it (it's really the iron oxide that doesn't dissolve off; it then acts as a protective layer for the pure iron below). Without loose iron atoms, rust can't get started.

If the pH level is reduced to around 8.5 (which is about like hair perm solution, toothpaste, and hand soap), then the iron will loosen up and go into solution. When the pH goes below about 8.5, the protective iron oxide layer starts dissolving off and, voila, rust. This is called carbonation, which is great for soda (pH about 3 or 4) but bad for concrete.

There are a few things that can cause the pH in concrete to dip. The first is chlorine, which reaches the rebar through cracks and voids and messes up that protective layer of iron oxide. As a result (well, there are other factors too, but this is the short version), loose iron atoms are everywhere, and those atoms start oxidizing. So, the lesson here is to keep chlorine away from reinforced concrete.

When you see concrete destroyed by rusty rebar in sidewalks, it's usually because of chlorine. Somebody salted the sidewalk and the chlorine got to the rebar. The same concept applies for roads and bridges and for balconies on high-rise apartment buildings right on the beach in Miami.

Photo: Jake Lewandowski

Rebar encased in concrete can still corrode, but the process is typically very slow. The surface corrosion shown here doesn't affect the steel's structural integrity and can be cleaned off prior to repriming and concrete repair work.

Another factor that can cause rebar to rust prematurely is carbon dioxide, or CO_2, which reacts with loose calcium, sodium, and potassium ions and starts reducing the pH in the concrete. When you see concrete within a building that has been damaged by rusty rebar, that's usually because of CO_2-caused carbonation.

Unfortunately, there's a lot of CO_2 around; fortunately, it doesn't migrate into concrete very quickly, with the rate of carbonation affected by the relative humidity in the concrete. When concrete gets wet, there is typically high relative humidity, and the rate of carbonation increases because the CO_2 dissolves in the condensed water in the pores—capillary condensation—and moves faster through the water. When concrete remains dry, it usually stays at a low internal relative humidity, and the amount of carbonation is insignificant. It's those sections of concrete that are exposed to the air and get wet while also providing only a thin layer of cover over the rebar that can lead to corrosion problems on the rebar.

That's why the American Concrete Institute's (ACI) coverage recommendations are so important. CO_2 moves slowly inward from the outer surface of the concrete where it is exposed to air, so keep rebar away from the outer edges as much as structurally possible. The goal is to make sure the rebar stays in an area that is less likely to get wet and less likely to experience carbonation (and therefore less likely to have low pH levels), so the iron is less likely to start rusting.

Reinforced concrete footings, for example, have a very high relative humidity since they exist in the ground. But because there's not much air movement down there, carbonation goes super slow; the CO_2 at the surface of the concrete isn't being replenished by any fresh breezes blowing by. Also, specifying at least 3 inches of cover for the rebar—per ACI recommendations—helps to insulate the rebar. It will take a few hundred years or so for any stray CO_2 to migrate through 3 inches of concrete, and then another few hundred years before there's enough to cause problems. To me, that's nothing to worry about.

Except for the problem with rebar, CO_2 is great for concrete and for mortar, making them stronger and more adherent. And we should all be happy that the CO_2 is getting pulled out of the atmosphere.

Learning From the Past

BY BRENT HULL

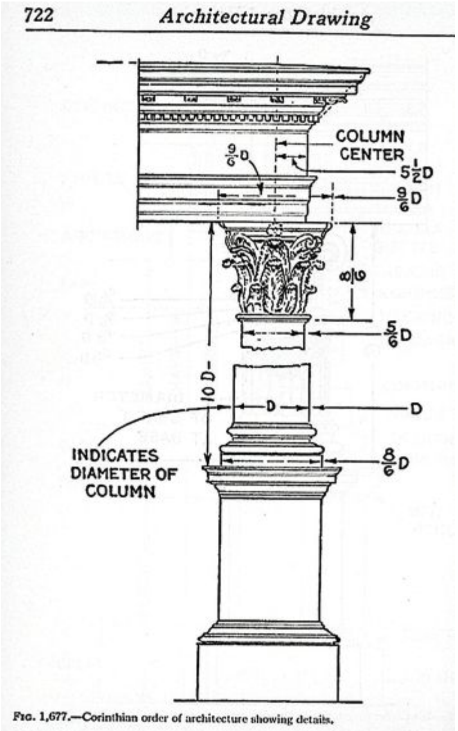
You have no doubt heard this common expression: “They don’t build ’em like they used to.” In response, I’ve heard some craftspeople say, “Thank goodness,” while others nod in agreement, longing for a time when craftsmanship was celebrated over efficiency and profit. In my career as a builder specializing in historic preservation, I can see both sides. I’m usually saying “Thank goodness” when I look at structural issues. For example, framing in old bungalow houses near Fort Worth, Texas, where my business is based, can be a mess. I commonly see 15-by-20-foot rooms built with 2x4 ceiling joists. These joists often carry heavy plaster ceilings and bow 3 to 4 inches across a room. Even with joists cut from old-growth yellow pine, the weight of the plaster has overwhelmed the undersized members. It seems builders hadn’t quite worked out lumber-span charts when those bungalows were built. Another example I often see is basement walls of historic houses that were poured without rebar. In our area of North Texas, we have a lot of clay in our soil that is expansive, and these foundation walls have not aged well, to say the least.

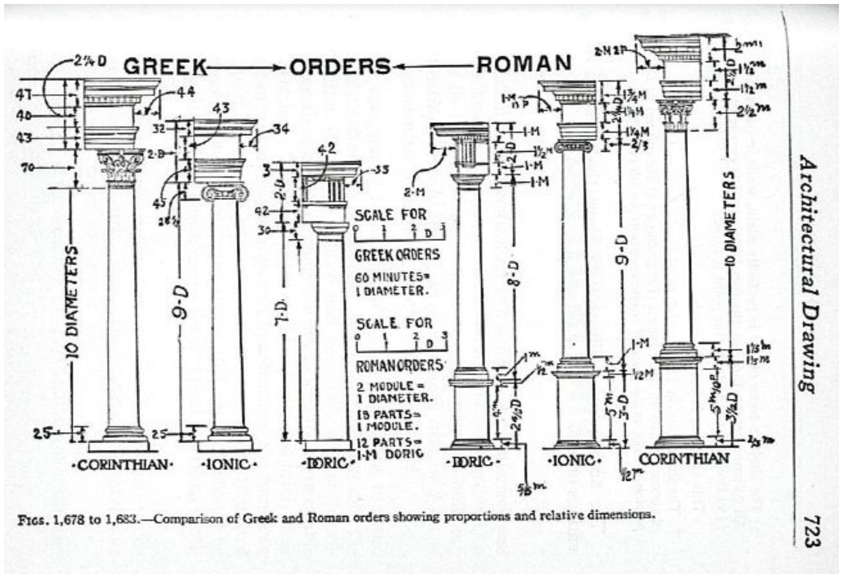
Structure aside, I would argue that historic homes surpass new homes today when it comes to aesthetics and design. Let’s start at the front door for an example: The well-proportioned casing around a 1910 bungalow can be 4 to 5 inches in width, with a cap made from three different moldings. In 1920, no opening or pass-through existed that wasn’t trimmed and decorated. The idea of drywall (or plaster) returns without trim around an opening wasn’t considered, even on the cheapest of houses. When you add in decorative built-ins and working fireplaces, it’s easy to see that there has been a change of mindset about building.

This shift occurred after WWII, led by men like William Levitt, who changed home building in the U.S. In an effort to meet the post-war surge in housing demand, Levitt broke unions, ignored craft, and adopted a cookie-cutter, one-after-another approach. This approach had grown out of “American Housing”—a long governmental report written in the 1940s that analyzed the home-building industry of the 1930s. It reduced home building to a few clear “problems”—the biggest, according to the report, was that builders spent too much time crafting homes instead of building them with a production, or “car-factory,” mindset. But in the process of instilling factory-like efficiencies to home building, Levitt and his cohort also changed design by stripping any sense of scale and proportion out of the building. The cookie-cutter Monopoly houses of 1950s “tracts” evolved by 1980 to a period of “McMansions” and “starter castles”—large, cheaply built houses that completely lacked elegance in scale and proportion.

Photos by Brent Hull

The photo at far left **(1)** shows an oversized attempt at a Georgian Colonial entry. Notice how the pediment is too wide and dwarfs the columns, which look spindly by comparison. This doorway **(2)** is a proportionally correct interpretation of this style Georgian entry.





The 1926 edition of *Audels Carpenters and Builders Guide* included instruction on the Classical order of architecture. At left is an explanation of the proportion of the elements for a Corinthian column and pediment (each part sized as a multiple of the column diameter). Above is a comparison of the Greek and Roman orders showing proportions and relative diameters.

There are at least three key takeaways from the past that can help us build better today: First, by studying historic homes we can learn to infuse our buildings with a better sense of scale and proportion. Second, examples from the past challenge and encourage us to raise our level of craftsmanship. Finally, both traditional design and traditional craftsmanship provide us with a distinct sales and marketing advantage in today's home-building market.

SCALE AND PROPORTION

Scale and proportion are words that are often thrown around without much understanding of what they mean. Top designers and architects study these concepts and spend their lives honing their eye and touch because they know that when the scale and proportion of building elements are right, they are magical.

Scale has to do with size. For instance, when a pediment is too large for its door **(1)**, it dwarfs the columns and throws off the proportions (the relationship between parts). In the correct way to execute a Georgian-style door, the sizes of the elements look balanced **(2)**.

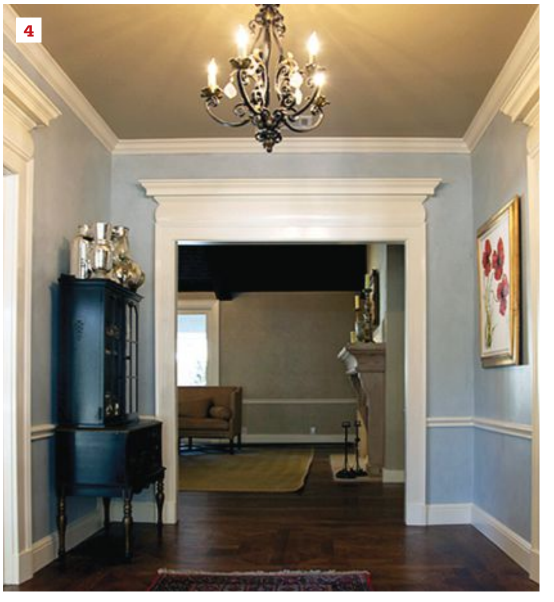
Often, historic design, like the well-proportioned door example, was based on well-defined rules for building—guidelines grounded in the Classical orders of architecture. The 1926 edition of the four-volume *Audels Carpenters and Builders Guide* by Frank D. Graham and Thomas Emery included examples of good design and taught carpenters scale and proportion by introducing the Classical orders (see excerpts, above).

Understanding the orders of architecture is a great gift from the past. Do you want to build graceful and elegant mantels? Awesome door headers? Any of the finer points of a traditional house can be learned by studying the past. Most of my teaching videos on the Build Show (buildshownetwork.com/go/brenthull) and YouTube (youtube.com/c/brenthull) are lessons gleaned from the past about every element of a house, from plinth blocks to pediments.

REVIVING CRAFTSMANSHIP

The second lesson we can learn from the past is how to become better craftsmen and craftswomen. At the North Bennett Street School in Boston, where I studied historic preservation, there was a furniture department that focused only on traditional furniture, including hand-carved ball-and-claw feet and traditional inlay and marquetry. These are challenging details to pull off, but the lessons are profound. If you can build traditional furniture, you can build anything.

The same lessons can be found in woodwork and trim. Moldings and trim on fine homes built from the Georgian period up through the 1940s are typically much more complicated and more intricate than those on houses today. Historically, an entry pediment was built by hand on site by a master builder, whereas today, pediments can be bought online and delivered ready to install. All millwork, in fact, before the industrial revolution of the 1850s was handmade. Thus, the skills of the craftsmen tended to be higher because they were required to build all windows, doors, mantels, and the like on site, and there was generally more woodwork in homes, including



A before **(3)** and after **(4)** view of an interior executed by the author's company. By focusing on well-crafted historic replication, the author has found a niche that has provided business stability for the past 30 years.

wainscot, window panels, crown molding, and interior pediments. Nothing could be ordered online. To raise your game and improve your skill as a craftsperson, practicing and copying details from the past is the path to finer skills.

I also look to the comparison between remodeling and home building. I feel strongly that remodeling is a more difficult craft than building new. Renovation work often involves a high level of complexity and requires a concentrated level of problem solving—namely, in solving for existing conditions—that is not required in new construction. For aspiring craftsmen and craftswomen, renovation work can definitely test their limits.

BUSINESS OPPORTUNITIES

Of course, having more woodwork that is passionately labored over in a home does cost more. But it doesn't have to cost more to keep elements proportional, even for the simplest trim work. More importantly, I think that pushing toward better design and craftsmanship provides us greater business opportunities; in particular, a huge sales and marketing advantage.

One of the secrets to the longevity of my business has been its flexibility and adaptability. Now in my 30th year in business, I've lived through many ups and downs, and one thing I'm thankful for is that I have carved out a niche here in North Texas for historic and pre-1940 homes. We both build new homes and remodel older homes, and when we build something new, it typically has a historic flair. Being able to do both means that when the market is down and people aren't building new homes, we are still busy remodeling existing homes. And when things pick up, and people are building new homes again, they can count on us.

Our niche, which has been grounded in high-skilled work and historic replication, has also helped us gain the trust of top architects and discerning clients. We are blessed to have wealthy clients who want what we can craft. But winning the trust of these clients is hard; it must be earned.

STUDENTS OF THE PAST

Learning from the past requires being a good student. The best way to begin to learn these skills is by visiting historic houses. I suspect in every town in America there is at least one historic house that you can visit. There are at least two here in Fort Worth. I've done extensive work at both and have learned a lot in the process.

Next, travel. There are plenty of places you can go to learn how to build better. I would start with Colonial Williamsburg. It is a magical place that will have you scratching your head and drooling over awesome details. Winterthur—the du Pont home in Maryland—is another wonderland of interior trim and examples of building that I can bet you have never seen. When you go, take a sketch pad. Something magical happens when you see a historic detail with your eyes and draw it with your hand. You gain information, and it seals itself into your memory better than just taking pictures.

Architects often go on "sketching tours" because they learn firsthand how to resolve details. The process of drawing forces you to recreate the same proportions on paper that craftspeople worked out with materials. Find a challenging element and ask yourself how you would build it today. I often spend time working out details and thinking through all the parts and pieces. I think if you do this, you will say to yourself, they really don't build 'em like they used to.

Brent Hull is the owner of Hull Works (hullworks.com), based in Fort Worth, Texas. Follow him on Instagram (@hullmillwork_hullhomes), on his YouTube channel (youtube.com/brenthull), and on the Build Show (buildshownetwork.com/go/brenthull).

Barrette OUTDOOR LIVING

EVOLUTION OF THE NEW BACK YARD

How composite decking has played a key role in bringing newfound visions of creative outdoor living spaces to life.

If the past two years have shown us anything, it's how adaptable we can be when faced with the unimaginable. Countless stories have been told about the ways businesses have shifted, families found creative ways to gather, kids found new ways of learning and how homeowners redefined the spaces in which they lived.

In the outdoor products industry, the greatest trend that emerged was a new way of embracing the outdoors as people pushed beyond the four walls of their homes to create unique outdoor living spaces. These spaces created new ways to cook, to entertain, to work, to play and to gather safely—helping boost moods, calm anxiety and providing solace to those who needed it. Leading the way on many outdoor expansions is composite decking—one of many products that are playing a role in helping bring homeowner's outdoor dreams to life.

In the outdoor products industry, the greatest trend that has emerged over the past two years is a new way of embracing the outdoors. Homeowners are pushing beyond their home's four walls, creating unique outdoor living spaces to cook, to entertain, to work, to play and to gather.

WHAT'S TRENDING IN DECK DESIGNS?

Deck design trends are beginning to mirror trends in home-building more closely—moving toward more modern, contemporary styling that showcases clean lines and incorporates railing products that may offer modern mixed material options, such as glass, decorative screen panel or cable infills.

Homeowners are coordinating deck board colors, railing and outdoor décor to create a cohesive aesthetic that tends to blend more seamlessly with outdoor landscapes. A notable increase in color variegation and more realistic wood grain patterns also echo the desire to create a more natural-looking landing space for newly extended areas.

"We've noticed a dramatic increase in homeowners who are looking to expand their outdoor spaces to be more usable areas—some of which are really unique transformations that increase overall quality of life," said Michael Gabso, Owner, MG Construction & Decks. "Installing a composite deck or expanding an existing one is a great way to achieve that extra square footage. We've found the variety of color and patterns found in Barrette Outdoor Living composite decking to be extremely popular amongst our clients."

FRAMING OUTDOOR SPACE AND FOCAL FEATURES

In addition to increasing a home's square footage by adding or extending a deck, unique ways of framing spaces and creating focal features have propelled deck design to a whole new level. For example, installing a pergola can create the illusion of an outdoor room by defining an area and adding height while also providing protection from the elements. Outdoor fire features—fireplaces, fire pits and fire tables—help extend the outdoor living season. And water features are a fun and often affordable way to help bring a sense of tranquility to an outdoor space—adding to an outdoor oasis. A grand staircase or outdoor entertainment center to watch the game or movies also make for great focal features.

Whatever outdoor vision a homeowner may have, Barrette Outdoor Living offers a multitude of outdoor products that can help people embrace their Outside Side, moving beyond the confines of their home's four walls and bringing outdoor spaces to life.

To learn more, visit **barretteoutdoorliving.com**

Produced by Zonda Media, a Delaware corporation.
marketing.zondahome.com

BY JON BEER

Why I Switched to Cost-Plus

All contractors deserve to earn a profit and cover their overhead, just as all clients deserve 100% transparency in how their money is spent. For me, cost-plus pricing is the best way to provide both for nearly all residential and small commercial construction projects. Before I get into how it works, I'll share how I got here.

I live and work in Newburgh, N.Y., home to the second largest historic district in the state, about an hour north of New York City. I run a small, five-person design-build company that does interior remodeling, custom cabinetry, additions, historic restoration, and retail build-outs. Like most contractors, I began my business working in the confines of fixed-price contracts. Because much of my remodeling work is in older homes that often have hidden conditions that are hard to predict, estimating can be difficult. But many clients expect the contract price provided at the beginning of a job to be its final cost, despite unforeseen issues; negotiating change orders can be dicey, as they are basically smaller fixed-priced contracts tied to specific issues.

After a few years of working with fixed-price contracts, I began to realize just how easy it is to miss things when preparing an estimate. It's a fair assumption that most if not all builders have experienced the anguish of discovering they forgot to include something but being reluctant to ask the client for additional money. A large enough error can impose a significant financial burden on a builder, particularly one who's in the early stages of establishing a business.

Adding to that challenge, as builders and remodelers, we work in a highly unregulated industry, with practices varying state to state, county to county, and even town to town. Some contractors even guess on pricing or give single-line prices for complex jobs. Unfortunately, contractors are often hired on price alone, and not on their attention to detail, knowledge of building code, familiarity with best practices, previous client relations, and jobsite cleanliness. Also, many clients see unrealistic costs on home remodeling TV shows and Pinterest and expect, for example, a luxury kitchen to cost $15,000. All builders of quality have heard horror stories about low-price bidders doing shoddy work and unscrupulous contractors running away with people's savings.

A client must trust the contractor to provide a reasonable estimated cost and good-quality work, while a contractor must trust the client to pay them for services rendered. But commonly, clients are (or feel they have been) taken advantage of by an overcharging (and sometimes, underperforming) contractor. Similarly, some clients decide to not pay a contractor because they think the bill exceeds the value of the work. Neither scenario is desirable.

The question is, how do we change misconceptions about contractors, increase client transparency, and ensure that builders get paid fairly? The answer: Change how we structure our pricing contracts. This is where cost-plus comes in.

WHAT IS COST-PLUS?

The full version of the term is "cost plus a fixed sum." It was first coined by engineer Frank B. Gilbreth in 1907 to describe how he structured his construction business. It has been implemented on many scales and was even used on U.S. government contracts with once small tech firms like Hewlett Packard (now HP) and Fairchild Semiconductor to bill the Department of Defense for research.

> Since switching to cost-plus, the stress I used to carry wondering whether I made money has evaporated, replaced by the security of knowing we are earning the wages we want and my business is making money.

For construction, the structure of cost-plus is simple: The contract stipulates that the builder will work for time and materials *plus* a fixed percentage to cover management, overhead, and profit. For example, a builder would track hours, material expenses, and subcontractor and equipment costs, and then add a 10% overhead and management markup and a 15% profit markup. This means that the builder will always earn their burdened labor wage and the business will always be able to cover overhead and make a profit directly tied to the scope and cost of each project. Cost-plus can be scaled to small jobs with a single operator as well as to bigger jobs for companies with multiple, large crews.

I first heard about cost-plus from several large high-end builders on the Modern Craftsman Podcast (themoderncraftsman.org). After having some problems that resulted in my losing money on a job (forgetting one expensive window and dealing with unforeseen rot issues in a porch restoration), I decided it was worth trying.

The transition took time—and over several months, I had to rewrite the information I presented to clients and create new systems for myself. As I went through the process of switching to cost-plus, I used the opportunity to develop a set of core values for my company: I want my company to do high-quality work and be paid for the time spent doing it. I do not want to rush myself or my team. I want our work to speak for itself. I also don't like bidding for jobs; instead, I want to be sought after and then become a client's contractor for life, cultivating a long-term relationship of mutual respect in which we are valued for our craft and professionalism.

Many clients (and contractors, myself included) find talking about money awkward. That also needed to change. The only way forward for me was to be 100% transparent when discussing anything financial, from what we bill per carpenter or helper to material and subcontractor costs. No type of contract will completely remove the awkwardness, but cost-plus puts it in the open. Some clients may push back, saying, "This isn't how my previous contractor worked," or "I want a fixed price," or "I haven't heard of this." The hard truth is that it's not up to your potential clients to determine how you run your business; it's up to you, as the business owner. I find that most clients have no issue with cost-plus once they understand how it works. In fact, many prospective clients say, "This makes so much more sense!" If a client pushes back and asks you to change how you operate, they are probably not the right fit for you.

BUSINESS OVERHAUL

Cost-plus is just a tool, and like all tools, it is only as good as its operator. But it has the potential to be a great vehicle for ensuring transparency, financial balance, and shared risk on expensive construction projects. And when coupled with the business practices of client vetting, paid estimates, and paid preconstruction planning, cost-plus can be a catalyst for transforming your business into a successful one that runs on data rather than guesswork.

Client vetting. Somewhere along the way, I started to understand two key principles: Not everyone who calls me is a good fit, and if I look at a project, I should get paid for it. To help decide which clients are worth pursuing, I send a simple, 15-question intake form to prospects via email. It gathers basic information but also asks crucial questions like the following:

- What is your budget range?
- Have you done a renovation before?
- Do you have an architect?
- Are you interested in designing the project with us?
- What is your timeline?

I am able to vet clients in 10 minutes sitting at my desk and save myself the headache of making a site visit and realizing that the budget doesn't fit the scope of work, or the timeline doesn't work with our schedule. If the responses indicate a project is worth pursuing, I move to the next step.

Paid estimate. The form indicates that I charge a $200 fee to do a site visit and provide a written ballpark line-item proposal. Before and during the site visit, I always explain how we operate.

Preconstruction planning. If we can agree on the ballpark line-item budget and a general timeline, and have a set of plans, the job moves to the paid preconstruction phase. In that time, we go through the plans with a fine-tooth comb, pricing everything from frame to finish. This includes selecting fixtures for pricing, receiving subcontractor quotes, and the like. Essentially, we run through the whole job on paper, while working together to make adjustments to maintain the bottom-line budget. This work is billed by the hour. Note: I have separate contracts for preconstruction and construction, in the off chance we don't perform the construction. It ensures that the planning service is paid for and underscores my belief that builders deserve to make a profit when they perform services for clients.

The budget document becomes a living reference for the job. Once construction starts, we track costs (man hours are tracked per category, such as framing or tile) and bill against the initial deposit. We provide real-time tracking to clients along with photos, daily logs, and schedules with construction management software. This transparency makes clients feel much more comfortable. A great selling point of cost-plus is that if things progress faster, they cost less and ultimately encourage efficiency on site. Cost-plus also ensures that detail-oriented and labor-intensive tasks are not subject to an educated guess of how long they *might* take.

One complaint I hear from clients about other contractors is a lack of communication. Cost-plus offers you the opportunity to brush up on your communication skills. It can be a lot to explain to clients in person, so I always follow up with an email after a site visit providing all the details. This also works in your advantage: You have your process outlined in writing should something go awry. (Though your preconstruction and construction contracts should be your legal fallback. Never enter any working relationship without the protection of a contract you've written and reviewed with an attorney.)

Once a job is complete, you can be sure it addressed both parties' interests. Another benefit of working cost-plus and tracking a job from start to finish comes in the form of hard data about the performance and costs associated with specific tasks. Comparing the initial preconstruction job estimates with subsequent tracking of job costs during construction highlights the accuracy or inaccuracy with which you understand your business.

CAUTIONS

There are many reasons cost-plus contracts, preconstruction planning, and job-cost tracking make sense, but there are also downsides. The main one is an increase in administrative work—though this is work you should already be doing. In theory, a good businessperson is tracking these things within a fixed-price contract so they know when to request change orders. I initially used spreadsheets, emails, and note-taking software to manage cost-plus projects but recently started using project management software to do all these things with one cloud-based application. Once set up, this, along with an estimating program, helped me cut my administrative time to one or two days a week in the office.

With these systems in place, it's hard for me to imagine ever going back to fixed-price contracts. Cost-plus is adaptable: If I want to increase profits, I simply change my percentage. The same is to be said for increases in overhead costs or projects that require extra management. And in a changing industry, adaptability is key.

Jon Beer is owner of Jon Beer Contracting, a design-build remodeling firm based in Newburgh, N.Y.

ABC Supply Co. inc.

ORDER ON THE GO WITH *myABCsupply*

Your job just got easier, wherever your projects take you.

- Place orders online 24/7
- Create templates to cut order placement time in half
- View order details and track deliveries
- Request aerial measurement reports from EagleView and GAF QuickMeasure. And coming soon from Hover.
- View statements and pay invoices

Scan to sign up for myABCsupply

“Perfect app for keeping track of all orders, deliveries and purchases. One less thing to worry about.”

★★★★★

- Stars and Stripes Roofing LLC
Allegan, Michigan

>> DOWNLOAD THE APP

Download on the App Store

GET IT ON Google Play

BY JAMES LEAMAN AND CHARLES HENDRICKS

Misleading R-Value and the Need to Reframe Insulation Scales

The use of R-value as a measure of the effectiveness of building insulation can create significant confusion, resulting in poor choices and wasteful consumption. Construction professionals and their clients need better thermal performance data and a more robust scale for comparing competing insulation products and product combinations. In this article, we review how insulation standards and regulations have evolved, explain strengths and weaknesses of the current model, and suggest how to provide industry professionals with better tools for supporting efficient buildings.

The R-value system originated in the United States in 1945 and was an important first step toward a science-based and standardized system for evaluating insulation products. As its use grew more widespread, it was eventually recognized and promulgated by the U.S. Federal Trade Commission (FTC), which continues to support the metric as an industry standard through regulation, referred to in the industry as the "R-value Rule." This regulation requires insulation manufacturers to disclose a product's thermal performance based on uniform testing procedures, and its stated purpose is to provide consumers with objective performance data to inform their purchasing decisions among competing products; indeed, insulation products in most markets overtly display the R-value rating.

However, the scaling metric of R-value is not optimal for understanding the practical efficacy of insulation or for comparing products, thicknesses, and product combinations. Additionally, the rating does not account for the effects of air leakage and other thermal losses. R-value as a metric is mathematically sound, as it measures an insulating material's resistance to conductive heat flow; the problem lies with what the R-value number means in practice. A building code may require R-15 insulation in walls, but that static rating communicates little about how well that R-value works against a standard or relative benchmark. Additionally, insulation products are rated across a broad scale, and without qualification about diminishing returns to thickness, many consumers and even industry professionals assume proportional efficacy based on the R-value numbering scale. A further complication is that windows, doors, and skylights are typically rated on a different scale (U-value or U-factor), which obscures relative insulating performance among various elements of the thermal envelope.

Before offering solutions, we discuss four problem areas with the use of R-value and other insulation metrics: scale, diminishing returns, other losses, and different rating systems. These all impact how industry professionals convey value to clients about choices in the thermal envelope.

SCALE

The first and most critical weakness of R-value is the scale's disconnect from practical understanding and application. The scale derived naturally from a mathematical formula (R-value = temperature difference across the insulation barrier divided by heat flux through the insulation barrier), but most people cannot extract actionable meaning from a static R-value rating. Benchmarking the percentage of conductive heat flow resisted by an insulation material against 100% (0 to 100% scale) would more intuitively communicate its relative effectiveness compared with competing products. R-value does have the helpful feature of being additive, meaning that insulating products may be stacked (or different insulation products combined) to achieve a cumulative R-value sum. Conversely, a percentage metric is not additive, which we discuss in the next section, but this difference could be clearly explained in labeling.

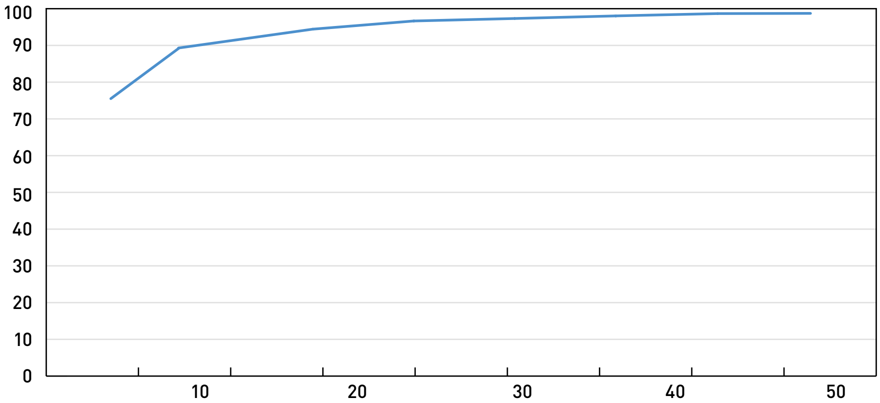
The R-value of an insulation product is the reciprocal of its thermal conductivity coefficient (TCC), and the percentage of heat flow blocked or resisted by that material is one minus the TCC. As an example, the TCC of an R-16 product is 0.0625 (1/16), and the percentage of conductive heat flow blocked or resisted (under typical conditions) is 94% (1 - 0.0625, rounded). Labeling an insulation product as achieving 94% resistance to heat flow would be far more instructive to decision makers than R-16. The "under typical conditions" qualifier above is needed for both R-value and its associated percentage of resistance to heat flow, as both metrics will vary slightly based on operating temperature, temperature difference across the insulation plane, and the building plane on which the insulation is installed (driving force). But the variances are small, and a more actionable number with caveats would be more practical than a precise metric that means little to consumers.

One simple improvement would be to require labeling that includes the percentage of conductive heat flow resisted. For the example above, the product might be labeled R-16=94%*. The asterisk is needed to qualify the additive differences between these two metrics, to acknowledge ratings under typical conditions, and to disclose limitations against other forms of heat flow. This is discussed in more detail in "Summary and Solutions," below.

DIMINISHING RETURNS

The second weakness with the R-value metric is that it ignores the diminishing returns of adding more of the same insulation, or stacking insulating products, which results in misconceptions

Resistance to Conductive Heat Flow by R-Value



R-4=75%	R-8=88%	R-12=92%	R-16=94%
R-24=96%	R-32=97%	R-40=98%	R-48=98%

This graph, along with the table showing R-values as a percentage of resistance to heat flow, illustrates the diminishing returns that result from scaling R-value.

about the value of increasing insulation levels (see "Resistance to Conductive Heat Flow by R-Value," above, for an illustration of the diminishing returns of scaling R-value). We have noted the helpful feature of R-value being stackable. However, without the percentage scale outlined above, most consumers will assume that insulating value is proportional to the combined R-value rating. For example, if we go from standard cavity insulation in a 2x4 wall (R-11) to a 2x6 wall (R-19), we do gain 42% more R-value (an increase of R-8). But many, even those who work in the building industry, assume that we get 42% greater resistance to heat flow, which is false. The 2x6 wall slows heat flow by only 4% more than the 2x4 wall.

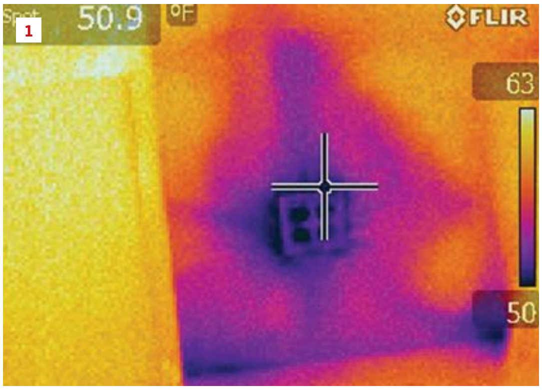
The R-values that building codes in most temperate climates currently require in floors, walls, and ceilings are on the waning end of diminishing returns. In many cases, adding thickness (and additional R-value) of the same insulation only negligibly reduces heat loss while incurring significant financial and environmental costs. To restate this concern, there may be fractional advantages in reduced conductive heat flow by increasing R-value beyond the code requirements, yet there will also be added labor and material costs, affecting both finances and resources. The returns are less than optimal for the individual payer and society at large, yet the perception persists of net benefits gained by bulking up the thermal envelope with insulation R-values. Depending on the building structure, it is often advantageous to combine different insulating products to reduce heat flow. The thermal advantages come from factors other than conductive losses, such as limiting thermal bridging and convection. One common example is continuous exterior rigid insulation, which, in combination with stud cavity insulation to meet R-value code for walls, helps reduce convection losses and breaks thermal bridging through framing members.

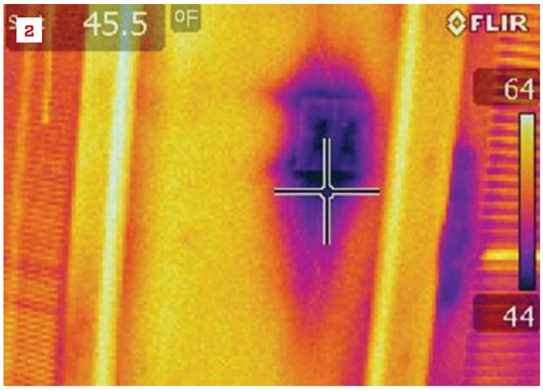
OTHER LOSSES

The third concern with the predominant use of R-value is that without labeled caveats, it invites the misconception that R-value determines the effectiveness of the thermal envelope. R-value is not misleading for what it claims and reports, but without context, it opens the door to misunderstanding. R-value is a measure of resistance to *conductive* heat flow, but there are also *convective* and *radiative* losses through thermal envelopes that insulation at any R-value will not resist; this is described in a concept called effective R-value. Additionally, myriad other weaknesses get designed and installed in buildings. Even after the thermal envelope is carefully engineered and crafted, we poke holes in it to meet other code requirements or to make the indoor space more livable and aesthetically pleasing. Bath fan vents, dryer vents, and range hoods vented to the outside open holes through the thermal envelope and are often dampered with just a thin rigid flap (minimal R-value and ripe for convective losses). Beyond those perpetual passive intrusions, occupants use those vents to force conditioned air outside during operation, pulling in unconditioned air as replacement—a significant heat loss unrelated to thermal envelope insulation.

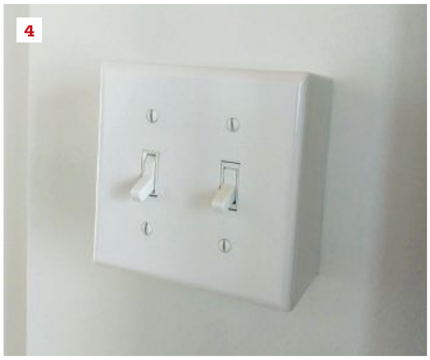
Utility penetrations also impact the thermal envelope. With careful planning, most plumbing pipes can be kept out of insulation planes, but required drain stack vents are open holes through the ceiling and roof, and they are often sealed with a single membrane around larger gaps in the upper thermal insulation plane. Electrical outlet and switch boxes are required by residential codes at prescribed spacing around walls, including exterior walls. These displace insulation and dramatically reduce R-value, creating permanent and excessive weak points in the thermal envelope, as illustrated by the thermal images on the following page **(1, 2)**.

Though this issue is independent of our call for improved metrics and labeling, it is further evidence that required R-values in building codes alone are not a sufficient measure of thermal effectiveness. Regardless of wall thickness or installed R-value, pulling electrical boxes out of insulation cavities will avoid significant compromises of the thermal plane. On the following page are a couple of examples of functional surface-mount options **(3, 4)**.





In these typical cold-season thermal images of a recessed electrical outlet **(1)** and a light switch **(2)** in an exterior wall, the purple and pink show cold spots resulting from air leakage and compromised insulation.



Surface-mount outlets, cable, and Ethernet can be integrated with baseboard **(3)**. The surface-mount wall switch **(4)** is an example of a fixture on an exterior wall that avoids wall penetrations.

Beyond these compromises, we design buildings with windows and doors (and maybe skylights) that have insulation values far lower than walls, floors, and ceilings, and this brings us to another matter of contention.

MULTIPLE RATING SYSTEMS

The fourth concern is the use of multiple rating systems in many jurisdictions. In the United States, building codes and insulation products applied to walls, floors, and ceilings reference the R-value rating system, whereas windows, doors, and skylights reference U-value or U-factor. R-values and U-factors are reciprocals, so it is not challenging to convert them to a single scale, but too many consumers do not understand this relationship, and labeling requirements do not mandate the disclosure.

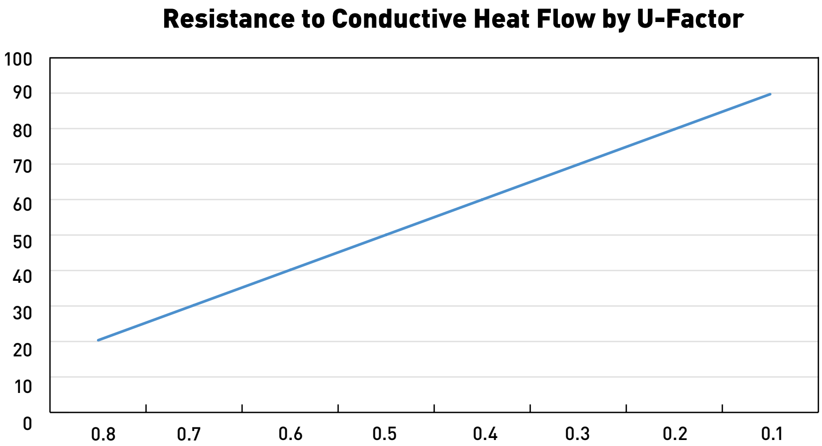
Why isn't there a common standard in labeling? One reason may be that different agencies evolved to regulate the different elements of the building envelope. The Federal Trade Commission (FTC) regulates the R-value system applied to walls, floors, and ceilings, and the National Fenestration Rating Council (NFRC) regulates the U-factor system applied to windows, doors, and skylights. While the FTC is a government agency, and the NFRC is an independent nonprofit organization, they have similar missions to improve the products and systems they regulate and improve product information to help consumers make informed decisions. To that end, we recommend that percentage resistance to conductive heat flow be added to the U-factor rating as well. That would create a standardized link between R-value and U-factor and provide an actionable metric for consumers to make informed choices.

The calculation to provide the percentage resistance to conductive heat flow from a U-factor rating is simple: One minus the U-factor. Since U-factor is already a proportionate measure of how well a window insulates, the scale is not misleading like the R-value rating.

Converting U-factors to percent of conductive heat flow resistance yields the values in the table at the top of the facing page. The chart does not represent the full range of U-factor ratings, but it covers most fenestration options and code requirements in temperate climates. Even the best insulated windows, sold at a high cost premium, typically lag the insulating value of the walls they are placed within, and that results in mismatched elements in a thermal envelope. For example, where we are writing in U.S. climate zone 4, the local building code requires a fenestration U-factor of 0.32, which is equivalent to an R-value of 3.1 ($1/0.32$) and 68% (1 - 0.32) resistance to conductive heat flow—well below the R-15/93% code requirement for walls in this jurisdiction. Consumers can upgrade windows, at relatively high cost, but even the best-insulated windows will resist conductive heat flow less than walls insulated to minimum code requirements.

SUMMARY AND SOLUTIONS

We have argued that current metrics for rating insulation do not provide the most helpful information for consumers to



U-0.80=20%	U-0.70=30%	U-0.60=40%	U-0.50=50%
U-0.40=60%	U-0.30=70%	U-0.20=80%	U-0.10=90%

Converting U-factors to percent of conductive heat flow resistance yields the values shown here, which cover the typical range for windows and doors.

make informed decisions. Instead, they create confusion and misconception, and multiple rating systems do not connect the different elements that form a complete thermal envelope. R-value is ingrained in the lexicon of the construction industry, if not the broader society, and it remains valuable because of its stackable feature. We are not recommending that these metrics be replaced, but rather that they be augmented with additional information.

The sample labeling scheme shown below would be one way to include the percentage resistance to conductive heat flow, which is an immediately actionable metric that's critically important for comparing different insulation products. Listing a broader range of the R-value scale would help consumers place specific products in the scope of possibility, and this range with the percentage scale would clearly reveal the diminishing returns to R-value. Finally, caveats could be added to disclose known limitations.

The U-factor scale does not suffer from the diminishing returns problem associated with R-value, but as a static metric, it does not support an intuitive understanding of heat flow. Also, it's egregious that we have no requirements for linking U-factor and R-value. The sample labeling scheme shown below would be one way to include the percentage resistance to conductive heat flow, which is an immediately actionable metric that would also provide the link between U-factor and R-value.

Additionally, listing an R-value range on the U-factor label would help consumers consider how fenestration products compare with wall assemblies.

Finally, as suggested with R-value labeling, caveats could be added to U-factor labels to disclose known limitations. Windows have other important specifications, like solar heat gain coefficient, visible transmittance, and air leakage, and those also need to be included. The Federal Trade Commission (FTC) and National Fenestration Rating Council (NFRC) should want to improve information to consumers about the products and systems they regulate, and these samples provide what we believe are needed additions to product labeling. These changes will better inform consumers of the effectiveness of the insulation products they buy, provide a linking standard to compare U-factor and R-value ratings, and begin dispelling the misconceptions associated with diminishing returns to R-value.

James Leaman is associate professor of business at Eastern Mennonite University and Charles Hendricks is principal at Gaines Group Architects, both in Harrisonburg, Va.

R-16=94% **94%** resistance to conductive heat flow*	R-4=75%*	*The percentage of heat flow resisted by associated R-values and heat flow resistance percentage ratings vary by operating conditions (temperature, location, and installation quality). This rating is limited to conductive heat transfer and does not account for other forms such as convection or radiation. R-values are additive/stackable, whereas heat flow resistance percentage is not.
	R-8=88%*	
	R-12=92%*	
	R-16=94%*	
	R-24=96%*	
	R-32=97%*	
	R-40=98%*	
	R-48=98%*	

U-0.32=68% **68%** resistance to conductive heat flow*	R-4=75%*	*This rating is limited to conductive heat transfer and does not account for other forms such as convection or radiation. Windows and doors are placed in walls, and skylights in ceilings, both of which typically have better resistance to conductive heat flow. R-values, which are used for walls and ceilings, are provided so consumers can understand and compare value across products.
	R-8=88%*	
	R-12=92%*	
	R-16=94%*	
	R-24=96%*	
	R-32=97%*	
	R-40=98%*	
	R-48=98%*	

The authors propose a labeling scheme like this for insulation products (above left) and windows, doors, and skylights (above right) to better convey to buyers the effectiveness of the products to limit heat flow. The U-factor label also helps buyers understand the link between U-factor and R-value.

Photo: Andrea Booher/FEMA; illustrations: Tim Healey

Earthquake-Resilient Buildings

Shear walls and strong connections are essential

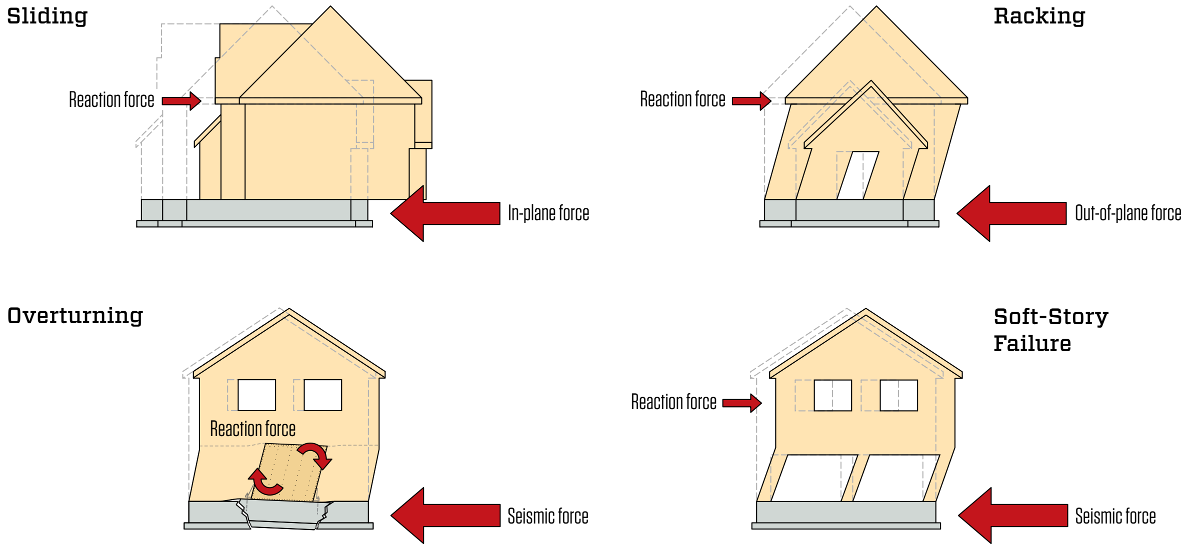
BY JLC STAFF

While we usually hear about only the most damaging earthquakes, every day the world shudders. On the day this article was completed, there were 22 earthquakes worldwide over M4 (M is the most common way to notate "moment magnitude," the most reliable estimate of earthquake size), including one at M4.6 on the U.S. border in El Sauzal, Mexico. In the past month, there were 642 earthquakes over M4.5 in the U.S. alone. The National Earthquake Information Center locates about 20,000 earthquakes around the world each year, an average of 55 per day. But while the U.S. Geological Survey has gotten good at tracking them, no one can accurately predict when they will hit. The best anyone can say is "There will be an M4 earthquake somewhere in the U.S. in the next 30 days, and there will be an M2 earthquake on the West Coast of the U.S. today."

SEISMIC FORCES

While many of the building elements used to resist earthquake forces are similar to those that resist hurricanes and tornadoes, the forces themselves are generally quite different. In high winds, uplift is the most significant force, whereas the predominant forces from earthquakes are lateral forces that apply horizontal loads. Earthquake waves do impose vertical forces on a building, but its weight often provides resistance to this load. A

Effects of Seismic Forces



In an earthquake, the ground accelerates horizontally, both back-and-forth and side-to-side. When the force is parallel to a wall (in-plane loading), it can cause that wall to slide off its foundation. When applied perpendicular to the same wall (out-of-plane loading), it causes the top to drift, in turn causing the meeting walls to rack. Partial resistance by building elements to these forces can transfer the horizontal force into rotational forces that can topple walls, pull out hold-downs, and destroy unreinforced masonry. Large openings in a lower story with a large gravity load overhead are especially vulnerable to racking and collapse.

building's weight also contributes to its response to the strong lateral force: As the ground shifts sideways (a force known as "ground acceleration"), the inertia of gravity delays movement in the upper parts of the house. By the time the upper parts move (the degree of deflection here is called "drift"), the ground is shifting in the other direction.

If we break down this force on just one wall, the lateral forces act both parallel and perpendicular to that wall plane:

In-plane forces acting parallel to the wall threaten to shear foundation-to-wall anchors and cause the building to slide off its foundation if those anchors fail. Partial failure of the anchor bolts can impose uplift forces on one side of the wall section and cause walls to overturn. In-plane forces acting on a wood-framed wall are resisted by "shear nailing"—the nails attaching wall sheathing to the top plate, studs, and sill—and by the anchor bolts attaching the sill to the foundation.

Out-of-plane forces act perpendicular to the wall and can cause the same wall to tilt forward and backward, and this motion can force the perpendicular walls to rack out of plumb. Partial failure of shear components can result in rotation of floor and roof diaphragms (torsion). And racking in the walls of a lower story (a "soft story") with a significant dead load over it may cause the building to collapse entirely. Out-of-plane forces are resisted by connections between the wall's top plate into floor and roof framing, and at the bottom by anchor bolts in the sill plate.

NEW CONSTRUCTION

In seismic zones, almost all new construction must be built according to an engineer's plan. Details in plans will vary, but they almost all share some basic elements.

Reinforced foundations. Foundations primarily support gravity loads, but in a seismic zone, they are called on to resist significant horizontal loads, as well as greater uplift on anchors that prevent shear walls from racking and overturning. This resistance is accomplished with thicker and wider footings, deeper turned-down slab edges, thicker walls and slabs, and much more and larger reinforcing steel. Common details are vertical rebar tying the footing to the stem walls at close intervals and extended rebar hooks overlapping horizontal rebar at corners and height transitions.

Slab-on-grade foundations often fare better than stem-wall foundations, owing to the continuous support under interior walls. If stiff enough, interior walls can provide bracing to an overall structure, so many buildings in seismic zones include intentional interior braced walls. To stiffen these walls, slabs usually require a thickened footing running under them. And in stem-wall and basement foundations, beams must be added to stiffen interior braced walls, even though these walls do not support gravity loads. Cripple, or "pony," walls that are part of a stem-wall foundation can create a short soft story; these are generally limited to 4 feet in height and require full shear panels.

Shear walls. Shear walls are designed to resist the lateral loading

Seismic-resistant new-construction details may vary according to engineered plans, but most wood-frame buildings include these elements: wider, thicker footings with closely spaced rebar verticals **(1)**; reinforcing around wide openings like garage doors **(2)**; larger sill anchors and ties to connect the sill and floor framing **(3)**; and strap ties or other connections to complete the load path between floors **(4)**.

caused by ground movement in an earthquake and transfer those loads to the foundation. Engineering plans typically include a shear-wall schedule calling for 15/32-inch CDX (plywood) or 7/16-inch "APA Rated Sheathing" (OSB). All panel edges that don't fall on plates must be blocked between studs to accept edge nailing (see "Typical Shear Wall Details," next page). The shear-wall schedule also calls out the attachment of sheathing to framing and the attachment of the wall to the foundation and roof. It's critically important that panels are gapped 1/8 inch at joints to allow panels to expand and contract without buckling. Longer panels (9 and 10 feet) are often preferred, as they require less blocking in the walls and a lot less edge nailing.

For shear panel to be fastened correctly, it must be nailed off at the correct spacing and the nails set properly. The shear-wall schedule provided by a designer or engineer typically includes nail size and spacing. It will specify both edge nailing and field nailing.

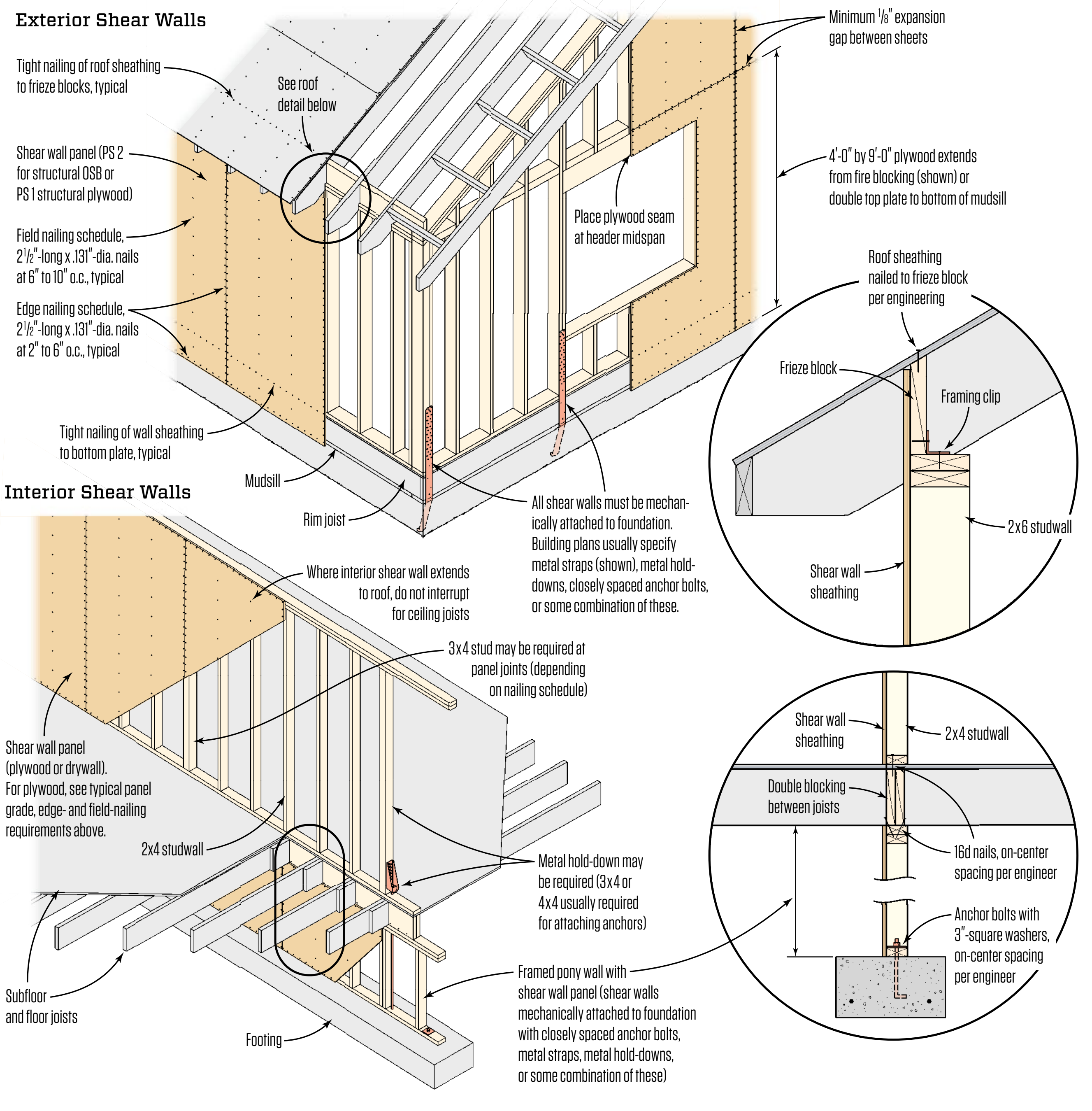
All shear walls must be mechanically attached to the foundation. The plans usually specify metal straps, hold-downs, closely spaced anchor bolts, or some combination.

Force collectors. The lateral forces from earthquakes (or high winds) are spread out over the entire area of the floor and roof diaphragms, which in many contemporary home designs is a much greater area than shear-wall areas. Many structural designs will therefore require force collectors (sometimes called "drag struts" or "drag ties") that gather lateral forces spread through a diaphragm and transfer, or "drag," them to the shear wall.

Often, much of this work is done by nailing off the roof sheathing, which transfers force to the eaves blocking and from there into the double top wall plate. In seismic zones, frieze blocking is often secured to the top plate with clips or structural screws to ensure the force is transferred to shear walls. In some seismic designs,

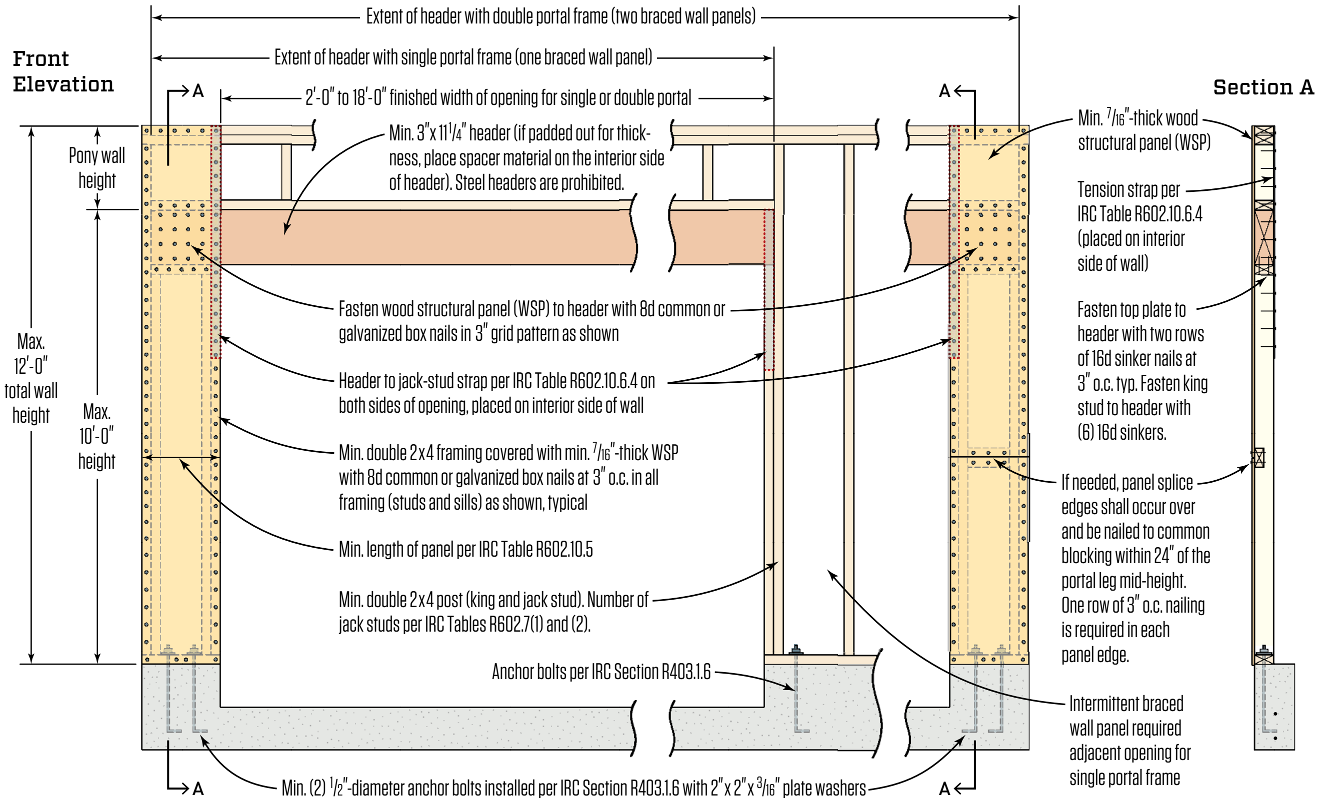
Photos: Tim Uhler

Typical Shear Wall Details



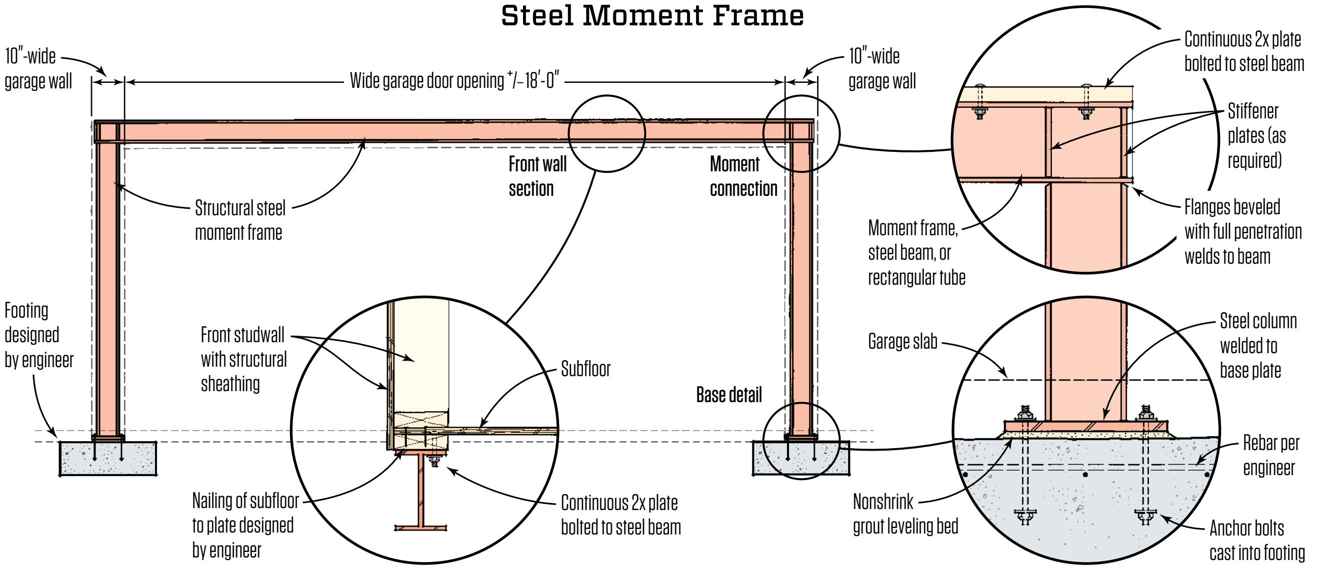
In seismic zones, most engineered plans require exterior walls, and often some interior walls, to be framed as shear walls. This is not just continuous sheathing. True shear wall also requires continuous foundation support; hold-downs to tie posts in shear-wall sections to the foundation; and all panel edges secured with tight nailing and supported by blocking or framing.

Portal Frame at Garage Door Openings

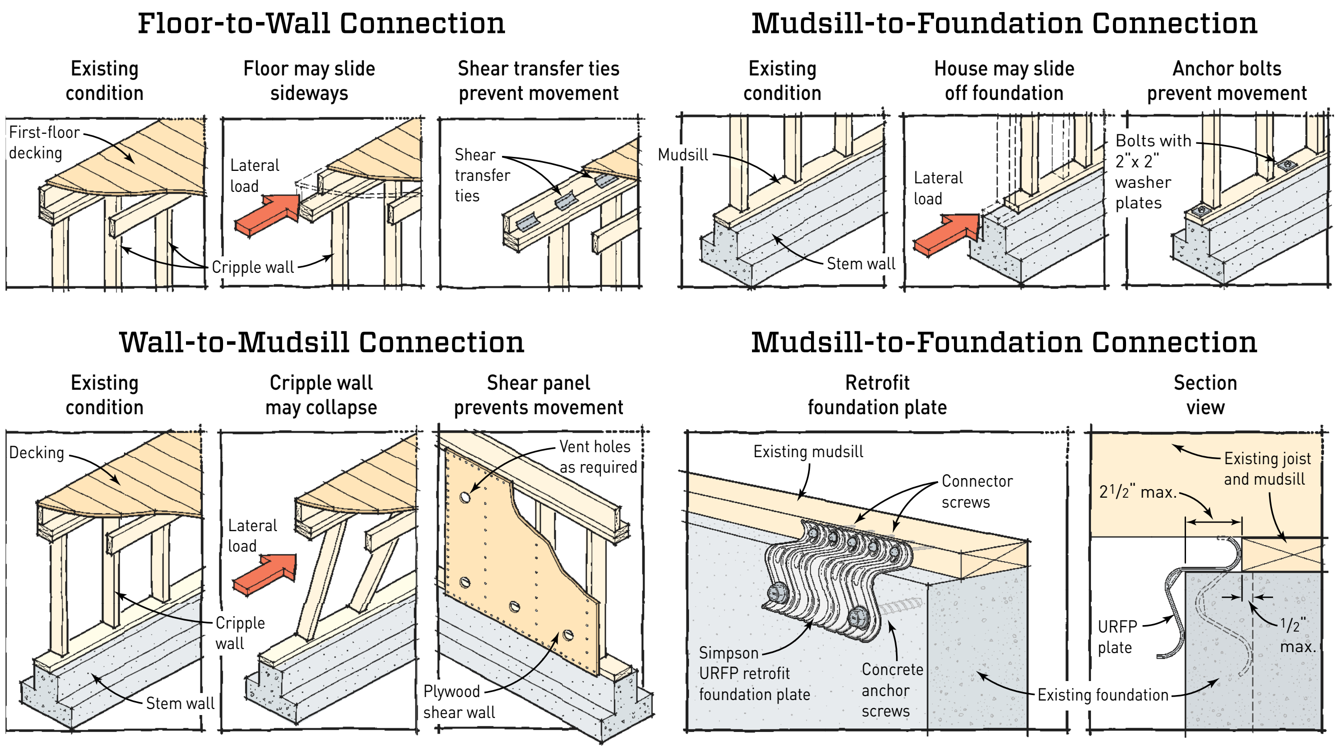


This type of portal frame can be used if the supporting walls are 8 feet tall and at least 24 inches wide (wider for taller walls), and must be bolted to concrete. Other types of wood portal frames are possible (see "The Portal Frame Option," Aug/17).

Steel Moment Frame



A steel moment frame can be used to provide shear strength for narrow-walled structures when standard framing solutions are inadequate. In all cases, beam and column sizes and connection details need to be designed by a structural engineer.



A house with cripple walls must be reinforced at three common weak spots below the floor: The floor must be tied to the cripple walls, the cripple walls must be stiffened with plywood and tied to the mudsill, and the mudsill must be bolted to the foundation. When access is tight and anchors can't be drilled in from above the plate, Simpson Strong-Tie URFP plates can be used for making the mudsill-to-foundation connection.

blocking or bracing, often reinforced with strap ties, may be added in the midspans of roof and floor members to further collect and transfer lateral loads.

Moment frames. When a lateral force is applied at the top plate of an unsheathed wall, and the wall racks, the studs rotate with respect to the top plate. Shear panels resist this rotation and transfer that force to the foundation. But in a wall with a large opening, such as a garage door or large window wall without enough sheathing area, the opening requires a "moment frame." In some cases, this can be built with plywood as a "portal frame" if the supporting walls are wide enough, but often it requires steel (see details, page 39). In many garages, the rear wall must be detailed as an interior shear wall to add sufficient resistance to racking.

SEISMIC RETROFIT

Older homes built in seismic zones are often at risk of failure and need to be retrofit to improve stiffness. In many West Coast houses, cripple walls and poor foundation connections are the weakest structural links and (in addition to retrofit moment frames) are the most common fixes to increase a home's chance of surviving an earthquake. Most of these homes would benefit from stiffening the upper walls and connections as well, but the cost of those repairs is often prohibitive.

The goal of below-floor retrofitting is to connect a house firmly to the foundation and stiffen cripple walls by turning all or part of them into shear walls so that lateral forces are transferred through them into the foundation. In addition to turning cripple walls into shear walls, most of the focus is on strengthening the floor-to-wall connection to transfer lateral loads to the shear walls, and the sill-to-foundation connections to resist sliding. Overturning is often not an issue with cripple walls because the walls are typically relatively short. Therefore, hold-downs to resist uplift at the ends of shear-wall sections are not often called for.

This work assumes the foundation is adequate to hold anchors, which in some older homes it isn't. The shear strength of the concrete is not the issue. Even unreinforced, 1,500-psi concrete will be sufficient against shear (the wood members anchored to it are often weaker), but the old concrete may be too weak or too shallow to hold anchors. In these cases, it may be necessary to pour new footings. But usually, this new concrete can be poured around the old.

Photo: courtesy Rockwool

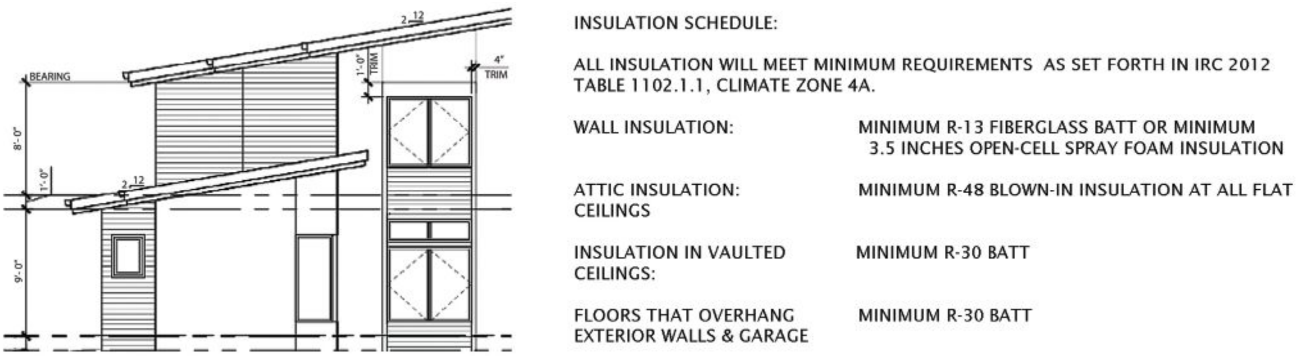
Why and How to Build an Insulated Overroof

Avoiding the condensation risk of a modern roof design

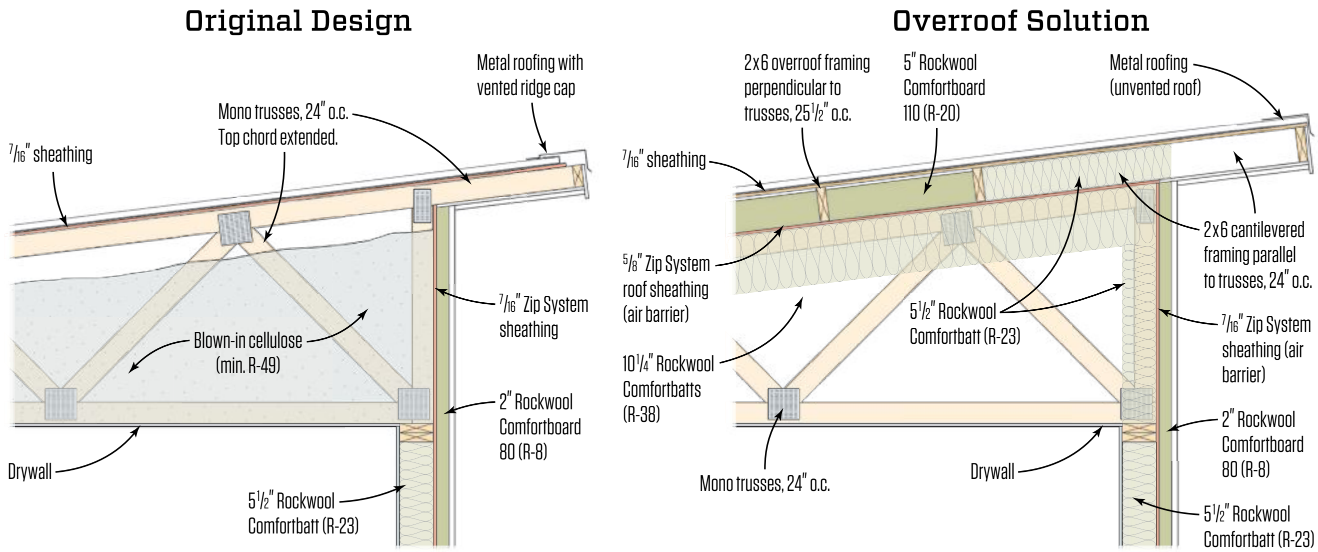
BY TRAVIS BRUNGARDT

Over the last few years, our firm has built several homes with clients and architects who favored more contemporary, "Mid-century-Modern" styles. These designs had rooflines and ceiling planes that met the clients' aesthetic tastes but left us with roof assemblies that did not align with our performance goals. When a low-slope roof or vaulted ceiling comes together with narrow fascia profiles, there is little depth in the roof assembly for adequate insulation. This frequently requires a series of concessions that wind up leaving the house underinsulated for comfort and efficiency, and even worse, at risk of water damage from condensation. For us, the most successful way to address this three-headed monster has been to provide an insulated overroof.

I chose to title this article "Why and How …" rather than with the traditional order of "how and why." This is because the why is so much more important than the how for these types of details. There are probably a dozen effective ways to flash a window opening, and people use these different approaches with great success every day because they understand *why* leaks happen. This same relationship holds true for many things in building and especially for the specific risks we have to address with these roof details. You can correctly solve for thermal and vapor control with different materials and methods as long as you fully understand why changing the type, location, or depth of the insulation moves the dew point or increases risk of condensation. "How" is variable, but "why" is constant.



A couple of years ago, the author was asked to build this Midcentury Modern home. The roof framing did not allow adequate insulation for the climate, forcing him to spend an inordinate amount of time on air-sealing to avoid condensation problems.



On a recent project, the author encountered another Midcentury Modern design (above left). He was successful in persuading the architect and client to adjust the design with a robust air barrier and an insulated overroof (above right).

THE LOW SLOPE/THIN FASCIA CONUNDRUM

A couple of years back, we built a large home with long, open spans, vaulted ceilings, and an I-joist roof structure that could accommodate only minimum code R-values of fiberglass insulation and no viable ventilation strategy (see excerpt from the plan set at the top of this page). The aesthetic desired by the architect and owner did not allow for a thicker roof edge or fascia to accommodate a greater depth of insulation, nor did they want to introduce a greater pitch to allow for stack-driven venting. Since the jurisdiction where the home was to be built was enforcing the 2012 IRC, the architect designed it to meet the code minimum R-38 for ceilings with a reduction to R-30 allowed for "Ceilings Without Attic Spaces." In the building code, this reduction is "limited to 500 sq. ft. of ceiling area." I've met a number of code officials in our area who read this as a reduction for each individual ceiling (room to room) rather than a reduction for the whole house, and that interpretation has resulted in an awful lot of woefully underperforming assemblies.

Having the minimum R-value and currently enforced code of the jurisdiction printed on the plan set has the unintended consequence of suggesting to all prospective bidders that building the home as designed would include R-30 fiberglass batts in an unvented roof. Of course, this creates an incorrect baseline of cost to the client in the competitive bidding process where all bidders include

Illustration: Tim Healey

Having completed the truss roof assembly (the "underroof), the framing crew built ladder **(1)** sections that would cantilever over the building line to create the narrow fascia essential to the Midcentury-Modern look. Between the overhanging sections, Joe Cook, the author's business partner, toenails on 2x6s running perpendicular to the truss frame **(2)**.

Photos: Travis Brungardt

the underperforming assembly in their estimate and then try to sell what should be the minimum as an upgrade after the fact.

To make a long story short, on this particular house, the client was not in favor of expanding the budget to arrive at our desired level of performance, nor were we involved in the process early enough to win over the architect and help "design out" this potentially problematic assembly. In this situation, we had to build the plan as designed, approved, and budgeted. We then worked around those fixed points with ambitious air-sealing in hopes of avoiding future problems. So far, so good, but we lost an obscene number of labor hours trying to make the airtight drywall lid work sufficiently to protect us from the condensation risk we fear. Meanwhile, the occupant will pay higher energy bills due to this underinsulated roof for as long as the home exists in this condition.

THE OVERROOF SOLUTION

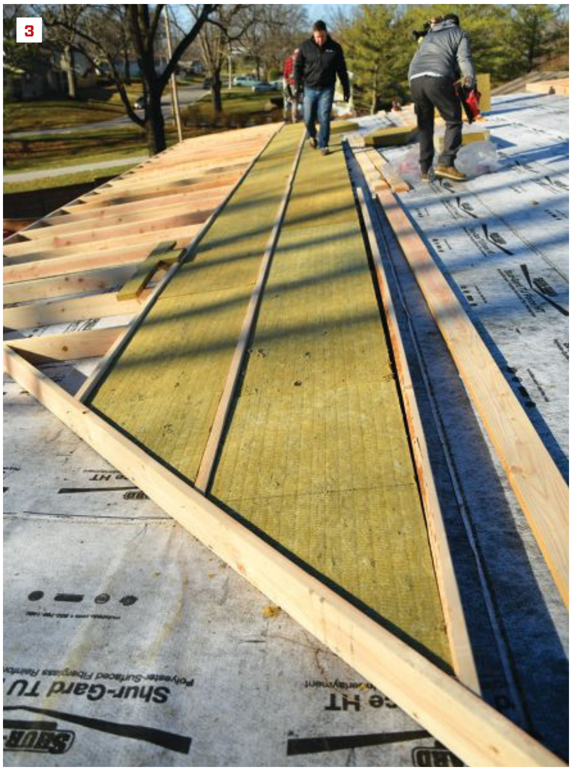
When we were asked by another client to bid a smaller home in a similar design style a year later, we went to the architect straight away with our concerns about condensation. With their design team and our firm at the table, we went through the working drawings and raised those concerns, asked pointed questions, and eventually worked together to achieve a solution that didn't involve an unvented low-slope roof with fibrous insulation.

In lieu of a single roof assembly that achieved the vault and narrow roof edges that were desired, we suggested building two roof assemblies. One would use trusses, as originally intended, but without the generous overhangs as part of them. (On the original design, this was an extension of the top chord; see illustration on previous page.) On top of this truss assembly, we would then build an overroof structure that would cantilever beyond the exterior walls to achieve the narrow fascia profile.

Truss roof assembly. Having a lower truss assembly without overhangs would allow us to more conveniently (two less turns and much less material) use Zip System sheathing at the wall and over the "under" roof to accomplish our air barrier.

Overroof. Once the Zip System was complete, we would build an independent roof volume framed in 2x6s that could project beyond the building line. This created the narrow fascia profile desired and could be insulated with a vapor-open fibrous insulation.

Thermal control. We frequently self-perform insulation and air-sealing, rather than subbing it out, and for many years, we've used stone wool in our builds since it handles and cuts in a way more familiar to us as carpenters. Being able to instantly assess the quality of the insulation install without connection details being hidden behind a piece of Kraft paper is important. And we actually enjoy working with stone wool: It is gratifying to be able to fit it precisely, and it's reassuring to get both high performance and low risk.



Increasing rafter spacing to 25 1/2 inches on-center allowed for 2-foot-wide R-20 insulation boards. The only insulation cuts required were at the valley **(3)**. The ladder sections at the edges were framed 24 inches on-center to allow full shear nailing at sheathing edges where uplift and other forces are greater. These cavities were insulated with R-23 stone wool batts **(4)**.

Photos: courtesy Rockwool

Vapor control. Since Rockwool is our preferred material, we reached out to the company's building-science team to model the performance of the assembly we proposed with the 2x6 frame and 5-inch Comfortboard. Because Zip System is not impermeable, they identified a risk that vapor from the interior of the home could move into the overroof assembly and condense on the top layer of OSB. This is a risk our friend Ben Bogie had been warning us of, as well. To remove that risk, Rockwool suggested a peel-and-stick membrane over the underroof deck prior to framing the overroof.

The overroof solution met with the architect's approval (satisfying both aesthetic and performance goals), as well as our own as builders (high performance and low risk), so the last hurdle we needed to overcome was meeting the client's budget.

Selling performance. Usually if we simply pitch a second set of framing members and another layer of roof sheathing topped by yet another roof membrane, the added cost makes it pretty easy for most folks to reject it without much consideration. The first step in "selling" our solution was making sure everyone involved knew the potential risks and problems we might face if we didn't do the overroof.

With that baseline of understanding, we could then compare the overroof option against other options. These included an undesirable thickened roof edge and fascia profile to allow for sufficient free air that would equate to venting; the prospect of introducing a potentially riskier material like spray foam to this unvented assembly (see "Why Not Just 'Blow and Go,'" page 46); or the revision of the interior ceiling plane to allow for a traditionally vented attic and still meet desired R-value.

Compared to these options, the low-profile overroof solution stood out as the clear winner. As a value-add, the stone wool offered excellent noise reduction at the metal roof during rain and hail, a feature the clients were quite happy to hear about (or not hear, as it were). We were fortunate that these clients were already on board with prioritizing performance in their selections, including a smaller footprint overall, a Zehnder ERV, Alpen windows, a standing-seam metal roof, and exterior rainscreen. Our proposed revision fell in line with these planned house features. The architect provided a rendering of the assembly for approval, and we all agreed on this as the way forward. The Rockwool building-science team then verified the performance through WUFI modeling, and we reached an agreement on price with the client, so all we had left to do was build it.

THE BUILD

To keep costs low, we began by considering the actual labor steps for the assembly and prioritized the reduction of cuts and complexity. It would be slow to cut down rigid Comfortboard. This dense insulation board is sold in 2-, 4-, and 8-foot dimensions (actual), so in a conventionally framed assembly, it would have to be cut lengthwise to fit into 16- or 24-inch-on-center bays. To avoid this, we sought and won approval from our structural engineer to expand the spacing of our 2x6 overroof framing to 25 1/2 inches on-center. This would allow us to use full-width 2-foot Comfortboards, avoiding all insulation cuts except for one angled cut at the valley. This 45-degree cut could be used on each side of the valley, so we had only one cut for every 2 feet of travel up the roof. By starting at the valley, we would begin with that cut, place the Comfortboard in whole units, and then place a 2x6 firmly against this rigid insulation and toenail it into the truss below.

We ran the 2x6 overroof members perpendicular to the truss orientation. This limited our thermal bridging to a 1 1/2-inch square at each connection, rather than having a continuous thermal bridge along the entire length of each member. We could have eliminated the thermal bridge entirely by laying down a continuous layer of insulation boards over the roof and then running 1- or 2-by strapping as a nailer for the sheathing on top. This would have required securing the strapping with long screws into the truss chords below, which was less than ideal. We intended for this entire scope of work to be completed by our framing crew, and they want to fire nails from pneumatic guns, not drive long screws through multiple materials. But the main concern I had was that the long screws might not remain plumb through the depth of insulation and that they could miss the trusses entirely, or worse, catch the edge of a top chord and split the truss, which would require an engineered repair at every location this occurred.

To move fast, we needed to not cut, not screw, and not strap. Toenailing was allowed in the field to secure the 2x6 overroof frame to the trusses but the engineer did require a hurricane tie at each of the cantilevered overroof members where it extended out past the underroof. With the "two in, one out" ratio applied to the structural cantilever, we had our framers build ladder frames just like they would build walls—flat on the low-slope deck (see photo, page 44). They were then able to slide these frames out to overhang the lower roof assembly the appropriate distance, creating the narrow roof edge. This meant no ladder work to add to the cost of this detail.

To build out the overroof, we simply installed one line of 2x6s by standing on it to keep the board flat against the deck and toenailed

WHY NOT JUST "BLOW AND GO"?

Many builders address unvented "hot roofs" by simply choosing to install spray-foam insulation to the underside of the roof deck and relying on it to achieve sufficient R-value and manage airtightness in one step. There are a lot of homes built this way, and I understand that it is possible for this to be successful. Over the last decade we have used this approach ourselves when the design required it, but after locating numerous failures in these installations, we simply aren't confident in this approach in our market, and we seek to avoid it in favor of less risky alternatives.

The failures we have found have run a gamut: On our last five attempts with reputable installers, we have found numerous voids on visual inspections; incomplete application where the installer had apparently anticipated greater expansion than what actually occurred (example at right); mix-ratio issues, resulting in improperly cured foam; delamination or pulling away from framing members, which created gaps where air and vapor can travel and accumulate; and, of course, many cavities simply being underfilled so that the desired R-value is never achieved. We've had many insulators tell us that roof decks need open-cell foam, so that leaks in the roof can flow through to the drywall beneath and signal their presence to clients, and we've had just as many tell us that closed-cell foam is the only way to go on a roof deck, so that water vapor from the interior can't get into the foam, be trapped under the roofing materials, and rot the roof sheathing.

I tend to defer to Building Science Corp. and the wisdom of Joe Lstiburek, who has been on record since 2014 saying that the closed-cell foam is less risky at roof decks in cold climates, that open cell is too vapor open for use at roof decks, and that the whole "it saves your roof by showing you the leak" thing is bogus, as there's no data to support it. Given all that, I will simply say that while I believe spray foam can be a path to success, I haven't seen it executed successfully in my market, and I will avoid that risk whenever I can. —*T.B.*

Photo: Travis Brungardt

The author uses commodity OSB to sheathe the overroof. Once covered with a peel-and-stick synthetic underlayment and metal roofing, the assembly is sound (5). The truss-frame underroof was insulated with R-38 stone wool batts (6), resulting in a nominal R-58 for the lid of the home. Combined with the rigorous air barrier, the assembly avoids any condensation risk.

it to the truss below. We then laid down a piece of insulation, made the valley cut, and finished the line of insulation, pushing each insulation board snug against the 2x6. Then, we installed the next line of 2x6s, pushing them snug against the insulation. After that first 45-degree cut at the valley, there was no measuring or cutting the insulation or framing members until reaching the opposite roof edge where we would cut the 2x6 to the correct length. We would let the insulation "run wild" past the edge of the exterior wall below to complete the thermal boundary.

While the engineer had been agreeable to the toenailing and $25\frac{1}{2}$-inch-on-center framing in the field, he required that we stay 24 inches on-center for the ladder-framed cantilever sections in order to provide better shear nailing on the sheathing.

The sheathing in the field over the $25\frac{1}{2}$-inch-on-center framing did not always align on the framing. In those places, we "spliced" panels together by laying down a scrap of $\frac{1}{2}$-inch OSB on top of the insulation and nailing any sheathing edges that didn't fall on framing into this scrap. (The Comfortboard is 5 inches thick, allowing just enough space for the scrap in the 2x6 cavity.) While this was sufficient in the field, this was not an approach the engineer approved at the edges of the roof, where uplift and other forces are greater.

The 24-inch cavities at the edges were insulated with R-23 stone wool batts, which are made to fit the 24-inch-on-center cavity. These offered slightly more R-value than the 5-inch, R-20 Comfortboard. This meant walking joists at the edges, which was slightly slower than what we enjoyed in the field. The Comfortboard we used has a compressive strength of 110 psi, so we could walk on it with virtually no give. Sheathing the roof with commodity OSB saved us a little money, and because we covered it with a peel-and-stick synthetic underlayment and metal roofing, we weren't sacrificing any durability. Even with the time we took to shoot video and photos, we completed the framed, insulated, and sheathed overroof in two days. The client and architect are thrilled, and my team can rest easy knowing we don't have any condensation risks.

Travis Brungardt, co-owner of Catalyst Construction, builds high-performance homes in and around Kansas City, Mo.

Photos: Travis Brungardt

professional
deck builder

May 2022

PHOTO BY EMANUEL SILVA

Forest Floor Deck

By Dave Settlemyer

PHOTOS BY DAVE SETTLEMYER

The seeds for this project were planted in 2011, when we set up a booth at a local home show featuring the basic design idea of log rounds illuminated from below. Although intended to show a patio concept, our display was built on a frame, and everyone referred to it as a deck. For the next several years, I tried to develop the concept as a viable deck project, but at the time my company was focused on landscape and hardscape builds. It wasn't until we began offering decks in 2018 that we felt confident in our ability to turn our Forest Floor deck concept into reality.

Foundation and Framing

This project started with demolition and the removal of an existing patio, landscape boulders, and a wood-burning fire pit. We set aside all the existing landscape boulders for future use, then excavated and poured 13 concrete footings, each 10 inches in diameter by 36 inches deep and reinforced with welded rebar cages. Even though the deck is relatively small, we needed all these footings to allow for proper beam placement and to angle the framing around the landscape boulder outcroppings that would protrude through the deck surface.

Before installing the short Alaskan cedar glulam beams (none were longer than 7 feet, and the average length was between 4 and 5 feet), we encapsulated the hardscaping with concrete to stabilize the structure. The framing consists of 2x8 #1 pressure treated southern yellow pine joists 12 inches on-center. We kept the elevation of the deck as low as possible to allow the boulder outcroppings to project a few more inches above the surface of the deck for more visual impact.

We kerfed the 2x10 rim joist that we used around the perimeter of the deck so that we could bend it to the desired radius. Normally, it's the inner face of the board that is kerfed to allow it to bend while maintaining its appearance. In this case, we found we weren't able to achieve the desired radius without splitting the board. Reversing direction so that the kerfs were on the outside face solved the problem. Plenty of blocking reinforced the rim joist, which in the end primarily serves as backing for a composite fascia.

We built the deck with a slope away from the house, like a patio, since we wouldn't have any gaps between deck boards to allow for drainage. We sheathed the framing with ¾-inch pressure treated sheathing rated for ground contact, fastening it to the joists with PL 400 construction adhesive (to avoid

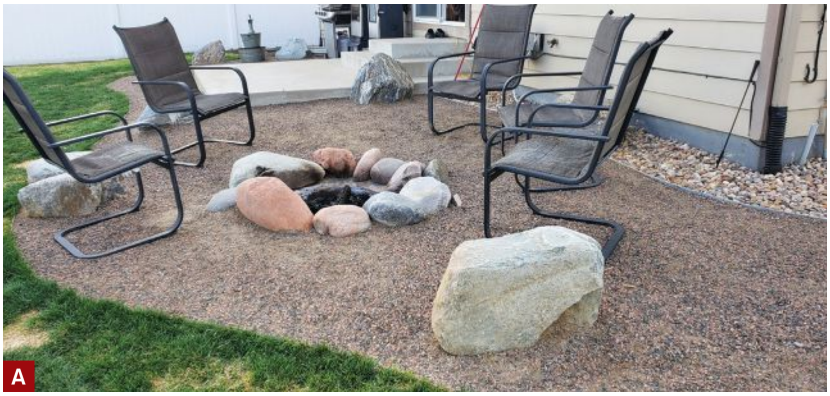


Figure 1. The existing backyard had a small concrete patio, a fire ring, and a few boulders (A). The author removed the patio and repositioned the boulders and fire ring, stabilizing them with concrete (B). The new deck frame was built over new footings and around these features, with a curved rim joist (C).

squeaks) and 3-inch-long GRK screws every 10 inches on-center.

Around the perimeter of the deck, we added a 12-inch-wide band of ½-inch pressure treated plywood to create containment sidewalls for the remaining internal areas on the deck. This had the added benefit of reducing the volume of costly resin needed to build the illuminated section of the deck, resulting in significant savings. In addition, the lighting scheme we planned had certain zones of illumination and we didn't want any border to receive light.

After the deck was sheathed, we filled small gaps in the subfloor around boulders and plywood seams with spray foam, then scraped away the excess after the foam had cured to end up with a continuous and well-sealed substrate for the resin. Then we applied several coats of rubberized sealant to the entire assembly, creating a reasonably watertight seal to hold the epoxy while it cured.

Lighting

I had always wanted to light a deck from beneath the flooring, but this is difficult to do on a typical deck. On this project, the homeowner supplied us with suitable lighting cables with two LED bulbs per inch contained in a ½-inch-diameter shield. We used more than 1,000 feet of cable; rated at 100,000 hours, this seemed to be the longest-lasting product available. Should the lights ever fail, there isn't a possible replacement scenario, so we had to trust the product as we secured it to the deck with steel clips. As soon as the circuits were all connected and tested, we were ready to encapsulate the lighting in epoxy.

Epoxy

We began the first of 10 pours of epoxy by mixing up a batch of Colored Epoxies' (coloredepoxies.com) industrial exterior-grade flexible resin and hardener. Because the deck was sloped, we began on its lower edge and built our way up, starting the next pour as each batch began to harden. For the final pour, we used the company's UV-resistant overcoat over the cured epoxy, filling the entire ½-inch-deep bowl containing the lighting cable with a smooth and uniform surface.

After the epoxy cured, we were ready to install our innovative decking material. Meanwhile, it was a very cool feeling walking across a glass surface with all that light shining beneath our feet.


Set the stage for every picture-perfect moment to come.
Elegant aesthetics. Unmatched performance. And an eco-friendly lineup that will leave homeowners inspired. For nearly 30 years, Trex® has been the leader in outdoor living with offerings like Trex Transcend® decking and Trex Signature® railings designed to help you build an outdoor space that can endure the test of time – in style. At Trex, we see it too. To learn more, visit Trex.com.
Trex
Engineering What's Next in Outdoor Living®
To see our collection, scan the code above.
© 2022 Trex Company, Inc. All Rights Reserved. Trex® is a federally registered trademark of Trex Company, Inc., Winchester, Virginia

Figure 2. The author sheathed the deck frame with pressure treated plywood, filling gaps in the sheathing and around the boulders with spray foam (A). Next, he coated the sheathing with a rubberized sealant and installed the lighting cable (B). Ten coats of clear epoxy were then used to encase the cables (C).

Wood for the Forest Floor

While I wanted to use hardwoods to cover the deck, I wanted to use material that you'd never see on a standard deck. Our material accumulation began with a project earlier in the year, where a new deck required the removal of an old, dead Russian olive tree. In my area, these trees are considered weeds, which is why the city requests (but doesn't pay for) their removal, and paying for tree removal before the build could begin was above the client's budget. I rarely offer work for free, but I knew this tree would be a key component later in the year so we offered to cut down and remove the tree in trade for accepting our deck proposal.

Russian olive is beautiful in cross section, brown in the center and retaining a vibrant golden edge before the darker outer bark. After harvest, I brought the wood home to begin sectioning the tree into 2½-inch cross sections, but I had no plan on where to find the rest of the wood I would need. When I checked with local tree-removal companies and the city tree-limb collection facility, all they had was cottonwood, a soft wood that wouldn't qualify for the project.

Then, I stumbled across a couple of guys who were taking down a black walnut tree in my neighborhood, a tree that would fetch close to $20,000 at the local sawmill. They allowed me to harvest some of the tree's 3-inch to 4-inch caliper limbs, and when I loaned them a climbing rope to replace one that they had snapped, they gave me a bigger branch as thanks, inviting me back to their yard and telling me I was welcome to snoop around. There I found larger birch and peach limbs, as well as more of the black walnut in smaller branches.

We were lucky to have made this connection, as now it looked like I would have more than enough wood to fulfill the order, with excellent browns from the olive, purples from the walnut, creams from the birch, and pinks and orange shades from the peach. For three days, we produced thousands of crosscuts, from 24-inch-diameter trunks all the way down to ½-inch-diameter branch tips, then stored every usable piece of wood for three months to dry.

Installation

We began the installation by fastening every log ring larger than 4 inches in diameter to the plywood deck with countersunk FastenMaster deck screws

Figure 3. The author cut thousands of log rounds from a variety of sizes and species of wood for the decking (A). During installation, he used screws to hold the larger rounds in place and filled between them with smaller pieces, which were held in place with epoxy (B). After planing and sanding the surface smooth, the author continued to coat the assembly with more coats of epoxy, and wrapped the edge of the deck with composite fascia material (C, D).

in a 6-inch grid pattern. We then filled the gaps with smaller pieces, which would be secured only by the future epoxy encapsulation. However, as we installed the decking, we soon realized that all the days of cutting still left us short on the quantity of material we needed, so my hunt for material resumed.

At the city tree-limb division, I came across a beetle-kill ponderosa pine tree that had recently been dropped off. Although not a true hardwood, ponderosa pine exceeds the strength of redwood and was on my client's wish list, so we altered our pattern to use the pine for the border. This was the perfect scenario, as the beetle-kill pine was already very dry, and we wanted the border to stand out from the rest of the inlay on the floor, anyway.

After everything was secured, we began pouring more epoxy resin to fill and seal any inconsistencies under the cross sections halfway up the $2\frac{1}{2}$-inch-thick rings. But it was impossible to determine the volume of epoxy needed to fill the voids, and we exhausted our entire supply; still, we had just enough to allow us to start sanding everything flat while we waited for additional epoxy to arrive.

All the work with power planers on our hands and knees turned into an even more labor intensive and time-consuming task than cutting the cross sections. Eventually, we were able to switch to a floor sander for the final leveling work, but inconsistencies from piece to piece had to be addressed first.

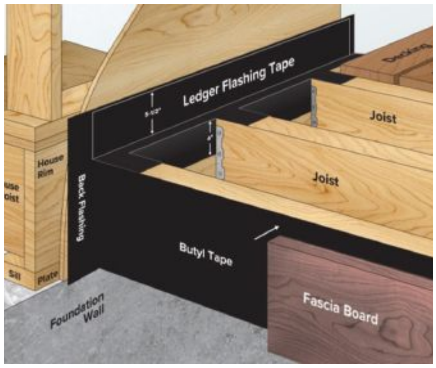
We originally planned to use plugs cut from each species of wood to fill the countersunk screw holes but found during floor sanding that all the holes had already filled with compacted sawdust. This saved us countless hours, and at the end of sanding, it was impossible to tell where the screws were.

Before pouring the final layer of epoxy, we wrapped the fascia and edges with TimberTech Azek dark hickory decking and fascia material. At the last minute, I decided to use a plumbing torch that I had in my truck to burn the border with a gradient effect.

An estimated 10,000 lights, 10,000+ wood slices of different sizes from five tree species, and 135 gallons of epoxy later, the project was finished. ❖

Dave Settlemyer owns LS Underground in Longmont, Colo.

Trex Seal™
LEDGER TAPE



PRO FIXES FOR FIGHTING DECK FAILURE

Tips on extending deck lifespan by protecting a substructure's vulnerable areas

Ask any contractor where a deck is most likely to fail and, chances are, they'll point to the ledger board and the deck frame. If not correctly installed and protected, these elements can be the Achilles' heel of a deck's structure. To better understand this issue and how to prevent it, we tapped the expertise of professional deck builders.

IDENTIFYING THE ISSUE

"Deck failure happens at the connection point to the home," said Ed Pacylowski, owner of ProBuilt Construction, Inc. in Highland, Md. "Either decks are not connected properly or there is rot on the wood—most commonly caused by exposure to water over time."

In almost every case, pros pointed to moisture as the primary source of deck framing failures.

Easily one of wood's worst enemies, moisture poses a serious threat not only to the frame itself, but also to other critical areas, such as the ledger board. When left exposed, water can seep into screw holes and sit on the wood causing it to rot and the screws to rust. Additionally, the natural expansion and contraction of wood can cause framing, and the ledger board, in particular, to weaken, split and deteriorate over time, posing serious safety issues.

"The biggest cause of deck failure is moisture getting on or into lumber," confirmed Scott Seal of Seal's Building and Remodeling in Lexington, KY. "This is actually going to be a larger issue because of younger trees not having closer growth rings. Moisture will be able to penetrate even easier."

A SIMPLE SOLUTION

In most cases, boards rot prematurely due to lack of proper flashing. When it comes to protecting the ledger board, there are two main approaches—metal flashing and flashing tape.

The biggest advantages of metal are that it's inexpensive and can be installed in any type of weather. It requires bending, which is time consuming, and can be dangerous to handle due to its sharp edges. Metal also requires nails or screws for installation, which creates opportunities for moisture penetration. While it diverts water away, it doesn't seal water out. In fact, many counties no longer allow metal flashing because it is so prone to leaks.

Flashing tape is better for waterproofing. It creates a tight seal on boards and around hardware. Some tapes can be difficult to control due to their stickiness and, historically, have not come in an optimal size for ledger-specific applications.

These concerns have been addressed in a new product called Trex Seal, which combines the best performance features of metal and tape flashing. Reinforced with an aluminum liner, this 11-inch-wide butyl-based tape creates a waterproof barrier that provides complete coverage of the ledger board. It is self-adhering and seals any gaps between the ledger and the substructure for optimal protection. Featuring a convenient 5.5-inch double-release liner, Trex Seal is easy to apply for accurate installation and is Code AAMA711 compliant.

"Trex Seal is designed specifically for deck installations," commented Pacylowski. "Trex Seal comes in the appropriate sizes for proper flashing of framing members, and it can be set in place without flexing back like other flashing tapes. We also use Trex Protect Rim Tape around the perimeter of the deck between the treated wood and fascia trim to protect the frame from exposure to water that drips between the decking boards."

Flashing tapes are proven to preserve a deck's integrity and longevity. And, with the selection of easy-to-apply options now available, there's no reason for any deck to be left vulnerable to the elements and premature failure.

For more information about deck flashing, visit **http://www.trexseal.com/**.

Produced by Zonda Media, a Delaware corporation.
marketing.zondahome.com

FOOTINGPAD®
ENGINEERED COMPOSITE FOOTINGS BY AG-CO
Below-Grade Post Foundations
Save Time, Labor, and Hassle
FootingPad® structural post foundations are engineered to meet or exceed the load capacity of concrete, while reducing hassle, time, and labor costs.
• Proven Performance: over 600,000 in use
• Can be used with most post types, including wood, Perma-Column, and concrete tube form
• Available in 5 sizes from 10" to 24"
Learn more or request a sample at footingpad.com or call us at 989-224-7095
LIFETIME GUARANTEE Made in USA
REPLACES CONCRETE FOOTINGS
EASY TO HANDLE
ICC ES
ICC Building Code Compliant
ESR-2147

Discover What Others Already Know!™
3x The Strength • 3 Colors To Choose • Stainless Steel Insert
Ipe Clip®
Hidden Deck Fasteners
THE DECKWISE®
HIDDEN
DECK FASTENER!
Scratch Here!
(Just Kidding!)
DeckWise®.com
The Ipe Clip® Fastener Company, LLC
Manufacturers of Hidden Deck Fasteners & Accessories
MADE IN THE USA HIDDEN DECK FASTENERS
It's a hidden deck fastener. You're not supposed to see it.
To see our hidden deck fasteners up close go to www.DeckWise.com.
Let us help you build the deck of your dreams!
Call 866.427.2547 or Chat Online

PHOTOS BY EMANUEL SILVA

Better Porch Stairs

With pattern-routed stringers and rot-resistant details, this porch was built to last

by Emanuel Silva

Much of my work these days is repairing or replacing windows, doors, and porches on homes that were built fairly recently, some even within the last 15 to 20 years. In most cases, the damage was caused by poor workmanship, such as reversed or nonexistent flashing. It's frustrating because these features would have lasted a lot longer if the contractor had paid more attention to details; on the other hand, these problems create a good business opportunity for me.

The porch described in this article offers a good example. Built at the same time as the house in the 1980s, it seemed to be in reasonable condition until one took a closer look. The cracked and peeling paint finish on the fir decking concealed the beginnings of rot, the wobbly railing needed replacement, and when I dug around the bottom of the corner support post to evaluate the footing, I found a couple of inches of rot and no hardware to connect the post to the footing. In addition, the homeowner wanted to replace an extremely heavy access door to the area under the porch with a lighter one that would be easier for him to operate.

Demo

After temporarily supporting the porch roof with diagonal bracing, I began dismantling the existing porch, starting with the stairs. The stringers were overnotched and starting to rot, but to comply with the building permit, I needed to duplicate the stair's rise and run, so I kept the best one as a reference for the new stringers.

The undersized 8-inch-diameter pier supporting the corner post needed to be replaced with a 12-inch-diameter pier. While digging around the pier to pull it out of the ground, I discovered that it was resting on a big spread footing that must have been placed when the house foundation was poured. While there was no way to remove it without a machine, it was buried below frost level, and my inspector approved my plan to pin the new pier to the existing footing with rebar dowels drilled and epoxied into the footing.

The concrete landing slab at the foot of the stairs was also massive, but cracked and buckled; it too needed replacement.

Figure 1. The new porch and stairs had to fit the existing footprint (A). The author covered the wall sheathing with a peel-and-stick flashing membrane (B) and screwed PVC shims to the ledger (C) before installing it. After framing the new porch on temporary supports, the author determined the landing slab's location and elevation (D).

Figure 2. The author used a plywood template he made to cut the stair stringers to confirm the location of the landing slab, which he reinforced with rebar (A). The concrete needed to fill the form was mixed on site (B).

Breaking it up was difficult, but necessary; I wanted the new stringers to be supported with a reliable foundation.

Rebuilding the Porch

Per the building permit, the new porch had to exactly match the footprint of the existing one. After marking the locations of the new landing and footing but before pouring any concrete, I installed a new ledger for the porch framing. To prevent moisture damage at this critical location, I cut away the existing housewrap and replaced it with Vycor Plus self-adhering membrane (**Figure 1**).

Before installing the new ledger over the membrane, I screwed 1/2-inch-thick PVC shims to the back of the ledger 16 inches on-center to match the locations of the lag screws I would use to fasten it to the house framing. For drainage, I also installed shims between the doubled rim joist and end joist, which had been temporarily propped up into position as I rebuilt the porch framing and installed the floor joists.

Landing. I had to remove a couple of courses of the brick walkway to build a form for pouring the new landing. For good drainage, I built the formwork over a base of stone and broken-up concrete from the existing slab, and to reinforce the slab, I wired together a rebar grid. In addition, I drilled short rebar dowels into the concrete footing supporting a brick planter next to the stairs.

Prior to filling the form with about 15 80-pound bags of concrete mix that I mixed up on site, I used a stringer template (more on this below), which I had cut for the new stairs, to fine-tune the position of the landing. This allowed me to pinpoint the landing's elevation so that all the risers would be exactly equal, with the outside edge of the landing slab perfectly aligned with the front edge of the stringers (**Figure 2**).

While I had the mixer on site, I slid a cardboard tube form over the lengths of rebar that I had doweled to the footing, cut the form to length so that the pier would extend slightly above grade, and filled the form with concrete. I used the corner of the temporarily supported deck framing to establish the location of the corner post.

Pattern-Routed Stringers

Usually, I cut out the sawtooth shape of open stringers using a track saw. On this job, however, I made a template out of scrap 7/16-inch Zip System sheathing, then used it to pattern-rout the nine identical stringers needed for the 8-foot-wide staircase. My hope was that cutting the stringers production style instead of individually would result in uniform sizing that would eliminate the shimming

Figure 3. Using a template cut from a double layer of $7/16$-inch Zip sheathing, the author pattern-routed the stringers (A). He used a Kreg jig to make pocket holes for mounting screws (B), then screwed the cut stringers together to prevent warping. To prevent rot, he applied preservative to the cuts and notches on the stringers (C) and the landing plate (D).

Figure 4. The author installed the end stringers first, then used the template to fine-tune the position of the remaining ones (A). The author used wedge anchors to fasten the plate to the slab (B), and metal angles to attach the dropped header for the stringers to the framing (C). Plenty of blocking was used to reinforce the landing post connection (D).

of treads and risers that would be otherwise necessary (**Figure 3**).

First, I ripped the sheathing to match the width of the 2x12 pressure treated stringer stock. Using a track saw, I carefully cut the treads and risers following the layout I had preserved from the original staircase. After finishing up the corners with a handsaw, I smoothed out the cuts with a sander so that the sheathing could be used to guide the bearing of the router bit. This is the template that I used to fine-tune the position of the landing.

Because the long, narrow Zip System stringer template was a little floppy, I doubled up the sheathing to reinforce it. This had the added benefit of allowing me to fine-tune my pattern-routing technique, as I traced the second length of sheathing to the template, cut slightly off the line with the track saw, screwed the two lengths of sheathing together, then trimmed the second piece to the first with the router.

I used the same approach when cutting out the pressure treated stringers. First, I traced the cuts onto the 2-by stock, then cut within about $1/8$ inch of the line with the track saw. Next, I screwed the template to the stringer and finished the cuts with the router. This was tedious going, as wet, $1\frac{1}{2}$-inch-thick pressure treated stock doesn't cut easily with a router, so I worked slowly and made a careful second pass with the router to clean up the edges. When I was done routing, I unscrewed the template and used a handsaw to carefully square up the rounded corners left by the router bearing.

Without a doubt, this method proved to be slower than cutting the stringers out with a saw, but I was pleased with

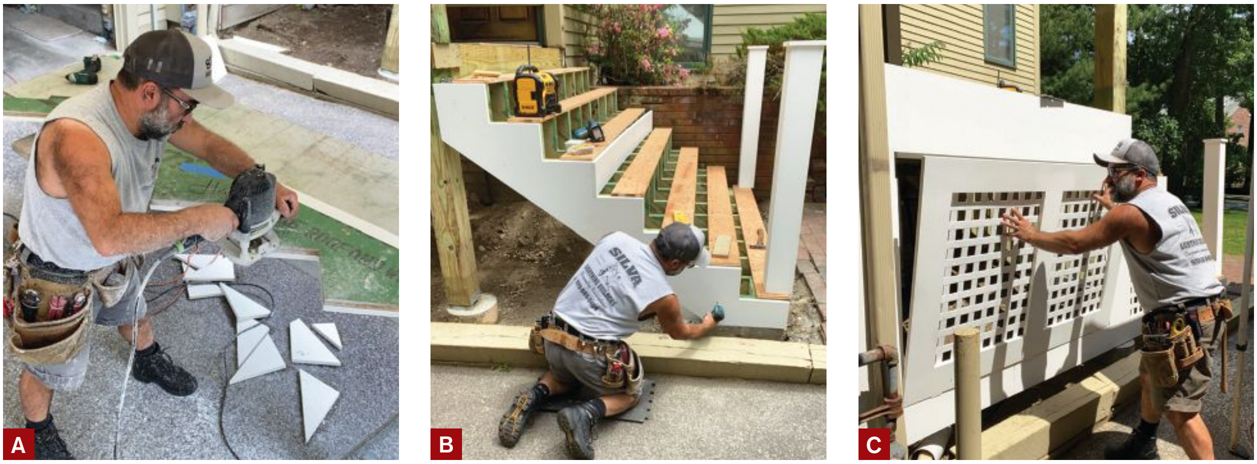


Figure 5. The author used the template that he had made to fabricate the stringers to pattern-rout the PVC stringer trim (A), which resulted in a very accurate fit (B). The author also fabricated the post sleeves, stair risers, access door (C), and other porch trim from PVC stock. Along with the 1x4 decking, the railings, balusters, and stair treads were all fabricated from vertical-grain fir that the author prefinished on all four sides with a solid stain (D, E).

the result: perfectly identical stringers. To keep them that way—since pressure treated stock has a bad habit of moving around once it's been cut and notched—I screwed each stringer to the previous one as I completed it before moving on to the next. Then, before leaving for the day, I gave all the cuts a couple of coats of copper naphthenate preservative.

Assembly

The stringers connect to the landing via a 2x8 pressure treated plate cut to match the width of the stairs, less 3 inches to account for the end stringers. For better drainage and rot protection, I incised the bottom of the plate with 1/4-inch-wide by 1/4-inch-deep notches, which I then saturated with preservative (**Figure 4**).

With the plate placed on the slab, I screwed structural screws through the sides of the two end stringers into the ends of the plate; the remaining seven stringers were notched to fit over the plate. To fasten the stringers to the deck framing, I drove structural screws through pocket holes into the rim joist. I also fastened a dropped header to the rim joist with metal angles and drove screws through the header into the stringers. After installing the stringers, I anchored the plate to the slab with wedge bolts.

To provide a solid connection between the landing newel post and the framing, I used plenty of structural screws and 2x4 and 4x4 blocking that I'd notched for drainage. After cutting the pieces to fit, I saturated all the cuts and end grain prior to assembly to improve their resistance to rot.

To match the appearance of the original porch, the homeowner specced clear vertical-grain fir for the railing, decking, and treads, which I prefinished on all four sides with a solid stain. I emphasized that this choice would require regular maintenance but was able to talk him into PVC post sleeves and stair risers. I also covered the stringers with PVC trim, using my template to accurately lay out and cut the stringer trim (**Figure 5**).

Finally, I used PVC trim and lattice to enclose the porch base. Held in place with double-wing flush clips, the new PVC access door is light and easy to open and close. ❖

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

PHOTOS BY ROB CORBO

Building a Deck With a Welded Steel Frame

A concrete paver patio and improved drainage were also part of this urban backyard makeover

by Rob Corbo

As part of a large home renovation project in the Castle Point section of Hoboken, N.J.—just across the Hudson River from New York City—our clients wanted to upgrade their small, urban backyard. While the project included new hardscaping, the centerpiece was an elevated deck from which to enjoy the home's spectacular view of New York's famous skyline. The new deck would replace a smaller one built many years ago that had a welded steel frame fabricated on site from mild steel with a low carbon content, and the project architect specced the new one to be built the same way. This was a type of deck construction we had not done before.

Unlike the majority of the rest of Hoboken where we typically work, which consists primarily of attached homes and brownstones, Castle Point is an area where the homes are primarily detached. This meant that there was a 3-foot-wide walkway for access to the backyard, a luxury for us because it meant we wouldn't have to transport our demolition debris and new construction supplies through the house.

In addition to the deck, the project included a new stone-paver patio to replace the existing patio, which was made up of large cast-concrete pads. And, to reduce the effects of winter winds emanating off the Hudson River, we were asked to replace the back door leading out onto the deck and a pair of windows on the back façade.

Footings

Our first order of business was to deconstruct the backyard, breaking up the concrete pads that made up the patio so that the debris could be hauled away. Not only were the pads in poor condition, they had settled every which way over the years, destroying the original pitch toward a central drain that had been installed in the backyard. As a result, rainwater pooled in the backyard instead of draining properly.

Next, we removed the original steel steps, landing platform, and small steel deck that were used to access the back door. With the back door access and patio removed, we turned our attention to locating the six footings required for the 11-foot-by-15-foot deck (**Figure 1**).

To support the frame, the architect specified two footings 5 feet 7 inches off the house and a second set of footings 12 feet 10 inches off the house. The footings in both sets were placed 10 feet apart. Each set eventually received an 8-inch steel C-channel beam that ran parallel to the house (north to south) and carried 4-inch C-channel joists running perpendicular (east to west) to the house. In addition, we marked out a pair of footings to carry the east-facing side of the stair platform, then dug footing holes by hand wide enough to receive 14-inch-diameter concrete form tubes, and deep enough—3 feet 6 inches—to get below New Jersey's frostline.

Prior to pouring the footings, we cut and wired together triangular-shaped rebar cages to insert into the cardboard forms. After the building inspector checked the cages and approved our footing design, we pulled out a laser level to check elevations so that we would be able to cut the forms to the proper height before mixing and pouring concrete.

Our benchmark elevation was the height of the front-to-backyard walkway, which needed to be flush with the new pavers where they would intersect. Project manager Danny DoCouto backed off this elevation by 4 3⁄8 inches to allow for the 2 3⁄8-inch-thick pavers planned for the new patio and 2 inches of sloped stone base underneath. Then he transferred this elevation to each of the forms and cut them so that the concrete footings would be at the proper elevation and remain hidden beneath the paver patio.

Figure 1. Workers dismantled the existing steel deck and concrete patio pads (A) and replaced an entry door (B). The six new poured-concrete deck footings were reinforced with triangular rebar cages (C).

Paver Patio

With the six footing forms ready to go, we brought in mason Victor Bezama of Unlimited Building Management and his crew, the subcontractor who had been hired to pour the concrete and install the patio. First, though, his crew finished clearing away the rubble that remained from the concrete patio, removed 3 inches of soil, demoed a crumbling 6-inch planting-bed border wall that separated the patio from the lawn area, and removed the first sidewalk pad of the lawn walkway.

Next, they wheeled in a portable mixer and about 45 bags of concrete mix. Each footing required roughly seven bags. Before any additional work proceeded, we

Figure 2. A new linear drain was installed to improve drainage (A), along with a properly sloped QP (quarry process) setting bed for the new concrete patio (B). These measures were needed to capture water draining from the narrow backyard, which is at a higher elevation (C). Upturned pavers mark the locations of the new deck footings (D).

had to develop a plan to improve the property's drainage (**Figure 2**).

Drainage. The backyard lawn was higher than the patio, which caused water to flow off the lawn and toward the house. This problem was compounded by a walkway through the middle of the V-shaped backyard, which acted as a culvert depositing water onto the patio. To make matters worse, a set of tennis courts belonging to nearby Stevens Institute of Technology lay to the south of the property at a higher elevation, and when the tennis court drains became clogged with leaves and debris, even more water flowed down into the yard and inundated the property.

Our plan to address the problem was simple, because there wasn't much we could do without major grading changes, which weren't in the budget. We rebuilt the planting-bed walls so water could enter the patio only from the lawn walkway and installed a linear drain connected to an existing drainpipe that extends the stormwater collection point toward the lawn walkway as much as possible. (We also made it a point to ask the Stevens staff to maintain clear drains.) Finally, and most importantly, we made sure the new patio was pitched properly to the drain, unlike the old patio, which had only a slight pitch and then settled over the years.

Hardscaping. After masons completed the planting-bed border wall, they wheelbarrowed in a mix of crushed stone and stone dust called QP (for quarry process) to create a solid base for the pavers. Working from our benchmark elevation at the alley walkway, we helped them set the drain so that its top would be 2 inches lower than the walkway and the perimeter pavers abutting the house.

Because the drain was offset toward the lawn walkway, there was a long, shallow pitch from the house to the drain 15 feet away. To help achieve the necessary pitch from perimeter pavers to the drain, the masons set up string lines to represent the top surface of the finished patio, then bedded $\frac{3}{4}$-inch-diameter rigid pipe in the QP $2\frac{3}{8}$ inches below their string lines. Then they screeded off these

Figure 3. The steel deck frame is basically free-standing but is connected to the house via a short steel ledger through-bolted to the masonry wall below the entry door (A). A portable lift was used to maneuver the heavy steel beams into place (B). After the 8-inch rim joists were welded together and to the columns, the 4-inch steel joists (C) and railing sections (D) were added to the frame. Once the frame was reprimed and repainted, 2x4 sleepers were bolted to the tops of the joists, and cleats were bolted to the rim joists to provide nailing for decking fasteners (E).

pipes to create a smoothly pitched setting bed for the $2\frac{3}{8}$-by-4-by-8-inch Holland concrete pavers.

The masons laid the pavers in a herringbone pattern. Whenever the layout intersected with a footing location, they left a paver up on edge so that we could easily locate each footing after the patio was completed.

Steel Frame

Right after the footings were poured, I called Joe Monga from Decorative Iron Works in Patterson, N.J., who came to the jobsite to measure for the deck's steel components. First, he and I established the final height of the deck. We decided that the short, 8-inch C-channel house ledger should be installed so that it would be $1\frac{1}{4}$ inches below the entry door's stone sill. This would allow 1-inch-thick composite decking material to slide easily underneath the sill, with a small step up from the deck into the house. Then we established the post heights, using a laser level set to the bottom of the ledger to measure down to the top of each footing.

Eight-inch C-channel was also specced for the rim joists, and Monga cross-checked all rim-joist lengths on the architectural plan with his field measurements for accuracy.

Next, we determined that the 4-inch steel joists should be welded $1\frac{1}{2}$-inches below the top edge of the perimeter 8-inch joists, so that we could bolt treated 2x4s to the top of each steel joist. This would create a wood substrate on top of the steel joists for the screwed hidden fastener system we intended to use for the composite decking.

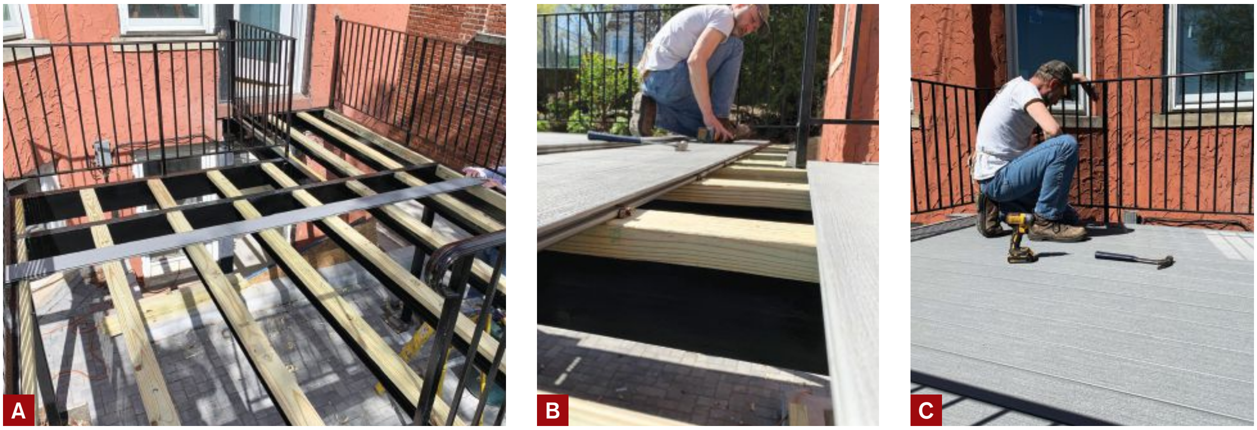


Figure 4. TimberTech Concealoc hidden fasteners were used to connect the grooved TimberTech deck boards to the pressure treated sleepers (A). The decking had to be notched to fit around the rail posts, which had been welded to the deck frame (B, C).

With all the measurements established, Monga went back to his shop to fabricate each deck frame component. We decided the stairs would be measured for and built after the steel structure was finished. We would have the time, since there was much interior work that would still need to be done. While Joe worked back in his shop, Danny installed the new back door, transom window above, and side window, along with some new interior trim.

Ledger installation. We weren't comfortable with the idea of using wedge bolts drilled into the century-old stone door lintel to install the short section of ledger that would connect the deck frame to the house. Instead, we opened up the interior wall to gain access and drilled a pair of 5⁄8-inch-diameter holes through the stone lintel spanning the basement door opening directly underneath the entry door for 1⁄2-inch-diameter through-bolts. Then we bolted the ledger to the house, inserting the long bolts through both the sill itself and a 1⁄4-inch-thick steel backing plate that we installed behind the stone sill (**Figure 3**).

Next, we placed the six deck posts onto the footings, holding them upright with a single, loosely-threaded nut on one of the anchor bolts. We waited to install the nuts on the remaining three anchors for each column until the frame was welded together. This allowed Joe to make slight adjustments to the steel framing so that everything was plumb and level prior to welding the assembly together.

First, Joe welded the two rim joists running perpendicular to the house to their support columns. He also welded the end of one of the rim joists cantilevering past its support column to the house ledger, adding integrity to the developing structure.

The installation then became a puzzle that Joe welded together in a meticulous way, starting with the two main rim joists that were parallel to the house and attached to the posts and perpendicular rim joists. This was followed by the perpendicular rim joist that attached to the opposite side of the lintel, followed by the last parallel rim joist closest to the house.

During the welding process, the posts self-located into their final positions on top of the footings, and we went ahead and installed the remaining wedge bolts to secure each in place.

Once the posts were secured and all the 8-inch C-channels were installed, Joe welded the 4-inch joists into place, followed by the steel rail system that he had also fabricated back in his shop. Before leaving, he ground smooth the welded joints, brushed on an oil-based primer, and then painted them with two coats of oil-based finish to match the finish that had been applied back in his shop. Then he measured for the stairs, which would also be fabricated in his shop.

Wood framing. To fasten the decking to the deck frame, we needed to first install pressure treated 2x4 sleepers on top of the steel joists. To do this, we drilled 3⁄8-inch-diameter holes in the C-channel flanges every 24 inches on-center for 5⁄16-inch-diameter hex-head bolts, which we used to bolt the sleepers to the flanges. To ensure that the bolt heads wouldn't interfere with the hidden fasteners or deck boards, Danny countersunk holes to accommodate the hex heads.

We also needed to install 2x4 cleats along the inside faces of the rim joists to receive the decking fasteners. Instead of drilling holes through the webs of the rim joists, we asked Joe to weld hex-head bolts to their inside faces every 2 feet on-center. Then Danny transferred those locations to the cleats and drilled holes for the bolts.

Then we lifted each cleat into place and secured it with washers and nuts, using a

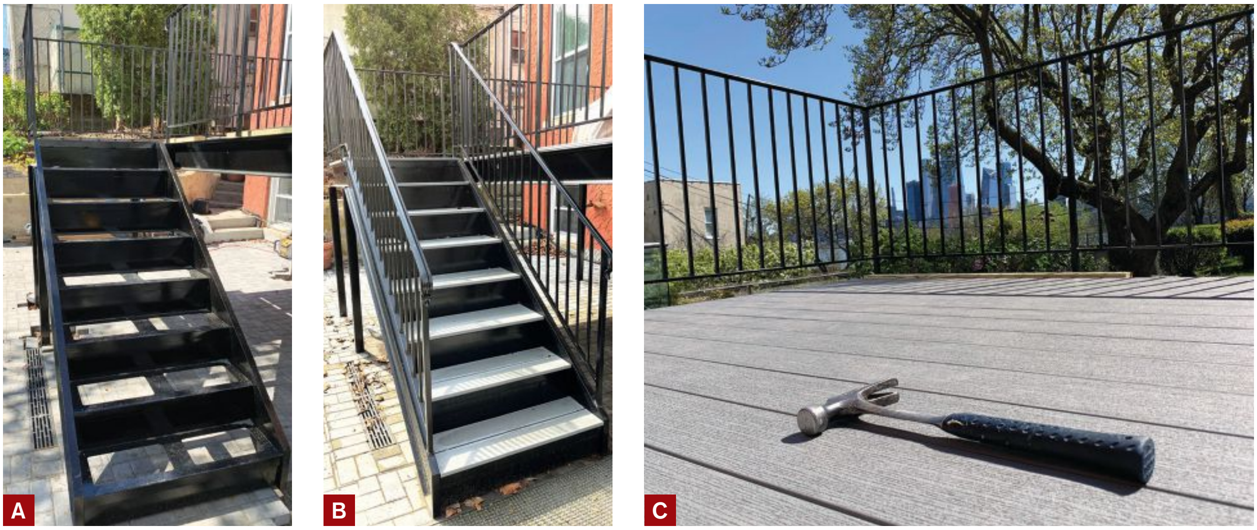


Figure 5. The staircase was fabricated off site, then brought on site and welded to the deck frame (A). Next, the prefabricated railings were welded to the stringers and the upper railing (B). The TimberTech composite treads were fastened to the steel subtreads with screws driven up into the treads from below. The New York skyline is clearly visible from the new steel-framed deck (C).

belt sander as needed to grind down the cleats wherever they stood proud of the rim joist. With all the sleepers and cleats in place, we moved on to the decking.

Decking. The hardest part about installing the decking was finding the right material, because the homeowner wanted to match the color of an existing third-floor deck. Because the decks were far enough apart, the color only had to be close, rather than a perfect match. Still, it was an effort, because we needed decking with grooved edges for a hidden fastening system, and we wanted 12-foot lengths to eliminate seams on the 10-foot-by-12-foot deck. One supplier had the color but only in solid edges, while another had the color and grooved edges but only in 16-foot and 20-foot lengths. Eventually, we found a supplier that had just what we needed: TimberTech Edge Premier maritime gray grooved boards in 12-foot lengths. We also ordered enough square-edged boards for the stair treads.

We installed the decking using TimberTech Concealoc hidden fasteners (**Figure 4**).

Stairs

A week later, Joe returned with a set of stairs that he had fabricated at his shop, and that were ready to be welded to the deck platform. He also brought with him two railings—one for each stair stringer—that he welded into place once the stairs were secured.

At the top landing, the top edge of the framing measured 66 inches above the bottom landing where the stairs bear on the patio pavers. Joe had joined the two 10x8.4 C-channel stringers together with seven 36-inch-long tread-riser assemblies and a single riser at the top fabricated from 9-gauge steel plate. Six of the assemblies and the single riser at the top measured $8\frac{1}{4}$ inches high, while Joe fabricated the tread-riser assembly at the base to have a $7\frac{1}{4}$-inch-high riser. With the treads attached, each riser measures a consistent $8\frac{1}{4}$ inches high.

The treads are made up of two pieces of 1x6 square-edge decking for a total width of 11 inches. The steel tread-riser assemblies measure $10\frac{5}{8}$ inches deep, allowing the treads to have a $\frac{5}{8}$-inch overhang with $\frac{1}{8}$-inch gaps between the deck boards and at the risers (**Figure 5**).

To fasten the decking to the steel stairs, Joe had drilled holes in the subtreads, two at each end and two in the middle for a total of six holes per board, or 12 holes per tread. The holes allowed Danny to fasten the boards to the frame from underneath, keeping the board faces unblemished. The first set of boards, low to the paver patio, was a challenge, but a right-angle offset driver—and a little bit of cursing—did the trick.

Thanks to the mason, who provided us with a solid, well-drained paver patio, the steel fabricator, whose measurements and fabrications produced a secure and square deck frame, and project manager Danny DoCouto, who nailed the footing elevations and otherwise guided the project to completion, our clients were more than pleased with the result. In construction, it often takes a team approach to accomplish a task well. ❖

Rob Corbo is a building contractor based in Elizabeth, N.J., specializing in high-quality gut rehabs and renovations of inner-city residences.

A Farewell to a Friend

by Andrew Wormer

One of the changes that Andy Engel introduced to *Professional Deck Builder* when he was hired as editor of the magazine in 2007 was a new department called "Day's End," positioned inside the back cover. He named it that because it would feature the kind of projects you talk about with your co-workers at the tailgate of someone's truck, winding down at the end of a hard day's work. As far as I know, none of Andy's various construction projects ever appeared in this column, but certainly any number of them could have. He was a good craftsman, and an even better person.

Five years later, in his last "Editor's Letter" for *PDB*, he wrote: "In this job, I met a lot of great people: colleagues, authors, and readers. I think it's safe to say that I made more friends than enemies." That was true then, and even more true today.

While he may have ruffled a few industry feathers with his no-nonsense approach to journalism, over the 25+ years that I've known Andy, I've never met anyone who didn't have great respect for him as an editor and writer, a talented carpenter, a family man, an engaging and observant conversationalist, and as a friend. Sadly, Andy passed away suddenly on March 23, 2022, at his home in Roxbury, Conn., following a heart attack. He was 60 years old.

Andy's path and mine often seemed to cross. When I left my full-time position as an editor at *Fine Homebuilding* magazine back in 1996, he was hired there to take my seat. Both he and I wrote books that were published by *FHB*'s publisher, the Taunton Press. And when Hanley Wood—the publisher of *JLC* and *PDB* at that time—hired Andy, I had been working as a *JLC* editor since 2005.

While Andy was running the show at *PDB*, our two magazines shared editorial, art, and production services, and we were in frequent contact, even while he worked remotely to remain in the home that he built on his "gentleman's farm" in Roxbury. At least, that's how I always envisioned it; I know he owned a classic IH Farmall tractor, and I was always looking forward to hearing about his next project.

Andy remained in close touch with the *JLC* community after leaving *PDB*. Many of you worked with him on articles; if not, chances are good that you met him at Deck Expo or on the JLC Live show floor, where he could often be found sporting a kilt during one of his presentations, or—later—as the show floor manager. Through his work at *FHB, PDB, JLC*, as lead carpenter for Hudson Valley Preservation in Kent, Conn., and as a self-employed carpenter both before and after these stints, Andy played a large role in making the building community better. As Andy himself might have said about his life, and as I'm sure his friends would agree were they gathered around the back of a pickup truck after a long day of framing talking about their friend, he nailed it.

Andy is survived by his wife, Patricia Steed, and his two sons, Duncan and Kevin Engel. ❖

Andrew Wormer is executive editor of JLC.

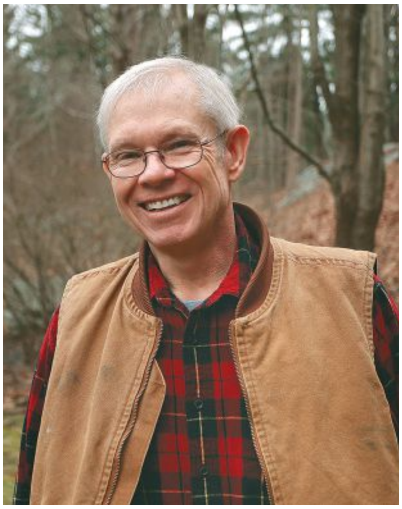


PHOTO COURTESY FINE HOMEBUILDING

HOW TO EASE PROJECT BACKLOG PRESSURE

Installation speed and simplicity are difference makers, especially with cladding.

The good news from the ABC Construction Backlog Indicator is the index hasn't trended up recently. The bad news? It hasn't gone down, either.

This steady-state condition may not be big news to most residential and light commercial contractors. Many pros are booked through the summer and into the fall and beyond. "The security of having all that work in the hopper is a good feeling," reminds veteran remodeler Paul Winans.

But a backlog has a downside. Where will material costs be in three to six months? How will your crew or subs change? How do you keep waiting customers happy? When a bid comes down to two contractors with similar ability, who usually wins the business? The contractor with a 60-day backlog or 120 days?

BEST OF BOTH

More and more contractors are actively taking steps to compress project timelines without shortchanging the customer experience. Take cladding, for example. It's tough to top vinyl siding for speed and ease of installation. Any crew can take it on. When the exterior work calls for fiber cement or engineered wood, it's a different story. That requires a different skill set.

So how do you thread the needle between an engineered high-end look and vinyl's installation simplicity and speed?

Shawn Hardy, senior vice president and general manager of integrated products at Ohio-based Associated Materials, has an idea.

50% MORE INSTALLATION PERFORMANCE

"Contractors have enough challenges. Why add to them? Contractors who have ability to influence cladding choice should push for products that are faster and easier to install," says Hardy.

"Simpler installation can be the difference between having four crews of six installers versus six crews of four installers. Six crews adds 50 percent project muscle. Extra bandwidth helps shrink backlogs, multiplies cash flow and makes more customers happier quicker."

That threading needle turns out to be composite cladding, a siding material that brings together vinyl siding installation simplicity with superior performance and the high-end look of real wood. Until recently, that look was only available by using fiber cement or engineered wood—materials that come with installation and handling trade-offs.

ALL-IN-ONE SOLUTION

One composite siding product, Ascend Composite Cladding by Alside, provides such installation ease with a high-end aesthetic that it was named the 2021 NAHB Best of IBSx Most Innovative Building Material. Hardy says Alside's new cladding is gaining fast acceptance because it blends all the good points of vinyl, fiber cement and engineered wood in one solution:

- Solid feel against the wall and a flat face similar to fiber cement and engineered wood planks
- 7-inch profile with embossed cedar mill grain for authentic wood look
- Compatible with high-end trim options for a crisp, engineered appearance
- No rotting, warping, shrinking or swelling planks
- Minimal maintenance without the need to repaint
- Reinforced nail hem for wind load resistance up to 180 mph
- 20 low-gloss, low-maintenance colors with no need to seal, touch-up or caulk
- Graphite-Infused (GP)2 technology to achieve superior performance in tests for wind load and impact resistance, workability and flame/smoke spread, all backed by a lifetime warranty

In Hardy's view, backlog and installation labor issues aren't going away anytime soon, so it's time to "adapt your business to the new normal. Look for ways to streamline workflows and utilize materials that don't require a high skill level for efficient installations," he advises. "The good news is, that kind of performance is now available for nearly any project with Ascend composite cladding."

Learn more on how to speed cladding installation time with high-end aesthetics and nearly maintenance-free performance at **www.ascendcompositecladding.com**.

Produced by Zonda Media, a Delaware corporation.
marketing.zondahome.com

Products

BY VINCENT SALANDRO

1. Enhanced Outdoor Living
The Trex Pergola Collection has three new additions: Trex Privacy aluminum wall panels (shown), offered in both permanent and movable options in multiple patterns; Trex Shade aluminum panels, also offered in multiple patterns; and Trex Pergola Retreat free-standing aluminum pergolas with an open rafter design, offered in 16 standard sizes and custom orders. All are available in a variety of powder-coat colors. trex.com

2. Four-in-One Decking Spacers
Builders use different jigs and methods to provide a gap between deck boards to allow debris and water to fall through and to give the boards room to expand as they absorb moisture. With four "wings" of different sizes, reusable Spax deck spacers can help ensure uniform gaps of four common dimensions—$^{1}/_{16}$ inch and $^{1}/_{8}$ inch for pressure-treated boards and $^{3}/_{16}$ inch and $^{1}/_{4}$ inch for composite or PVC boards. Each wing is notched to help with fastener alignment. A hole in one wing is handy for pulling out a spacer if it becomes stuck. The spacers come three in a package. spax.us

3. Smooth Profile Cabinet Fronts
Wood-Mode Fine Custom Cabinetry's Moditional collection features simplified profiles for smooth cabinetry fronts, beveled molding details, and hidden dust rails. The dust rail (the midrail of the face frame) is tucked behind the drawer front, simplifying the visual field. Doors in the Moditional Collection are available in four designs with either a transitional full overlay or inset style. wood-mode.com

4. Galvanized Steel Knee-Brace Connectors
Simpson Strong-Tie introduced a selection of knee-brace connectors to its Outdoor Accents Avant Collection decorative hardware line. Available in two sizes to accommodate both 4-by and 6-by lumber, the Outdoor Accents APVKB knee-brace connectors are fabricated from ZMax galvanized steel with a black powder coat for corrosion protection against the elements. Both sizes of the connector can be installed with a 3 $^{1}/_{2}$-inch structural wood screw and STN22 hex-head washer. The connectors cost approximately $2 each. strongtie.com

5. Collaborative Rainscreen and Cladding
A collaboration between Kebony and Grad Concept USA, Grad for Kebony is a combination rainscreen and cladding system using aluminum Grad Mini Rails and Kebony Grad Cladding. First, the rails are fastened to the sheathing, creating what will be an air space behind the cladding. Then Kebony modified-wood boards, which are grooved on the back to articulate with clips that have been factory-mounted on the rails, snap into place. The rails come in two versions: One results in a narrow gap between cladding boards for a nickel-gap look, and the other creates a wider gap for more of a shiplap appearance. Both can be installed vertically and horizontally. us.kebony.com

6. Powder-Coated Aluminum Railing
Color Guard Railing Systems' Grand Prix railing line is made from textured, powder-coated aluminum, with a PVC filler in top and bottom rails and $3/4$-inch round balusters. The railing is available in 36- and 42-inch heights for straight railing sections and in 36-inch heights for stair guard railing options. It's sold in kits, which include top and bottom rails, a baluster, rail supporting blocks, and four stainless steel mounting brackets; pricing ranges from $285 to $505. colorguardrailing.com

7. Soft-Close, Adjustable Cabinet Hinge
The Tec soft-close hinge system from Grass America features a three-tiered adjustment switch that controls the damping resistance, enabling fine-tuning of the closing action of cabinet doors. The hinges allow three-dimensional adjustment—for height, side, and depth—and are available in overlays ranging from $1/4$ inch to $1\,1/2$ inches. The low-profile cup allows for a shallow drilling depth of $7/16$ inch and contains no parts that protrude into the interior of the cabinet. grassusa.com

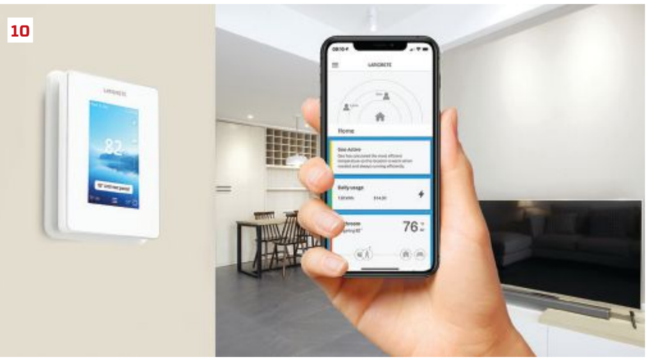
8. Water-Impervious Wood Alternative
Made from upcycled rice hulls and PVC resin, Acre from Modern Mill is available in sheets, trim boards, decking, siding, and millwork. According to the manufacturer, the material has the aesthetic appeal and warmth of wood without sacrificing performance or durability; is resistant to shrinking and swelling as well as pests, decay, and climate impact; and will not rot, crack, or splinter. Acre products can be stained, painted, or printed on and can be cut and milled without specialty tools. modern-mill.com

9. Black-Tone Stone Siding

A black-toned Onyx option is the latest introduction to the NovikStone Dry Stack Stone and Premium Hand-Cut lines. The manufacturer says Dry Stack stone siding offers the detail of precision-laid dry-stack stone and helps achieve the look of traditional masonry, while Premium Hand-Cut siding mimics the look of hand-chiseled stone. The stone siding is impervious to moisture and resistant to warping, expansion, contraction, and cracking, according to the manufacturer. The siding is suited for foundation covers and knee-wall cladding and can be installed without mortar or adhesives. novik.com

10. Smart Heated Floor Control

Laticrete has developed two thermostats to allow easier control over its Strata_Heat floor warming system. The Wi-Fi Thermostat and Smart LCD Wi-Fi Thermostat can be controlled through an app to provide real-time information and can learn a user's routine. Both have built-in ground fault control. Latricrete's Strata_Heat system can be installed under tile, stone, or hardwood floors. The thermostats cost about $200. laticrete.com

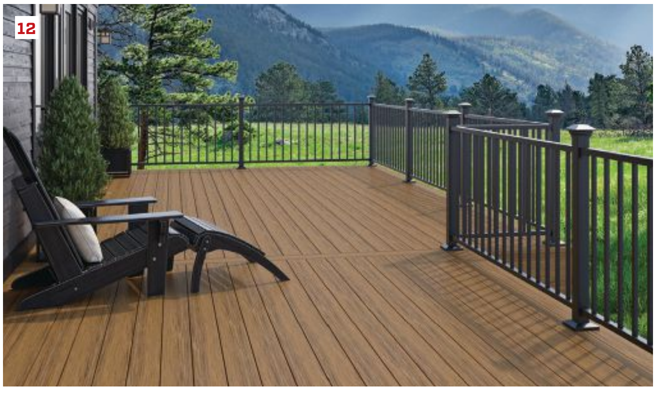


11. Multi-Application Drain Pump

The Sanivite Drain Pump can discharge graywater away from a variety of fixture types up to 16 feet vertically or 150 feet horizontally, according to the manufacturer. The drain pump, which can be used for basement kitchens and baths, fits inside a cabinet and is designed to handle sinks, dishwashers, showers, and washing machines. It comes equipped with a pair of 2-inch low inlets on either side and an additional 1 1/2-inch inlet on top, along with a vent connection. Built-in check valves handle the drainage from any sink or tub. The unit discharges wastewater through a 1-inch, 1 1/4-inch, or 1 1/2-inch rigid pipe. The unit costs approximately $440. saniflo.com

12. Mineral-Based Composite Decking

Sedona, a warm brown tone new to Deckorators' Voyage line of mineral-based composite decking, complements the popularity of mossy and sage green palettes. The manufacturer says Voyage decking features a fiber-like structure similar to wood that is nearly 35% lighter than traditional composites and similar in weight to PVC. Available in four different widths and 16- and 20-foot lengths, Voyage decking is also approved for use as residential cladding. deckorators.com



Classifieds

Advertising Index

Castle 110 Pocket Cutter

BY GARY STRIEGLER

Most cabinet shops I know of rely on some pocket-hole joinery, typically using a high-production machine to quickly make either routed or drilled pocket holes. Until recently, drilled pocket holes have been the only economical option for trim carpenters, one-man shops, and homeowners, but the Castle 110 pocket cutter is a midrange-priced option for routed holes. While it's not a high-production machine, it cuts low-angle pocket holes that offer some benefits over drilled ones. We do a lot of pocket-hole joinery on jobsites using Kreg's Foreman pocket-hole machine, which is comparably priced to the Castle 110 machine. So it made sense to compare these two machines and the joints they make.

Unlike the Foreman, which has a lever-actuated drill equipped with a step bit to make the pocket hole, the Castle 110 has a router and requires a three-step process. First, you lower the clamping arm to lock the workpiece in place. Next, you push a handle that engages the router, which cuts the low-angle pocket with a router bit. Finally, you use a separate drill equipped with a long bit to drill the pilot hole for the screw from the reverse side of the workpiece through a guide built into the machine. The result is a clean, 3-degree pocket hole with minimal tear-out, around either the pocket or the pilot hole.

The Foreman machine is faster, because as you pull the handle down to clamp the workpiece to the table, it activates the drill to make the hole in one quick action. If the machine is set correctly, the pilot point stops right before breaking through. The resulting drilled pocket hole is not as clean as the routed one produced by the Castle 110 and is cut at a steeper, 15-degree angle.

The main advantage of the Castle 110 is that—with some practice—you can put together the joints without clamping, thanks to the clean cuts and the low angle, which minimizes joint creep as the screws pull the two pieces together. The main disadvantage is that it took me over twice as long to produce the pocket hole.

While both machines are light and portable, the Castle 110 has a smaller footprint and weighs less than the Foreman. And with the Castle, you can make pocket holes in large panels by taking the machine to a stationary panel; you can't do that with the Foreman. Designed and assembled in the USA, the Castle 110 is mainly metal, while the Foreman has aluminum and steel components but is largely made of plastic polymer material. That said, the Foreman is plenty rugged; I've never damaged one on a jobsite.

I especially like the Castle's material clamp, which seems sturdier than the Foreman clamp and doesn't need occasional readjustment to keep the workpiece from slipping. Both machines offer a dust collection option, which is essential with the Castle because the small base quickly fills up with sawdust and chips from the router. To be honest, I've never used the dust collection with our Foreman. Drilling just produces chips, and if you disconnect the hose, you can use the tool all day and still not fill up the large base.

One last observation: During the routing operation, the Castle was a lot louder than the Foreman. $660 from Castle USA. castleusa.com

Gary Striegler, a JLC contributing editor, owns Craftsman Builders (craftsmanbuildersnwa.com), in Fayetteville, Ark.


1


2


3


4

Photos: Gary Striegler

The Castle 110 is fitted with a router that cuts the pocket when the handle is lowered **(1)**. With the workpiece still clamped, a separate drill is used to make the pilot hole **(2)**. Pocket holes made by the Castle 110 are cleaner and cut at a lower angle than those made with the Kreg Foreman **(3)**. Because the Castle 110 produces low-angle pocket holes, a clamp isn't necessary to prevent the joint from slipping when you're joining workpieces together **(4)**.

Makita 40-Volt 10¼-Inch XGT Beam Saw

BY TIM UHLER

Life just keeps getting better on the framing site. Last year, I reviewed Skilsaw's 10¼-inch cordless wormdrive saw, which allowed us to finally unplug the last of our corded tools (see "Skilsaw 10¼-inch Cordless Beam Saw," Feb/21). Now Makita has introduced another entry in the big, battery-powered, rear-handled beam saw category: The GSR02M1 40V Max XGT 10¼-inch circular saw kit, part of the tool maker's XGT line of cordless power tools.

Features. The saw features a brushless motor that spins a 10¼-inch blade at 4,000 rpm, giving it a 3¾-inch cutting capacity. It has an electric brake to stop the big blade, an important safety feature, especially with large blades that can take a while to wind down without a brake. Makita says to expect up to 150 cuts per 4.0-Ah battery charge in 4x4 SPF lumber, which—based on our experience with the saw—sounds about right. This saw will bevel to 56 degrees, with positive stops at 22.5 and 45 degrees, and it has a rafter hook that's large enough to fit over 2½-inch I-joists.

One of the saw's best features is that it weighed in at only 13.6 pounds—with the battery!—on my scale. This is a lot less than the Skil beam saw that I reviewed last year, which weighed in at 18.6 pounds on the same scale, and even lighter than the corded 7¼-inch Skil wormdrive that I started with in the mid '90s. And not only is it light, but the balance is perfect.

The saw includes Makita's AWS auto-start wireless system, which allows it to communicate using Bluetooth to a dust extractor (we didn't test this feature, as we rarely use dust collection on our jobsites).

The kit comes with a 4.0-Ah 40-volt battery and a charger with a claimed recharging time of 45 minutes. It also includes a saw blade, wrench, and tool bag.

Power. After using the saw for a few weeks, the only negative that I can think of—at least for now—is that the kit comes with only one battery. I never ran out of juice and didn't have a second battery, but for crews that are cutting a lot of beams, I-joists, or blocking out of 4-by material, two batteries would be a must. Of course, if the crew is already invested in Makita's XGT platform, this wouldn't be a problem.

I also noticed that this saw did seem to lack some power, though maybe that was a function of a feature that the company calls "Automatic Torque Drive," which it says adjusts cutting speed under load to optimize cutting performance. I'll be interested to see if future, higher-Ah batteries will help with this. But it was never a major problem; it just meant that on certain glulams, I had to slow down during cutting.

We also had Makita's smaller, 7¼-inch XGT saw on site during our testing, and we noticed that the bigger saw seems to draw down the battery a little more quickly. That said, I would absolutely recommend this tool. It saves time since you can cut thick stock or double plates in a single pass instead of two, even beveled rake wall plates. It's available online as a kit with charger and 4.0-Ah battery for about $500. makitatools.com

Tim Uhler is a lead carpenter for Pioneer Builders in Port Orchard, Wash., and a contributing editor to JLC.

The Makita 40-volt XGT beam saw can cut through 4-by lumber in a single pass **(1)** and has a large rafter hook that fits over an I-joist **(2)**. The saw has an electric brake to stop the big, 10¼-inch blade **(3)**.

Photos: Tim Uhler

Metabo HPT MultiVolt Cordless Compressor

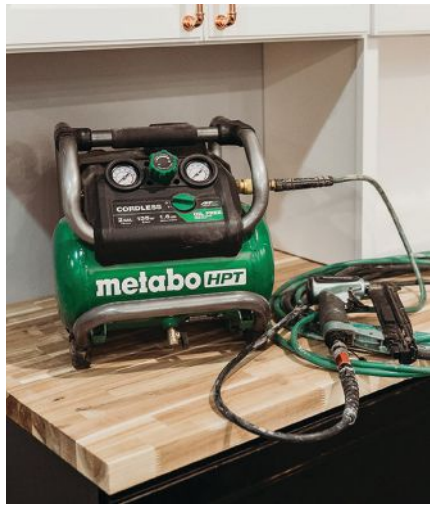
Recently, Metabo HPT sent me its new 36-volt MultiVolt 2-gallon cordless compressor (model EC36DAQ4) to test. Out of the box, this compact unit delivers 135 maximum psi, and Metabo claims that the brushless motor can easily drive more than 1,000 18-gauge brad nails on a single charge. I haven't tested that claim, but whether or not that's true, the compressor can be conventionally plugged into an AC outlet for all-day runtime, thanks to an available AC adapter (model ET36A) that also works with other tools in the company's MultiVolt lineup.

According to the specs, the compressor produces 1.6 cfm at 90 psi, and 2.3 cfm at 40 psi. That's not enough to power a framing or roofing crew running multiple guns, of course, but it's plenty for trim work, occasional light framing, filling tires, and all the other tasks you might use a small compressor for. Weighing only 27.3 pounds, this compressor is light and compact, with a form factor and rubber carrying handle that make it easy to schlep around.

The compressor has an all-metal roll-cage design to protect the integrated control panel, which has gauges for tank pressure and regulator pressure. It is easy to adjust the pressure by twisting the large green knob and then pushing it in to lock the pressure at the desired setting.

The refill time is about 17 seconds with a full battery charge. As the 4.0-Ah battery drew down, each refill seemed to take a little longer. But that didn't bother me, because the noise level while the compressor is running is noticeably less than my 6-gallon pancake compressor, which rocks my whole house. The tool's shock-absorbing feet did a good job of reducing vibration.

The EC36DAQ4 comes as a bare tool, with a factory-installed $1/4$-inch brass coupler. It costs $300. metabo-hpt.com —*Andrew Wormer*



Metabo HPT's MultiVolt cordless compressor has a compact footprint, a roll-cage design with a built-in carrying handle, and shock-absorbing feet.

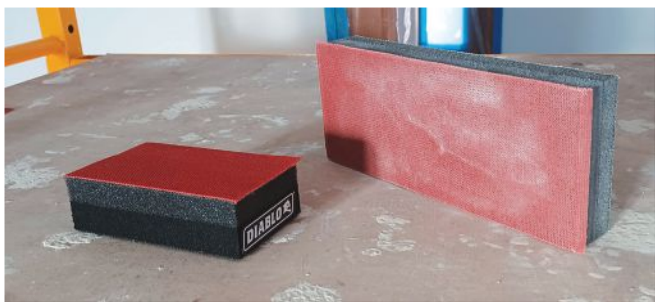
SandNet Abrasives

My first experience with Diablo's SandNet came at the end of taping out drywall ceilings and repairing plaster walls in two rooms with 11-foot ceilings. I had jumped into this job looking forward to the end when I could test out a fancy new power drywall sander. Suffice to say that I beat myself up using that fancy sander (a topic for another review); it was a heavy beast, but I kept at it and managed to finish both ceilings. I was determined to take advantage of the vacuum on it and not face that unique hell of staring upward into a rain of drywall dust.

After the ceilings, I still had the skim-coated wall area to sand out and looked for an alternative. On a whim, I had picked up a pack of 220-grit SandNet and a foam block by Diablo. What a dream this turned out to be, especially after wrestling that beast. Sanding walls is easier than doing ceilings; the dust falls harmlessly down the wall to pile up along the baseboard. Best of all, I ended up using just one sheet of SandNet for over 1,110 square feet of wall area.

SandNet is an open-weave nylon mesh with abrasives along the nylon fibers. Impressively, it does not clog. The abrasive sheet will eventually dull, but drywall dust falls away and does not clump on the surface. An occasional shake was all that was needed.

Enthusiastic to use SandNet again, I tackled sanding out epoxy repairs on old wood floors with a 5-inch random-orbit sander. (SandNet comes in a wide range of configurations for most hand and small power sanders, excluding belt sanders.) Epoxy is challenging for any abrasive, as the sticky dust gums up quickly. I can't say that SandNet is any better than any other abrasive, and at $2.50 to $3 a disc (versus about 60 cents for a paper disc), it's quite a bit pricier. On the open floor areas (a mix of unpainted and painted wood), SandNet did much better, but not nearly the "lasts 10x longer" that is printed on the package. A vacuum hose on the sander easily pulled dust through the net and clogging wasn't a factor. But the abrasive did dull and the edges frayed. Curiously, 80-grit discs seemed to fare worse than 120-grit discs, which did as well but lasted longer. I would venture they last two to three times longer than paper. But at their price, that doesn't net out to a savings. For any hand sanding, I'd choose SandNet; for power sanding, I'll stick with paper. diablotools.com —*Clayton DeKorne*



One sheet of 220-grit SandNet (on long foam block at right) sanded more than 1,110 square feet of skim-coated plaster.

Photos: top, courtesy Metabo HPT; bottom, Clayton DeKorne

Backfill

JLCONLINE.COM

BY JLC STAFF

California's Forgotten 'Big One'

On the morning of January 9, 1857, the Fort Tejon earthquake, one of the strongest ever recorded in the U.S., struck Southern California. Its strength was such that it was reported to have caused rivers to flow backward and lake waters to be thrown upon their shores, stranding fish miles from original lake beds.

A lonely military outpost, Fort Tejon—built a few years earlier in sparsely populated, 1850s Southern California—took the brunt of the quake. "We have accounts from one of the commanding officers, Captain John W.T. Gardiner, who was there the morning it hit," says Michael Deagon, an interpreter at Fort Tejon State Historic Park, a 75-mile drive high into mountains northwest of Los Angeles. "In letters, Captain Gardiner describes being thrown from his bed across the floor and not able to get on his feet because of the intensity of the earthquake." Throughout southern and central California, the strong shaking caused by the 1857 shock was reported to have lasted for at least one minute, possibly upwards of three. The earthquake acquired its name because Fort Tejon was the largest population center near the fault, but the quake's epicenter was actually 100 miles to the northwest of the fort, near Parkfield, Calif.—the self-proclaimed "earthquake capitol of the world" **(1)**.

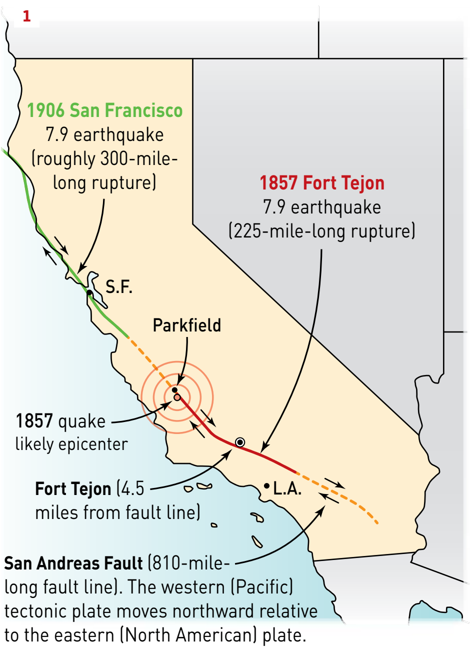
Damage, abandonment, and restoration. Restoration architect Clarence Cullimore gave a sense of the damage in *Old Adobes of Forgotten Fort Tejon* (1949). As reported by the Los Angeles *Star* on January 24, 1857, "Quarters occupied by Lt. Col. Beall has received more damage than any other finished building on the Post. Its chimnies [sic] have been thrown down, its plastering broken off in many places, and one of its ends so badly shaken and cracked as to be too insecure to be occupied."

The fort was rebuilt, but was later abandoned in September 1864. Once deserted, its many structures fell into decay, with rain and mountain snows taking their toll on the unprotected adobe wall surfaces **(2)**.

According to Deagon, "It was the late '40s, early '50s when they started rebuilding some of the structures. The park plan still calls for 15 other old historic structures to be rebuilt." A third of the original structures have been restored **(3)** with one in a state of "arrested decay"—adobe buttresses were placed around an exterior wall in the 1950s to stabilize it until it could be fully preserved **(4)**.

The next "big one." Deagon notes, "It was the last major earthquake of that size to hit this area. Seismologists tell us this part of the San Andreas tends to be on a 150-year cycle and the earthquake was over 160 years ago. So we're kind of overdue."

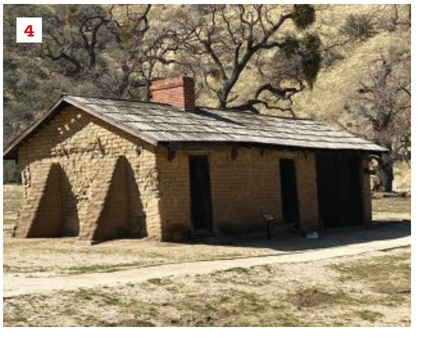
1



2

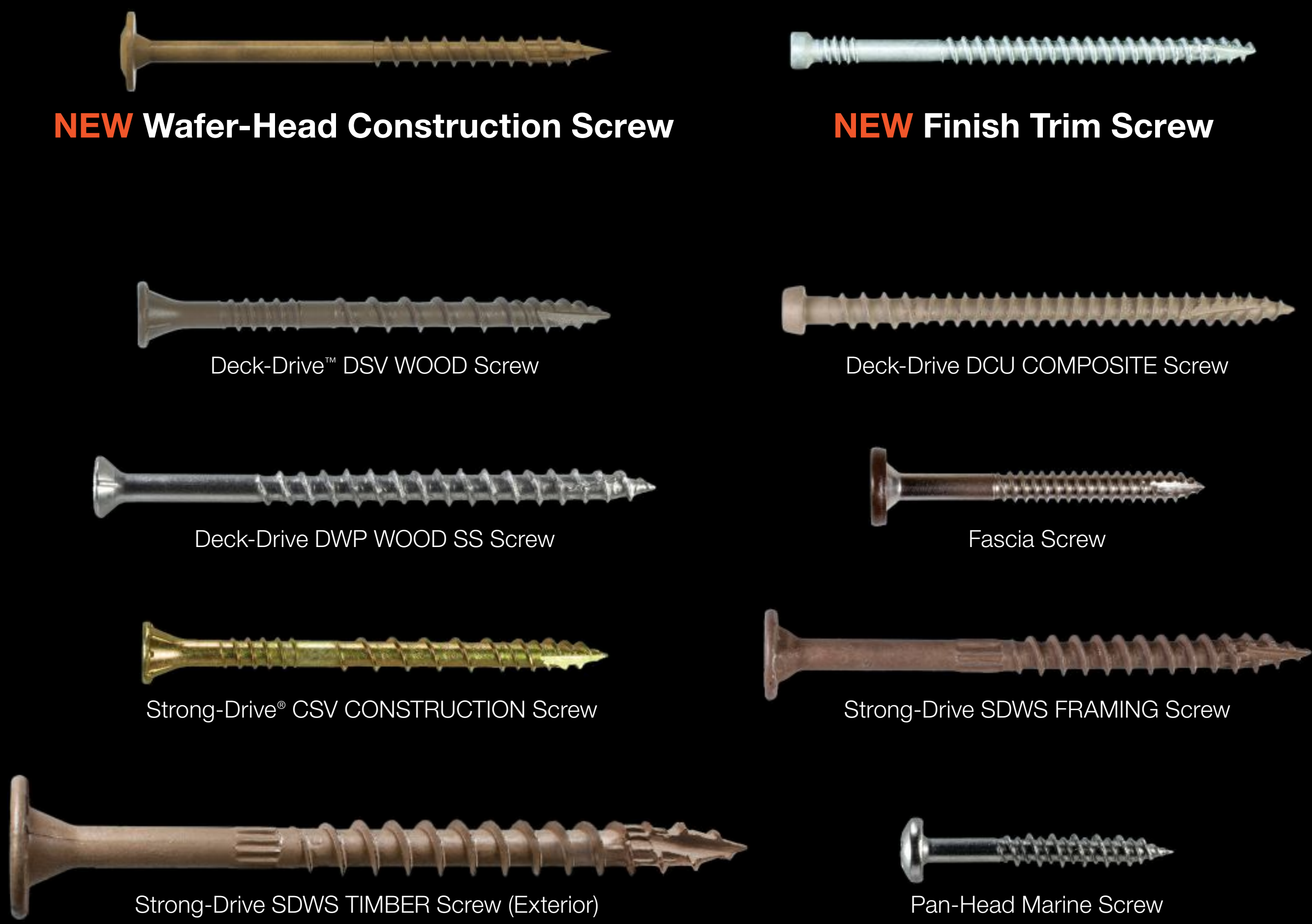
3

4



1, Tim Healey; 2, Library of Congress; 3, 4, courtesy California State Parks

Drive projects to a faster finish.



Save time on your next job with the new Finish Trim and Wafer-Head Construction screws from Simpson Strong-Tie. These high-performance fasteners are designed for a wide range of applications — framing, cabinetry, trim, outdoor furniture and more. The Finish Trim screw's low-profile head makes it ideal for finish work, while the Wafer-Head Construction screw offers high pull-through capacity for strength. Both feature our unique SawTooth® point, which eliminates the need for predrilling and makes driving easy. And with our Quik Guard® coating, they're suitable for interior and exterior jobs.

To learn more about our entire selection of Simpson Strong-Tie® fasteners, including the new Finish Trim and Wafer-Head Construction screws, visit **go.strongtie.com/fasterfinish** or call (800) 999-5099.

SIMPSON
Strong-Tie®