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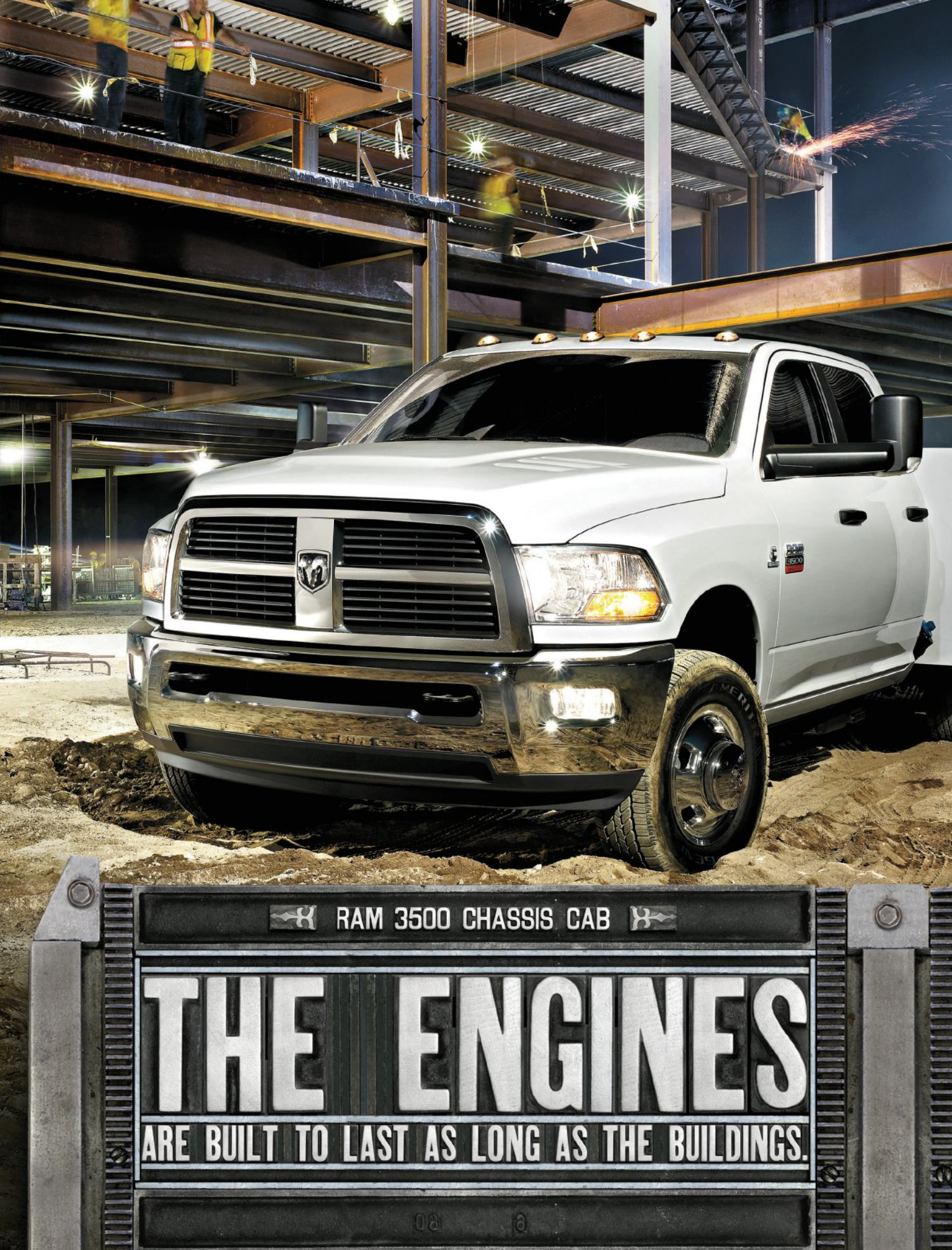
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Editorial Director Sal Alfano, salfano@hanleywood.com
Editor Don Jackson, djackson@hanleywood.com
Art Director Barbara Nevins, bnevins@hanleywood.com
Managing Editor Amy Doherty, adoherty@hanleywood.com
Illustrator Tim Healey, thealey@hanleywood.com
Senior Editor Jon Vara, jvara@hanleywood.com
Senior Editor Andrew Wormer, awormer@hanleywood.com
Assistant Managing Editor Laurie Elden, lelden@hanleywood.com
Contributing Editors Michael Byrne, Ted Cushman, Paul Fisette, Bruce Greenlaw, Carl Hagstrom, Dave Holbrook, Tom O'Brien, Joe Stoddard, Charles Wardell

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rspink@hanleywood.com
Kim Heneghan General Manager Online, Residential Remodeling
(202) 380-3831 Fax: (202) 785-1974
kheneghan@hanleywood.com
Helene Slavin
Group Publishing Support Manager
(202) 736-3428 Fax: (202) 785-1974
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Letters

Passive House Costs Explored

I've been following the *JLC* articles on super-insulated homes; one consistent thread seems to be the extraordinary labor hours required for all the details, especially air-sealing. The latest by Christian Corson ("An Affordable Passive House," 5/12, 6/12) was no exception. Although I like the Passive House concept, some of the requirements seem to offer little payback in the U.S., where natural gas costs a fraction of its cost in Europe. In Michigan, I can install a high-efficiency gas forced-air system for the same cost as this house's hvac system (that's one expensive ERV system!), and I don't see the savings from all the extra insulation.

Could the author compare this to a conventional project and comment on his profit margin? On the question of affordability, a breakdown of the $210,000 construction cost would be helpful. What's included? Obviously not the land, and I don't see a garage. Is the entire first floor a concrete slab? Are the kitchen and baths complete? Is there a well and septic? Is the lighting LED? What was the cost delta for the windows? (I find energy-efficient windows very expensive.) Also, what did the author use for entry doors?

Why not use foam board instead of OSB for a thermal break on the ceiling? Isn't there a cheaper approach to insulating and sealing the ceiling? Finally, a small supplemental wood stove seems a natural for this house (instead of baseboard electric). Did the author consider that, or is a stove "verboten" in Passive House standards?

Kenneth Ludvigsen
Aristocraft Homes
Ortonville, Mich.

Chris Corson responds: Why are we doing this? For me, the driver is climate change. We are on the brink of catastrophic, irreversible changes that will result not only in the extinction of species but ultimately in the loss of trillions of dollars of civil infrastructure. Passive House is a quantifiable approach that can achieve a 90 percent reduction in the energy consumption of the built environment. Given the global context, building healthy, comfortable, efficient homes that reduce the carbon footprint of the building to near zero using local, sustainable materials makes perfect sense.

While natural gas may be cheap right now, it is not renewable, and it's being harvested with environmentally destructive methods. True energy security will come from renewables. The sun supplies 86,000 terawatts annually. Global consumption in 2010 was just above 50,000 terawatts — and that accounts for every home, building, appliance, and automobile on the planet. We have a multi-billion-dollar industry waiting to be born. China, one of the world's largest solar-panel producers, has already figured this out.

As for your specific questions, the home was built for the same cost as a home built to code in this market; my margin was lower by choice. It was our intent to demonstrate that a Passive House could be built affordably using materials readily available to all builders in the U.S. This home is just one example of how it can be done — I and other builders continue to develop practical methods to streamline the processes.

Regarding labor hours, there was nothing extraordinary about this job. The house was turn-keyed in six months, by two carpenters and a laborer who worked standard 40-hour weeks with no overtime — hardly a time sink.

There's no garage, but the budget includes the house, driveway, site work, septic, and well. It does not include the PV, as the article pointed out. The downstairs finished floor is sealed, clear-coated concrete. The house has a full Ikea kitchen and finished baths. The lighting is 100 percent compact fluorescent.

I used Intus triple-glazed windows and doors on this project. The cost delta versus, say, an Anderson A-series double-glazed unit is zero. The doors are more expensive, at around $1,400 to $1,800 a pop. The construction and performance of these products is superior to U.S.-made products in every way.

The OSB ceiling is an air barrier, not a thermal break, and no, there is not a more affordable way to achieve the same performance.

Biomass systems are not forbidden in Passive Houses; in fact, biomass boilers are found frequently in European Passive Houses and other high-performance buildings. The units must be airtight, however, and need makeup air, so common inexpensive wood stoves are not the best choice. In this house, peak heating load is about 6,000 Btu per hour (with 7,345 HDD and a design temp of -2°F). Since the smallest woodstoves on the market are rated around 30,000 Btu/hr, you'd get severe overheating. So we used an air-source heat pump to supply both heating and cooling, for an installed cost of $2,000.

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Q&A

Q. Matching Old and New Cabinets

My client wants to change the design of her eight-year-old kitchen and add new cabinetry. Fortunately, the same maple cabinets are still available from the manufacturer, either unfinished or with a clear lacquer finish — but I know they will look much lighter than the originals until they've had a chance to age, and even then the match probably won't be exact. Short of replacing the old cabinets, what's the best way to match the new with the old?

A. *Scott Burt, owner of Topcoat Finishes in Jericho, Vt., responds:* A light-toned wood species like maple doesn't change in color as much as a dark-toned wood like cherry, but the change happens more slowly and the results are less predictable. That makes it difficult to "match" the effects of time on clear-finished maple cabinets. (The job would have been easier if the maple had been finished with a dark stain.)

Some cabinet shops that finish with HVLP equipment might try bleaching and toning all the finished cabinetry once the new units have been installed, but this takes a lot of prep work and protection, creates obnoxious odors, and produces results that can look artificial. I prefer a technique called overstaining, which is done manually on unfinished wood.

I begin by brushing a base coat onto the new unfinished cabinets, using a polymerized oil coating like Murdoch's Hard Oil (800/322-1245, sutherlandwelles.com) or a sanding sealer like Zinsser's Bulls Eye Sealcoat (847/367-7700, rustoleum.com). Over that, I apply an oil-based stain such as Old Masters gel stain (800/747-3436, myoldmasters.com). The process is similar to faux graining, only with a controllable tone, so getting good results takes some proficiency. After the wiping stain has cured, I apply a compatible clear finish, such as Zar Ultra Max waterborne oil modified polyurethane (800/845-5227, ugl.com).

For the project you describe, I would recommend leaving the new finish a tick on the light side and letting the target tone depth come in over time (typically within three to six months). Staining is a subjective art, so I always create about six stain-match samples and then narrow it down to three: one on the light side of the target, one on the dark side, and one that's dead on. These samples help me explain to the client what to expect during the aging process.

Sometimes in a case like yours it's easier to lighten the older cabinets by sanding and refinishing them. Solid wood face frames, doors, and drawer fronts can endure pretty vigorous sanding, though care must be taken not to punch through the veneer of sheet goods. After sanding, I make finish samples in the least conspicuous spots or on separate pieces of maple to find a good tone that matches the finish on the new cabinets. Waterborne poly is usually a good bet, since clear-finished maple tends to be quite blond — though some staining (over a sealer) might be necessary to get tones to match. While labor-intensive, this method makes finishing much less finicky and brings all of the cabinetry to a more predictable baseline; after that, natural tone depth change should be more uniform and less noticeable.

Q. Whole-House Remodeling Costs

I'm in the planning stage of an architecturally designed whole-house remodel. It's a big job for us — about $400K — but I'm seeing a few caution flags. The architect has never done a project this large before, and the drawings he's provided are a little rough. I'm concerned about coming up with a solid cost estimate, and although I'll be approaching it as a cost-plus job with a ceiling, I wonder about the potential for being dragged back and forth between the architect and the client. How do I manage expectations while staying on good terms with everyone?

A. *Paul Eldrenkamp, owner of Byggmeister, a design-build remodeling company in Newton, Mass., responds:* First, don't ease off on your marketing and sales efforts, because that $400K job could disappear in a flash. Given the architect's limited experience, the finished design could easily exceed the client's budget once everything is factored in. In my experience, it takes three to six months from the time the client first calls to the time we sign the construction contract — and even longer for larger jobs. So don't let your pipeline go empty because you think you have the rest of the year booked up.

Second, I think the best defense is a good offense. Write your own initial specs for the job and base your estimate on those specs. At every design meeting, document where things have changed from what you initially assumed, because these changes will always represent cost increases.

Finally, don't be afraid to abandon ship — if you get too much invested in this project, you'll start to convince yourself you can do things within the budget that you really can't.

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On the Job

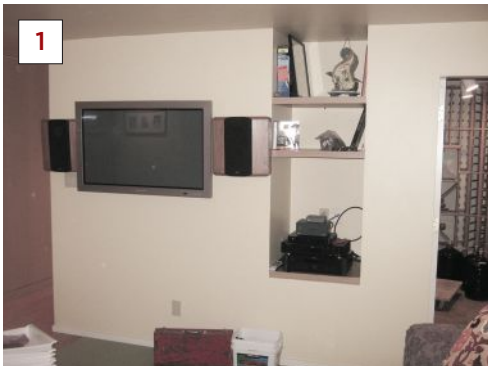
Supporting a Masonry Chimney From the Bottom Up

by Brad Hilse and Brad Hutt

The only thing standing in the way of the homeowners' plans to turn their partially finished daylight basement **(1)** into an open media room with a custom wine cellar was 32,000 pounds of brick — namely, the masonry mass containing the two flues for the wood-burning fireplaces on the upper floors **(2)**. Our company, a framing and structural contractor, was called in to help the GC remove the chimney — from its base at foundation level up to the first floor — while leaving the upper part intact and undamaged. The engineer's plan for supporting the chimney called for two 18-foot-long steel I-beams, along with a dozen other pieces of steel angle iron located both in the basement and the attic **(3)**.

Our first logistical challenge was simply getting the beams into the basement, using our boom truck **(4)**, some furniture dollies, and a pair of one-ton Genie lifts. A few days before the I-beams showed up, we did a test run with a full-length wood mockup to make sure we could get them where they needed to go. Fortunately, everything came off without a hitch on delivery day.

Once we had the beams in the basement, the welder had to do some fabrication — cutting to length, drilling holes for connections, and welding on web-stiffeners at various bearing points. Our brick mason had assured us that the brick chimney would behave monolithically, so that we could install the beams one side at a time without risking collapse. In preparation, we installed 3-inch tube supports at the end points, where they would be hidden in cabinets and wall framing, while the mason removed the brick to make way for the first beam **(5)**.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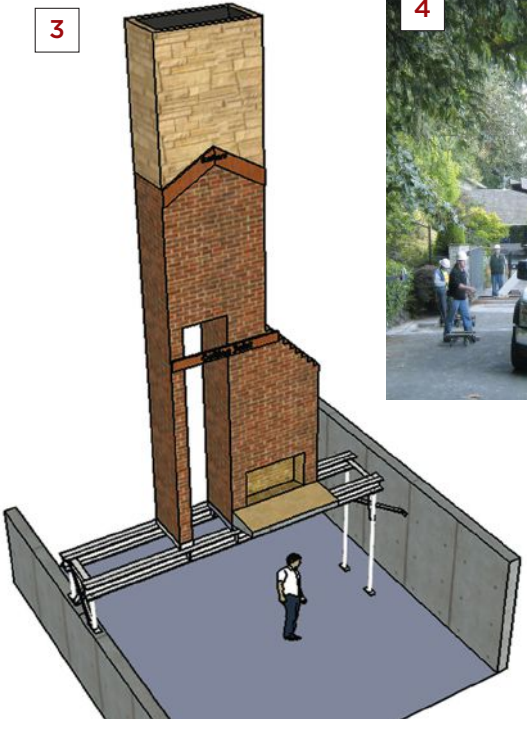
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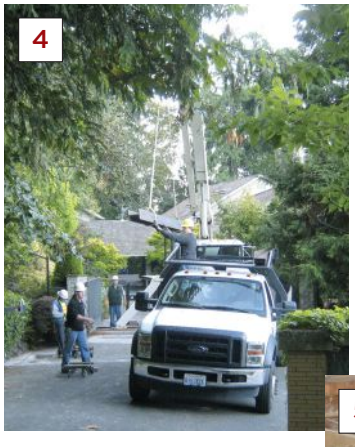
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The channel created for the beam was about an inch too high **(6)**, but the space would be filled later with stone shims and non-shrink grout. For now, it gave us the needed clearance to make the installation easier. We hoisted the first beam with our Genie lifts, positioned it **(7)**, and bolted it to the post caps at each end while our temporary supports were still in place **(8)**.

With the beam in place, the next step was to grout the empty spaces above it to ensure even bearing **(9)**. We also welded a 5-foot length of 6-by-¼-inch steel plate along the top flange for securely attaching the brick mass above to the I-beam. The steel plate was predrilled every 8 inches so that we could embed and epoxy ⅝-inch threaded rod anchors directly into the brick.

Once the steel plate was installed, we repeated the whole process on the other side of the chimney with the second 18-foot beam. Next came some pieces of steel angle that spanned the 30 inches between the I-beams at each end of the chimney **(10)**. These short members were notched into the brick above and grouted so that they picked up more of the load.

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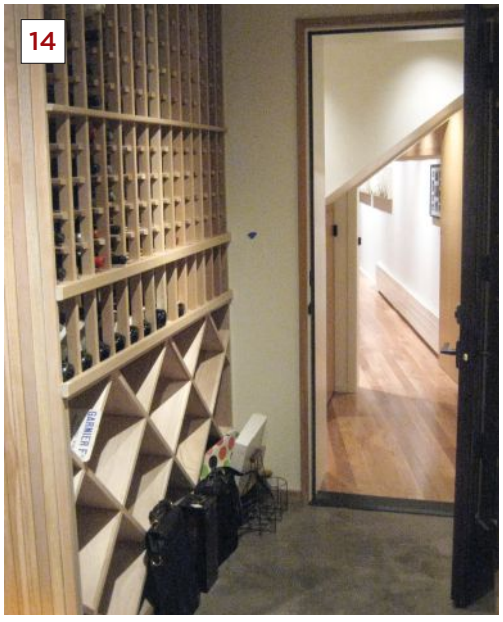

At this point, we were able to begin removing the bottom part of the chimney **(11)**. The engineer had warned us to expect as much as ¾ inch of deflection in the I-beams as they took the load. We gradually transferred the weight of the brick onto the steel by slowly lowering the 20-ton jacks we had used for temporary support. We worked our way around the chimney, first removing any loose shims, then removing loaded shims. When the final shims were removed, the beams had deflected about ⅜ inch, causing no damage to the tile and drywall finishes upstairs.

With the brick out of the way, we added a couple of angles from underneath and grouted any remaining voids between the steel and brick **(12)**, leaving that part of the basement open for construction **(13)**. We finished our phase of the job by framing the walls for the wine cellar **(14)** and the media room **(15)**, which were completed by the GC.

Brad Hilse *is foreman and* ***Brad Hutt*** *owner of Hutt Construction, a framing contractor in North Bend, Wash., specializing in challenging structural projects.*

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What's the Payback for Becoming a Home Performance Contractor?

by Myron Ferguson

I've been successfully hanging drywall for nearly three decades, but when work started slowing down a few years ago I decided to add home-performance contracting to my business. Getting trained and certified felt like a logical step, since drywall work directly involves the building envelope. I also do a lot of insulating (which is common for drywall contractors in my area).

Originally, I just wanted to increase the scope of services I could offer my clients, though I also thought that the added knowledge would give me an edge over my competitors when bidding drywall jobs. My hope was to derive about a quarter of my income from building-performance contracting to help cushion the blow if drywall work fell off again. But after taking the classes, I was pretty excited and open to the possibility of doing even more building performance–related work, figuring I would add certifications as I gained field experience. Unfortunately, it hasn't worked out that way, for reasons I'll describe in this article.

BPI Certification

There are a number of paths into home-performance contracting, ranging from utility training programs to private franchising opportunities. I chose to get certified by the Building Performance Institute, a national trade-based certification organization with home offices in Malta, N.Y., just a few minutes from my house. BPI certification — or its equivalent — is not necessary for private work but is often required of contractors working with government agencies, utilities, and other organizations that offer energy-efficiency programs.

Coursework. BPI doesn't actually provide training; for that I attended classes at Hudson Valley Community College in Troy, offered through New York's Workforce Development Institute. Independent training organizations in your area can be found on the BPI website.

I started with a course called "Building Analyst Professional." It met twice a week for about a month; during the afternoon and evening classes, which lasted about five hours each, we covered general building science topics like air leakage, moisture management, and ventilation. By the end of the course we had accumulated 24 hours of classroom time and 12 hours of field class.

After that I took a building-enve-

lope course, which covered the same subject matter but in greater detail, with a little more time spent in the field. As in the previous class, there were 12 to 15 students, most from the building trades and many sent by their employers.

Even with my years of experience, I found the coursework to be rigorous. Those who think they're just going to breeze through the courses and tests are usually surprised; about half of the students in my building-analyst class failed the written test.

Costs. Each class cost $1,200, with an additional charge of $250 for the written test and $350 for the field test at the end (the cost of a practice field test is $300). At the time I took the courses, I was eligible for an 80 percent refund from New York State Energy Research and Development Authority (NYSERDA), our state workforce development program.

Accreditation. After earning my certifications, I waited a year before becoming an accredited contractor. During that time I performed a few audits and enough improvement jobs to determine that there was real potential. Accreditation requires an annual renewal fee of $500 and a BPI quality assurance fee that varies depending on revenue — $1,000 if annual revenue is under $250,000, for example. This fee helps cover required meetings with Conservation Services Group (CSG), which also checks my field work and occasionally accompanies me on an audit.

Since accredited contractors must meet BPI standards, I figured that accreditation would help sell jobs to otherwise wary homeowners. Another benefit is that accredited contractors are listed on the BPI website, where a lot of people look for information about energy audits.

Equipment. After completing the coursework, I spent $3,500 on equipment, including a blower door, a gas-leak detector, a pressure pan, a foam gun, a CO detector, and an IR thermometer. I bought everything online directly from individual manufacturers; being an accredited contractor qualified me for a 20 percent refund.

Continuing education. Certifications are valid for three years. To renew a certification, I have to earn a certain number of continuing education credits (CEUs), retake a field exam, and in some cases (depending on the actual number of CEUs taken) take online exams for each designation. At least one field exam needs to be retaken every three years at an affiliated test center, at a cost of at least $600.

Insurance. BPI-accredited contractors must carry at least one million dollars in liability coverage, which is not significantly different from the amount I already carry as a drywall contractor.

The expenses add up: I estimate that the yearly cost to remain accredited is about $2,500.

All these expenses add up: I estimate that the yearly cost to remain accredited is about $2,500. In addition to the expenses mentioned above, this includes about $200 a year to keep my diagnostic tools calibrated and at least 30 hours per year meeting with CSG and taking CEU classes.

Doing Audits

It takes skilled detective work and proper diagnostic equipment to improve the comfort and energy performance of a house without causing damage to it. The process begins with an audit, where I use my blower door and other equipment to assess how much energy the home is currently consuming and determine what measures need to be taken to improve efficiency. The next step is to implement the improvements. Some contractors only perform audits, while others focus on the improvements; I prefer to do both.

In my area, energy audits are offered for free or at a reduced rate. I get referrals from NYSERDA, which pays a flat $250 fee for each audit. A full audit typically takes me at least a half day in the field, and then at least another two hours in the office to enter data and figure up work proposals.

I've never performed an audit where I haven't found a problem. Quite often, there's an unexpected safety issue, such as a disconnected smoke or CO detector, or a hot-water heater that doesn't pass the spillage test. Other common problems include the presence of flammable materials near the combustible appliance zone (CAZ), gas ranges that release too much CO into the air, and plugged or damaged dryer vent pipes.

In order to make any money, though, I have to actually sell the proposed improvements, as I don't really make anything on the audits (compared with my usual drywall work).

Selling Energy Improvements

While some home-performance contractors may think that improving energy efficiency is the main goal, I think energy savings are often the least important part of the job. It's easy to improve energy efficiency, but it's not cheap to perform the work, and on most projects the clients aren't going to see a return on their investment for many years. Instead, I try to focus more on how the work will improve my clients' comfort, health, and safety.

A recent proposal for a job I didn't end up getting illustrates that this approach doesn't always work either. After an audit, my recommendation was to add 10 inches of cellulose over the 10-year-old home's existing fiberglass insulation and —since I won't do this type of job otherwise —

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also properly air-seal the attic. The estimated job cost, including materials, came to $2,250.

I estimated that my clients would save $99 per year after the work, giving them a simple payback of 22.8 years and a savings-investment ratio (SIR) of .99. These numbers actually look pretty good compared with some jobs I've estimated (and will only look better as fuel prices increase). It should have been an easy sell.

To address comfort and indoor air quality, I proposed replacing two bathroom fans with units that can be set to run continuously at a low cfm, and providing an inlet port in the CAZ to improve the base pressure near the furnace. I also proposed installing new piping to vent the dryer. The cost for these improvements would have been $1,365. To date, the clients haven't decided to proceed with the work, though the approach of cooler weather and improved incentives may yet tip the balance in my favor.

Incentives. In my area, low-interest loan programs and financing options are available to help pay for upgrades. The main one I discuss with potential customers is NYSERDA's incentive, where the customer gets back 10 percent of the cost of eligible measures after work is completed. Initially, this incentive was available only if the SIR was 1 or higher, which meant that a lot of improvement projects didn't qualify. As a result, we lost a number of customers and were forced to try to lower costs so the numbers would work out. Recently, however, the program was changed to allow some approved work to qualify for the incentive even if it does not meet the SIR cutoff.

In my opinion, understanding how to work with and sell local incentive programs is one of the keys to being a successful home-performance contractor.

Should You Get Certified?

Unfortunately, the market for energy improvement work has never really taken off in my area, mostly because hoped-for energy savings don't actually add up. The SIR alone just isn't attractive enough to sell most jobs, and I probably don't spend enough time selling the loans and incentives that might make the numbers more appealing.

Over the past three years, in fact, I've become a little disillusioned. I've put on hold my plans to purchase a cellulose-blowing machine and an infrared camera, stopped taking additional classes, and decided not to become a HERS rater. A contractor I know who dropped out of the

program said he felt like he was competing against Disney World. "If people have a choice between air-sealing and insulating an attic or basement, or going on a family vacation, they will most likely choose the vacation," he told me.

Another problem is that most "clients" who get a free audit are tire-kickers who aren't really planning to spend any money on energy improvements. That means I have to perform a lot of audits to find a serious customer. Many building-performance contractors agree that eliminating free audits would be a good idea, because then we could charge market rates to serious customers.

Finally, the financial goals set by BPI are difficult for small contractors like me to reach. Though I am still a certified contractor, I'm no longer accredited, because I was unable to sell enough jobs. (By the end of the first year of participation, an accredited contractor must report at least 12 completed projects or at least $50,000 of contracted work. At least 24 completed projects or at least $100,000 of contracted work must be reported for each succeeding year of participation). Currently, I'm doing audits and quite a bit of improvement work for a local accredited contractor — who's also in danger of failing to meet BPI's financial goals.

Was It a Good Idea?

When my certification expires this fall, I'll be faced with the tough decision of whether to spend the time and money to maintain it. On the one hand, there's no question that my drywall and insulation business has improved. Thanks to my BPI coursework, I now offer airtight drywall, dense-packed cellulose, and other improved insulation packages to my customers. I don't mind the continuing education or recertification requirements, and I think the accountability measures are needed to ensure high standards in the program.

But I wish I could set my own fees for audits, and it would help if BPI relaxed its restrictive financial requirements — I would like to continue to use my home-improvement work as a supplement to my regular business while remaining a BPI-accredited contractor. Over time, I believe I can turn building-performance work into a profitable part of my business, and I feel that the time and money I've invested in learning more about building performance was worth it. It just hasn't worked out the way I had hoped.

Myron Ferguson *is a drywall and building performance contractor in Galway, N.Y.*

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Flashing and Trimming a Window

This methodical approach speeds the work and guarantees a durable, weathertight installation

by Emanuel Silva

Because window flashing disappears from sight once the window itself is in place, it's easy to rush through that part of the job and move on to something else. Windows are sometimes installed with no flashing at all, and in my work as a remodeler I often see windows that are installed right over the housewrap, with the adhesive membrane applied over both the housewrap and the window flange. That's better than nothing, but not by much — it can't stop any water that gets behind the housewrap above the level of the window, since by then water will already have gotten behind the flashing as well.

To prevent window leaks — along with the mold growth, rot, and callbacks from irate clients that go with them — I've developed a bombproof method of keeping my windows reliably watertight. It includes several tips and tricks I've learned from other builders, and I'll probably continue to tweak and improve it in the years to come. The key is to take accurate measurements and work methodically; cutting flashing by eye and sticking it in place freehand won't give you consistently good results.

Flashing the Rough Opening

Assuming that the housewrap has been properly lapped and fastened to the sheathing, my first move is to cut it back from the sides and bottom of the opening by the width of my level, using the level itself as a straightedge. I leave it flush with

Figure 1. Once the housewrap has been cut back from the sides and bottom of the rough opening by the width of a level (left), a flap along its upper edge is temporarily tucked out of the way (right).

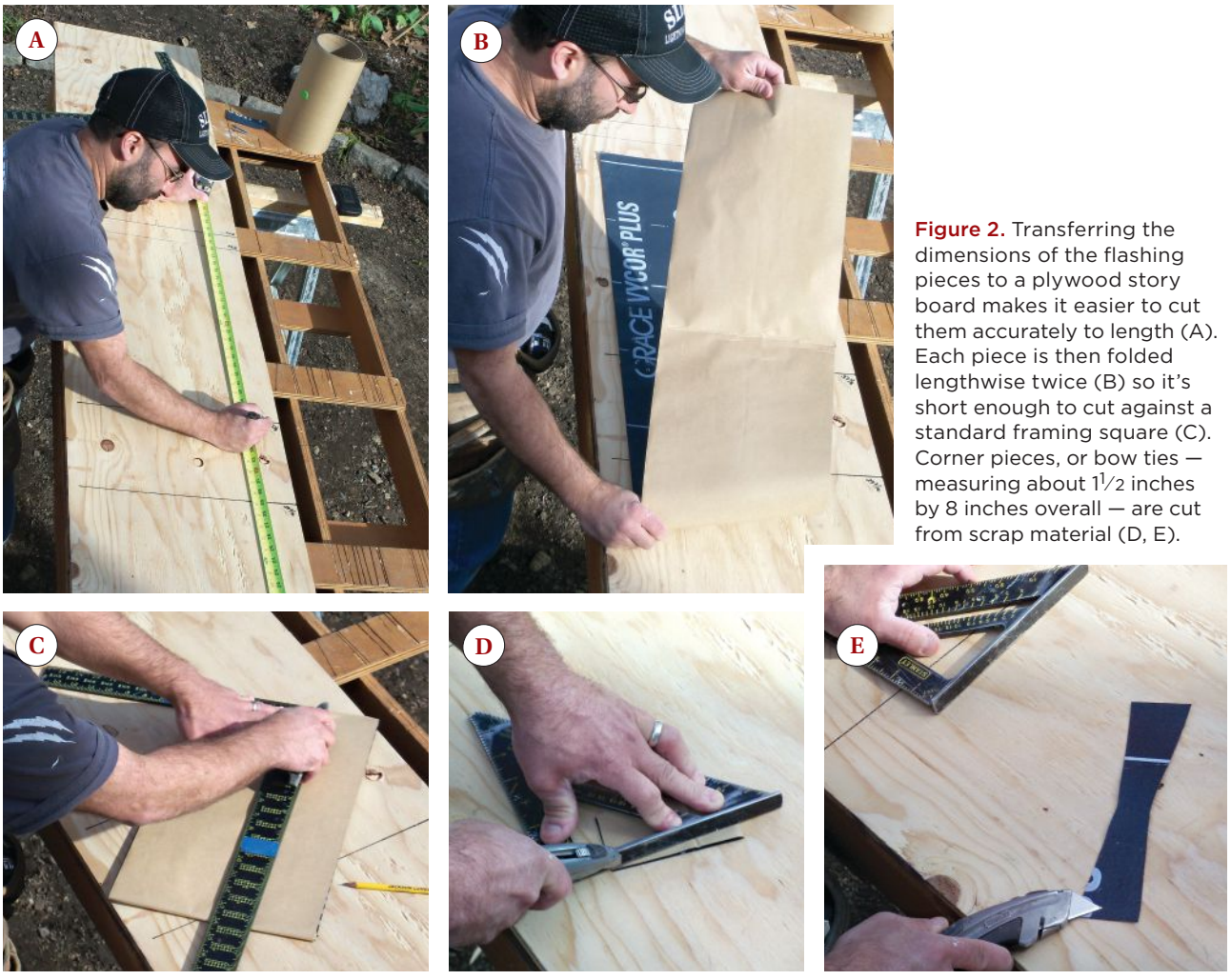

Figure 2. Transferring the dimensions of the flashing pieces to a plywood story board makes it easier to cut them accurately to length (A). Each piece is then folded lengthwise twice (B) so it's short enough to cut against a standard framing square (C). Corner pieces, or bow ties — measuring about 1½ inches by 8 inches overall — are cut from scrap material (D, E).

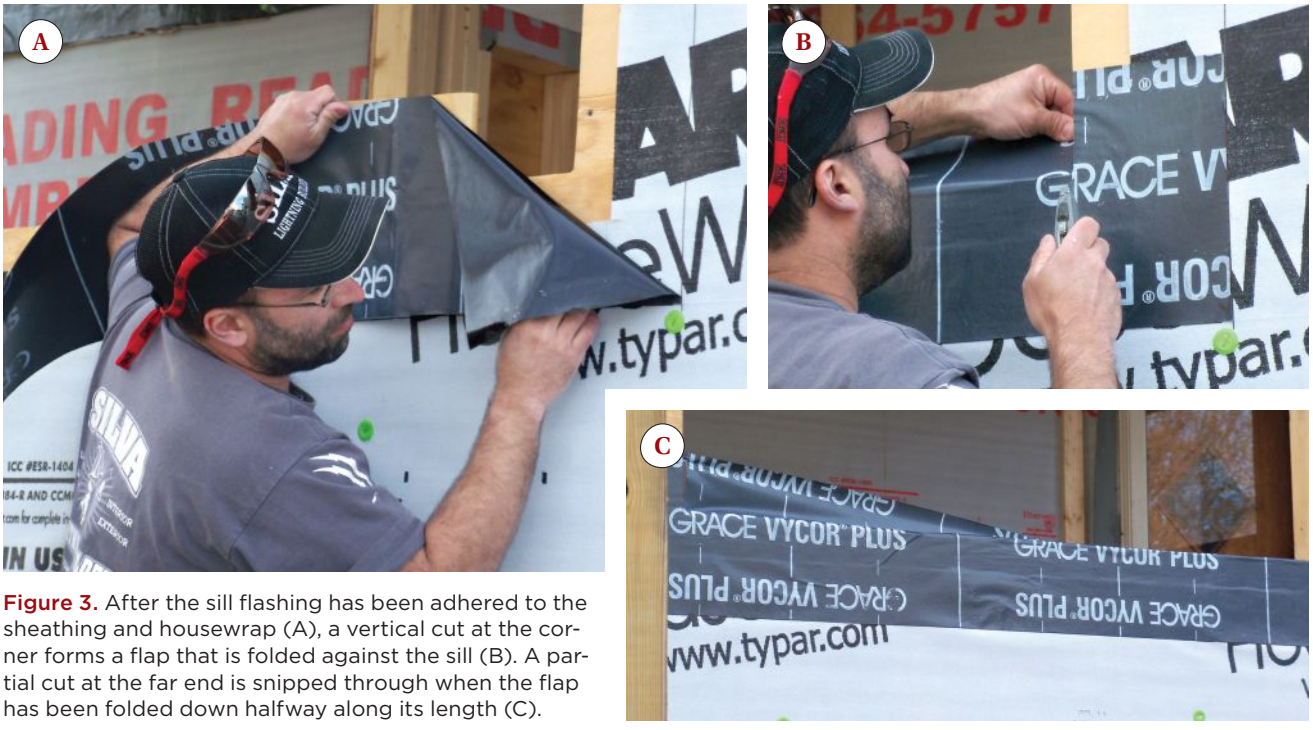

Figure 3. After the sill flashing has been adhered to the sheathing and housewrap (A), a vertical cut at the corner forms a flap that is folded against the sill (B). A partial cut at the far end is snipped through when the flap has been folded down halfway along its length (C).

the edge of the opening at the top (**see Figure 1**). I then make a 6-inch cut at each of the top corners, angled back from the opening at 45 degrees, and temporarily tuck the resulting flap under itself to get it out of the way.

To make it easier to put the flashing on straight, I use my level again to draw plumb and level lines at the sides and bottom of the opening. The distance the lines are from the opening depends on the width of the trim, since the flashing needs to extend far enough to protect the joint between the casings and siding — but 6 inches is usually fine.

Cutting the flashing membrane. There are two separate sets of flashing pieces: the inner pieces that are applied to the sheathing and fold back over the framing, and the outer pieces that cover the window flanges. I cut both sets at the same time, determining their lengths by measuring directly from my markings on the housewrap. To calculate the width of the inner pieces, I add the distance the lines are set back from the opening to the depth of the framing, plus the thickness of the sheathing. For the 2x4 framing shown here, that came to 6 inches plus 3½ inches plus ½ inch, or 10 inches even. The outer flashings are 3 inches or so wider than the window flanges themselves.

Figure 4. One end of a bow tie is adhered to the flashing membrane outside the opening, the other half folded to the inside (left). When applied correctly, the narrow center section will turn neatly up the corner of the opening (right).

For accurate cutting, I transfer those measurements to a story board — fashioned from a piece of plywood about a foot and a half wide by 8 feet long — that I attach to my work table (**Figure 2**). I prefer Grace Vycor flashing because it's premarked at 6- and 12-inch intervals, which simplifies measuring. I ordinarily buy it in the 12-inch width. Once I've cut the main flashing pieces to length and width, I cut a couple of "bow ties" to seal around the corners of the opening.

Figure 5. Side flashing is applied from the top; the backing paper is peeled away as the material is aligned with the pencil line on the housewrap (A). A precut slit at the bottom creates a flap that's folded into the opening and pressed into the corner (B, C). Head flashing is applied flush with the edge of the opening (D).

Figure 6. A bead of caulk on the top and sides of the flashed opening provides a bed for the window's nailing flanges (left). Once pressed into the caulk, the window is plumbed, leveled, and fastened in place (above).

Flashing the sill and sides. The sill piece is applied first. If the rough openings have been sized to allow it, I'll tack a full-length piece of clapboard to the rough sill before applying the membrane, creating an outward slope that will cause any water that somehow makes its way past the window to drain to the outside. In practice, though, this isn't always possible — I had to omit the clapboard from the job photographed here because including it would have left insufficient clearance at the window head.

To apply the membrane, I first peel back enough of the backing to accurately position one end, then peel off the rest, keeping the bottom edge aligned with the pencil line on the housewrap. Next, I cut most of the way through one end of the

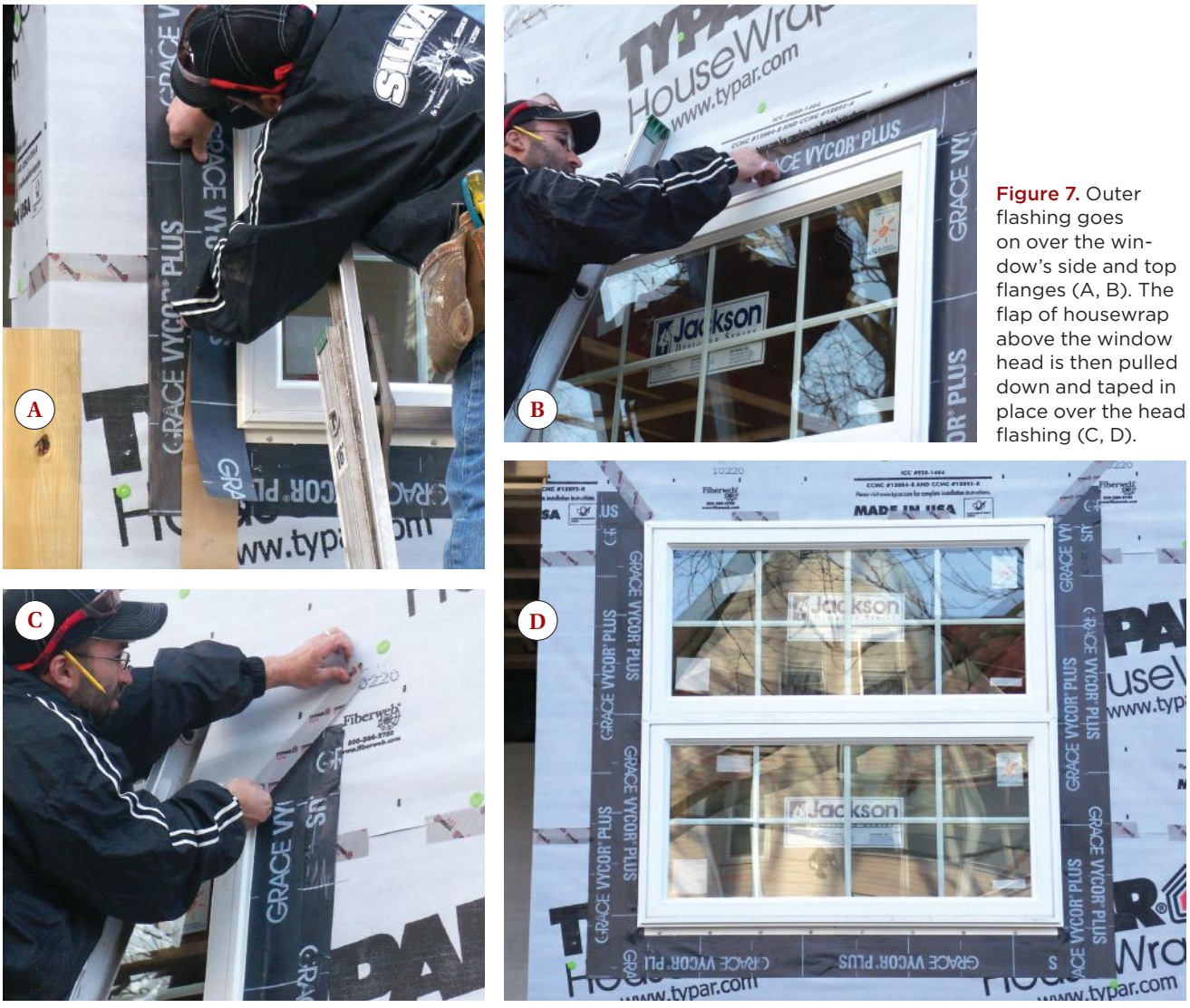

Figure 7. Outer flashing goes on over the window's side and top flanges (A, B). The flap of housewrap above the window head is then pulled down and taped in place over the head flashing (C, D).

flap that extends above the opening — starting from the corner but leaving a narrow connecting piece at the top — before completely cutting the other end free and folding it down against the sill (**Figure 3, page 33**). Once I've worked my way halfway down the sill, I cut through the last bit at the far corner with a quick jab of my utility knife and fold down the rest of the flap. This two-stage approach makes the material easier to control and helps prevent the formation of wrinkles and air bubbles.

Finally, I apply a bow tie to each bottom corner, which serves to seal the small pinhole where the side flashing will later fold over the sill flashing. Although this area is often ignored, it's a common source of leaks. When properly applied, the bow tie catches the end of the horizontal flap stuck to the sill, and turns the corner to extend a fraction of an inch up the trimmer stud (**Figure 4, page 33**).

Side and head flashing. The side pieces are applied in much the same way as the sill piece, except that I start at the top and work down. But one important preliminary step comes first: When the side pieces are still on the story board, I cut a vertical slit through the bottom of each to create the flap that will be turned up and stuck to the horizontal sill flashing (**Figure 5**).

Once I've pressed the membrane against the sheathing and housewrap, I carefully fold the side flap into the opening and stick the slitted section flat against the sill, using a layout square as a guide to form a neat inside corner. I then work my way back upward, pressing the side flap against the trimmer and cutting it loose at the top when I'm partway along, similar to how I installed the sill flashing.

With both pieces of side flashing in place, I'm ready to install the head piece. This is easy, because there are no folds to make — the membrane is just stuck to the sheathing above the window, its lower edge flush with the opening and the ends lapped over the side flashing.

Window and Outer Flashing

Before placing the window, I caulk the top and sides of the flashed opening to provide a bed for the flanges (**Figure 6**). I don't caulk the area behind the bottom flange, though — that way, water can drain to

Figure 8. The author uses a track saw to create exterior trim of any width from 3/4-inch PVC sheet stock.

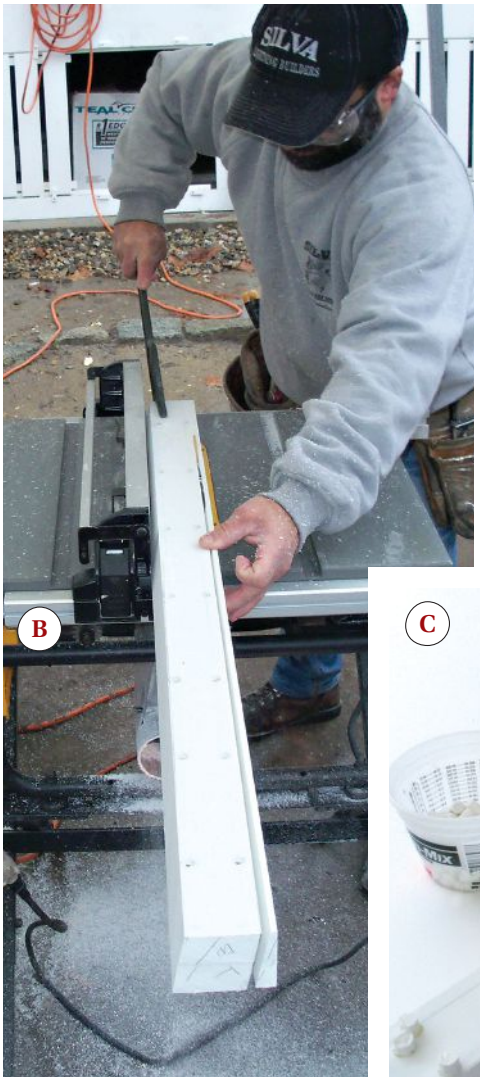

Figure 9. The exterior sill is built up from two thicknesses of material fastened with cement and screws; the screws are spaced back from the edges to avoid contact with the saw blade when the stock is ripped to the required angle (A, B). The countersunk screw holes are filled with manufactured plugs and cut flush (C).

the outside if necessary. For added insurance, I apply a continuous bead of caulk to the horizontal surface of the sill, about 2 inches in from the sheathing. This acts as a dam to prevent wind-driven rain from penetrating beyond it.

After installing the window and confirming that it's plumb and level, I nail it in place according to the manufacturer's directions.

Once the window is secure in the opening and operating freely, I'm ready to apply the outer flashings. I install the side pieces first, working from the top edge of the inner head flashing to the sill, then I go back to the top and add the head flashing (**Figure 7, previous page**). Finally, I pull down the folded strip of housewrap at the top and seal the corner cuts with strips of housewrap tape. I don't tape the bottom of the housewrap, so that any water that penetrates the housewrap can drain rather than soaking into the sheathing.

Assembling and Installing Exterior Trim

I cut the sill, head casing, and side casings from PVC sheet stock, preassemble them, and install them as a unit. Starting with sheet stock (rather than dimensional material) gives me the option of cutting my trim boards to any width I need without being limited to nominal sizes. Sheet

stock is easier to transport between jobs because it comes in bigger pieces.

It's not easy to push full sheets of material through a table saw, especially when I'm working by myself, so I make the initial cuts with my TrueTrac track saw, which is easy to set up and break down (**Figure 8**). Once I have my stock cut to width, I pull the length measurements directly from the installed window to make sure they're accurate. I often jot them down on the back of my tape-measure blade as I go, then rub them off with my thumb after I've made the cuts.

I build up the sill from two pieces of 5/4 stock fastened together with glue and screws (**Figure 9**). After ripping the edges to the required 10-degree angle and cutting a shallow dado along the underside to act as a drip edge, I clamp the side casings, sill, and head casing together and predrill them for pocket screws (**Figure 10**). Before assembling the unit, I put a screw in each hole to speed things along. Glue-up is fast once all the pieces are ready — I coat the mating surfaces with PVC cement and use a pocket-screw clamp to hold each joint together while I drive the screws home. The side casings are fastened to the sill first, then the head casing.

To fasten the trim assembly to the house, I use 2-inch deck screws, arranged in two rows about 8 inches apart within each row. I drill and countersink the screw holes and insert the screws, then turn the unit around and apply a good-quality caulk to the back just before installation.

Figure 10. The backs of the prepared sill and casings are drilled for pocket screws (A). Facing surfaces are then coated with PVC cement and temporarily clamped together while the screws are driven (B). Next, the completed trim assembly is drilled for the deck screws that will fasten it to the framing, and caulked on the back before being lifted into place (C, D).

Figure 11. Once the trim unit has been tacked in place and leveled, the screws are driven home, starting at the bottom (A, B). A PVC trim band covers the outer row of screws (C, D); the remaining holes are plugged.

The head and side casings each get a double bead, while the narrower sill gets a single bead.

Once I've tilted the unit into place, I tack it there temporarily and check it for plumb and level (**Figure 11**). When I'm satisfied, I start driving the screws from the bottom and work my way up. I then lay the level flat against each casing to make sure it's not bowed in or out by a localized dip or hump in the sheathing. If it is, I back off on the screws to allow the unit to shift position as needed.

The outer row of screw holes is covered by a separate band molding, which I assemble from three pieces of PVC stock that are mitered, glued, and pinned together at the corners with stainless-steel finish nails. I use more cement and the same nails to fasten the molding to the casings. The last step before paint is to cement PVC plugs into the remaining screw holes and cut them flush with a sharp 18-point handsaw.

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

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Getting Started in Multifamily

One- to four-unit apartment buildings are a good option for single-family home builders looking to invest in real estate

by Fernando Pagés Ruiz

As a California home builder during the early 1990s, I experienced first-hand the boom-or-bust cycles of residential construction. So when I moved to Lincoln, Neb., later in the decade, I began building one or two small rental properties per year, which I hoped would help insulate my business from those inevitable cycles. My strategy proved at least partly successful: Even though the recession of 2008 wiped out my home-building company, my apartments have provided a significant financial cushion that helps keep me afloat.

If you've been thinking about building or buying a rental property, this may be a good time to jump in, because multifamily construction is actually booming. Census Bureau numbers show that while single-family housing starts for February 2012 climbed nearly 24 percent nationally, multifamily shot up 60 percent. And numbers for small two-to-four-unit residential projects — the focus of this article — were 73 percent higher than the previous year.

Sizing up the Market

I used a simple strategy to plan my Lincoln projects. First, I would find out who the competition was and what they were building, which told me where oversupply was likely. Then I would try to find out how long it took to rent out typical one-, two-, three-, and four-bedroom apartments, which gave me a good indication of where demand was strongest. Back then, I gathered this information informally in conversations with friends who were real estate agents. Nowadays, it's much easier to get a feel for the market by looking on craigslist or other online bulletin boards to see what's being offered and how long the ads remain before the units are taken.

For example, in Lincoln, a college town of 250,000, most new complexes under construction when I was getting into the market offered only two- and three-bedroom units. One-bedroom and studio apartments were mainly available in old, rundown buildings, creating a niche for newer stock. But at the time it made little

In this four-plex, each apartment is a vertical unit with its own street entrance, which eliminates upstairs neighbors and simplifies fire-barrier and sound-control details. The apartments have separate laundry facilities and garages, making them attractive to young families.

Pro Forma for a Typical Small Apartment Building

$385,000 purchase price ($35,000 lot and $350,000 net construction costs)

Building Description: *Four-unit apartment building, three stories, each unit 1,500 sq. ft. • 4 garages, 6 parking spaces • Cluster mailbox and dumpster area • Utilities: house electric meter, water/sewer, trash*

Income		
Annual Rental Income	**$57,600.00**	($1,200 monthly rent for each four-BR unit; assumes 100% occupancy)
Expenses		
Mortgage	$24,824.00	per year based on $96,250 (25%) down, $288,750 mortgage, 20 years at 6%
Vacancy allowance	$1,728.00	or 3%, based on two apartments turning per year with 10-day vacancy to turn and rent
Insurance (property and liability)	$950.00	
Landscaping maintenance	$450.00	
Maintenance/apartment turnover	$1,800.00	
Property taxes	$6,500.00	
Snow removal	$750.00	
Utilities	$1,020.00	
Gross Annual Expenses	**$38,022.00**	
Building Depreciation Tax Credits (Building and improvements assessed at $385,000)		
Building depreciation @ 3.9 % x $325K	$12,725.00	(27-year straight-line depreciation, structure only)
Personal property: appliances, fixtures, carpet @ 20% x $25K	$6,500.00	(5-year mixed depreciation, wear items)
Total Tax Depreciation Credit	**$19,225.00**	
Summary		
Annual Gross Income	$57,600.00	
Annual Expenses	–$38,022.00	
Annual Gross Profit	**$19,578.00**	
Depreciation Credit	–$19,225.00	
Taxable Income	**$353.00**	

This pro forma is based on the four-plex shown above, which the author built on the site of an old house he held for five years while paying down the lot. The building sold in 2008 during the height of the real-estate crisis for the full asking price.

sense for me to build these units, because the local going rent — $300 to $400 per month — would barely cover my mortgage payment. So I focused on four-bedroom units, which had the lowest vacancy rate and were renting for $900 to $1,200, an amount that would easily pay the mortgage and expenses with a few dollars left over.

Today, most new apartments that aren't subsidized housing are being built in urban locations that can attract high rental rates, with designs geared toward younger, educated professionals ("echo boomers") and empty-nesters. To attract them, the big boys can offer large-complex amenities like health-club fitness centers. As a first-time multifamily builder, you won't be able to compete with a seasoned developer, but you can look for a property close to restaurants, cafes, health clubs, universities, and libraries. Another option is to rehab a rundown apartment in the right area of town, though this can involve some risk because of the uncertain costs of renovating an older building.

I discovered a slightly different market niche and built my first four-bedroom apartments near ethnic enclaves where culturally appropriate services like ethnic groceries and foreign-language video rentals were within walking distance. Nobody else was cultivating this market, which created an opportunity for me. If you're a small operator facing well-capitalized professional competition, a good strategy is to find a unique niche that nobody else serves.

How an Apartment Makes Money

The financing procedures for apartments and other commercial buildings are not that different from those for building a spec house, but you'll want to be well-armed with financial details before seeking out a lender (for more on the subject, see "Getting Started in Commercial Real Estate," *Business,* 2/12).

Glossary of Terms

Net operating income (NOI): A property's yearly gross income minus operating expenses is its NOI. An apartment building's fixed costs include taxes, insurance, utilities, and maintenance; what's left over is the net operating income, an important measure that tells the bank how much money is available to pay the mortgage.

Coverage ratio: The debt service coverage ratio shows the relationship between the rental income and property expenses, including mortgage principal and interest payments (P&I). Here's a simple example: You receive $1,000 in monthly rent, your P&I payment totals $500, and your expenses (utilities, taxes, and maintenance) amount to $300. This means you have an NOI of $700. With a mortgage payment of $500, your coverage ratio is 1.2 percent, or 120 percent of the money needed to pay the bills. Most lenders require a minimum coverage ratio of 1.1 percent to 1.3 percent for a commercial loan (the bigger the ratio, the better).

Of course, in the real world the equation is more complex and includes other factors, such as the vacancy rate in your area (a knowledgeable commercial real estate agent or an appraiser can help you pin down this information). In older buildings, you may need a replacement escrow for major components, which is an amount set aside every month to pay for major capital expenses. For example, if your building has a 10-year-old roof with a life expectancy of 15 years, you will want to reserve enough money during the next five years to pay for this anticipated replacement. If the new roof will cost $20,000, you'll need to set aside $20,000 ÷ 60, or roughly $333 per month, in an escrow account to cover the anticipated expense — your bank may require this and hold the money from your deposits.

Loan-to-value ratio (LTV): The LTV is the total amount that you are borrowing relative to the appraised value of the asset, which in this case is the building. If your building has an appraised value of $100,000 and you are asking the bank for $75,000, your loan has a 75 percent LTV. The lower the LTV, the safer the investment for both the bank and you.

During the recent real-estate downturn, a very conservative LTV of 75 percent would still have left you upside down if the property dropped in value by 40 percent (the national average). In other words, if your property was worth $100,000 and you borrowed $75,000 (75 percent LTV), you would still owe the bank $75,000 even if the market value dropped to $60,000. Your LTV has shot up to 125 percent. The good thing about income property is that the value is generally based on the income and capitalization (cap) rate. If your rents go up, the cap rate rises and your property's value increases.

Capitalization (cap) rate: Based on the net operating income, the cap rate measures the rate of return on the cash investment in the property, and is used by lenders to determine a property's value and risk. In the first example, with a capitalization rate of 10 percent on a property with a $700-a-month net income, or annual NOI of $8,400 (12 x $700), you would have an estimated property value of $84,000. Investors generally look for a cap rate between 8 percent and 10 percent. Had you paid $100,000 for the same property, your cap rate would be 8.4 percent ($8,400 ÷ $100,000). The cap rate estimates the relationship between the total property value (or cost) and income.

Cash-on-cash return: Since I can't (or won't) buy rental property without a loan, I prefer to look at the cash-on-cash return rather than the cap rate. This is the return on investment based on the amount of cash I have to put up to buy the property. I typically look for a cash-on-cash return of 6 percent to 8 percent. In other words, the actual cash invested in the deal, after collecting rents and paying expenses, yields a return of 6 percent to 8 percent on an annualized basis. For example, if the bank requires a $50,000 down payment to buy the building, and I net $3,000 a year after paying mortgage and expenses, the cash-on-cash return is 6 percent — much better than a savings account, and better than my 401K retirement account.

One key piece of information is the pro forma, the financial projection you'll prepare to accompany your loan application (see sample, facing page). In a few lines, this summary tells the story of how you expect the building you're buying or developing to pay expenses, repay the loan, and make a profit. The pro forma will include at a minimum the yearly gross rents, a vacancy factor, building operating expenses, and the yearly mortgage payments.

Hold or sell? Most people build or rehab apartment buildings in order to hold them for many years and realize the combined benefits of cash flow, building depreciation (a paper tax loss), and land appreciation. More than once I have spoken to a landlord who pointed proudly toward his or her property and declared, "That's my retirement." But that's not the only strategy.

I built several of my apartment buildings on speculation and later sold them. Unlike homes, which have an intrinsic value that can go up or down, income property derives its value primarily from rents. My strategy was to build, lease, and then immediately put the building on the market. Since the mortgage and expenses were being covered by the rental income, I had plenty of time to wait for the right buyer and had a fairly narrow negotiating range on price, since the basic value was set by the income.

Bear in mind that while the market is favorable in multifamily right now, with low interest rates and easy leasing, multifamily mortgages typically come with a five-year interest-rate reset. That means that the 4 percent mortgage you banked on to make the numbers work today could go up 2 percentage points or more in five years — in fact, you should plan on it. Plan too for lower rents, higher costs, and a mortgage that rests at the upper limits. If you prepare for the worst and don't bank on optimism, your apartment buildings may indeed provide a handsome retirement. (If you're interested in learning more about real estate as a wealth-building strategy, I recommend *What Every Real Estate Investor Needs to Know About Cash Flow,* by Frank Gallinelli.)

Buy or Build?

Rehabbing an older building in a good location can look good on paper, but rehab dollars are notoriously uncertain, making it difficult to develop an accurate pro forma. For example, it would be wise to include a large construction fudge-factor cost (20 percent would not be excessive) on any pro forma for a rehab project. Likewise, yearly maintenance costs on an older structure can be very unpredictable. Even the amount that you'll be able to charge for rent might turn out to be lower than you expected because of the perceived desirability of new vs. older property.

Offsetting some of these risks, many municipalities offer deferred (no interest and no payment until you sell the property) or very-low-interest loans to entice landlords to update and upgrade rental property in blighted areas (often called redevelopment zones).

New construction. If you've been building single-family homes, transitioning to two-to-four unit construction should be easy. You can use the same set of subs and — if you keep the building height at two stories or less — the same design team you used to draft single-family plans.

Building five units or more pushes you into another category that typically involves more stringent requirements and — in some jurisdictions — the commercial code instead of the more familiar residential code. In most areas, your plans for five units or more will also require the stamp of a licensed architect, and you may need a commercial contractor's license to build them.

Financing becomes more complex and expensive, too. While a building with up to four dwelling units would typically qualify for a residential mortgage, most lenders consider a building with five units or more to be commercial property, financed by mortgages with stricter underwriting requirements, significantly higher down payments, higher interest rates, and more expensive origination fees and appraisals.

Rehab projects can be difficult to budget accurately. For example, the three-plex shown here had an original purchase price of only $28,000, but renovation costs totalled $145,000. A deferred city mortgage for $30,000 helped defray some of the author's carrying costs during renovation.

Fire Barriers

A key difference between a single and a multifamily dwelling is the requirement for an occupancy fire barrier, which is needed to prevent relatively small kitchen or cigarette fires from spreading from apartment to apartment. There are three basic fire barriers you'll deal with in small multifamily construction.

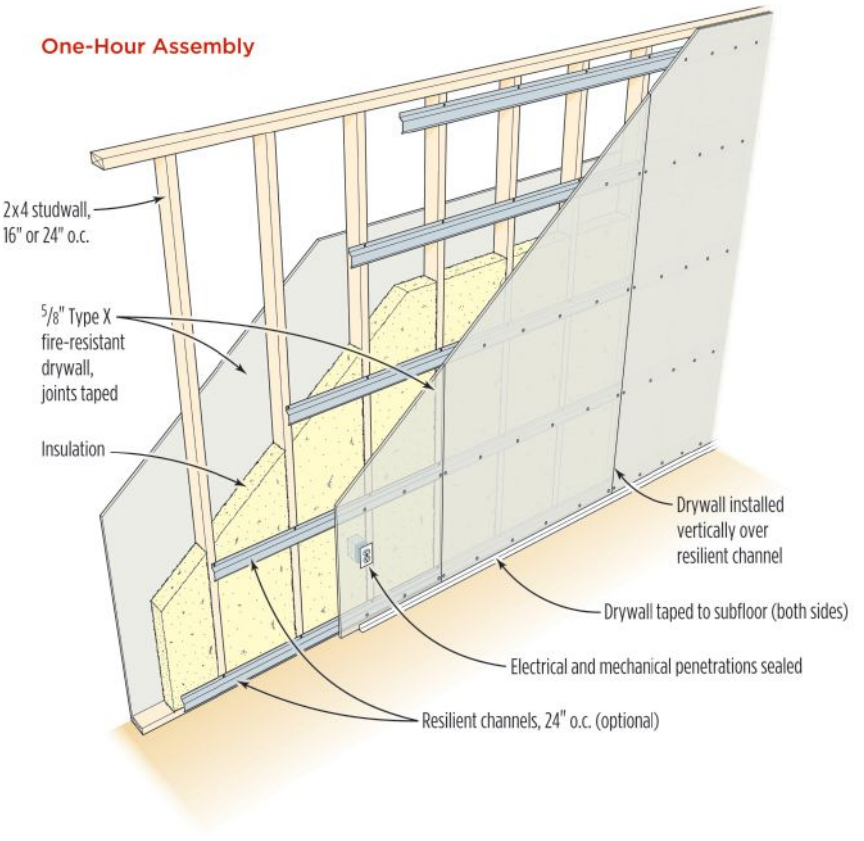
The most common is the one-hour fire barrier, which resembles the required fire barrier separating an attached garage from the dwelling portion of a house. You can achieve this separation easily by laminating both sides of the occupancy wall with $^5/_8$-inch type X gypsum wallboard from the foundation right up to your roof sheathing, or by creating a one-hour envelope with $^5/_8$-inch type X drywall on the occupancy wall and ceiling. This one-hour occupancy barrier is typical for two-to-four-dwelling buildings built on a single lot with one owner.

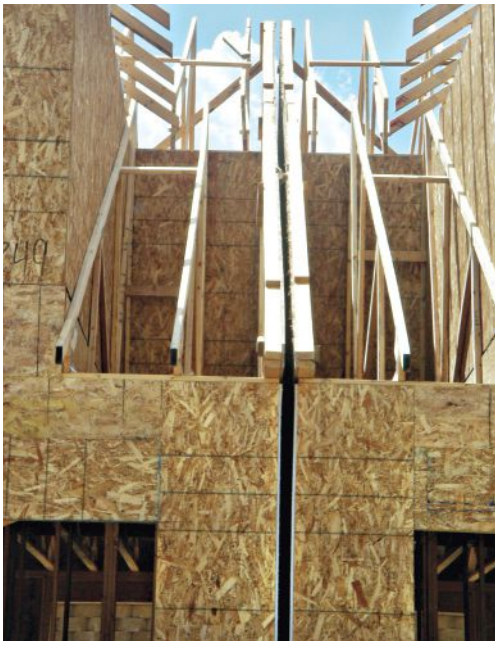
Condominiums and apartments with three or more stories or with five or more units typically require at least a two-hour fire barrier. It's hard to become creative with firewalls, and they are costly to build, but many different approved assemblies already exist.

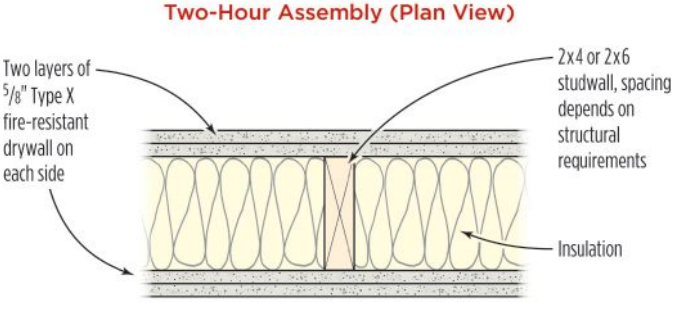
When there is separate ownership on separate lots, such as with a townhouse or a duplex, you will have to provide a two-hour fire barrier and a structural occupancy separation. The latter consists of two unconnected structural support walls along the common boundary, so that — theoretically — if one half of the building collapsed, the other half would remain intact. This wall assembly typically consists of two one-hour walls built side by side without plumbing or ductwork, with a 1-inch space in between. Furthermore, under certain circumstances, you are required to build a parapet or install

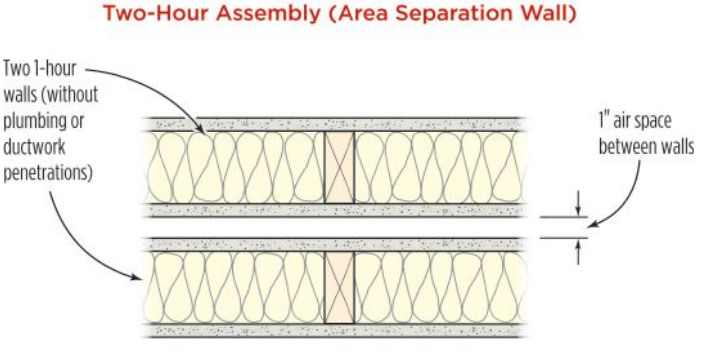
Fire Barrier Options

The author includes low-cost soundproofing details in the fire-rated wall assemblies he uses in multifamily construction. Installing the drywall over resilient channel, for example, improves a one-hour-rated wall assembly's STC (sound transmission class) rating from 46 to 50. He prefers mineral wool or cellulose insulation to fiberglass batts because those materials are more effective at absorbing sound; to block airborne sound transmission, he tapes the drywall to the subfloor and seals gaps and penetrations through the wall with acoustical sealant (top right). Upgrading partition walls to a two-hour rating by adding a second layer of drywall is a cost-effective measure that will make it easier to convert an apartment building into condominiums in the future (center right). Up to two layers of drywall can be fastened to RC-1 channel, giving the two-hour assembly an STC rating of 59. The same soundproofing details can be used in structural-occupancy separation walls between townhouses (bottom right and photo). For more fire-rated wall options, go to usgdesignstudio.com.









fire-resistant roof sheathing extending 5 feet on either side of the property line. These requirements make townhouse construction inherently expensive.

If you build with common corridors, interior stairwells, and other enclosed common areas, such as a laundry room, you will have to address more issues of fire separation. Most of these are greatly simplified with the addition of a fire sprinkler system.

Insights From Experience

There are some upgrades I think are worth including in my projects, despite the slight increase in construction cost. For example, even when two-hour fire barrier walls aren't required by code, I usually build them anyway. This not only makes my apartments quieter and safer — it also makes it much easier to turn my rental units into condominiums if the opportunity presents itself.

I also believe in good-looking buildings that enhance rather than detract from the neighborhood. Typically, small multiple-unit projects are built within older subdivisions, because that's where you're most likely to find affordable lots with zoning that allows apartments. Unfortunately, many apartment-building developers have earned a reputation for "slipping in" misfit structures that suck the charm out of these heritage neighborhoods. In reaction, neighborhood groups may draft strict neighborhood standards that are challenging to comply with architecturally if you want to remain economically viable.

Even when I'm not compelled to, I always try to build structures that look like they belong. In addition to making it easier to attract better tenants, paying attention to curb appeal goes a long way toward stretching the strict financial parameters set by an investor when it comes time to sell the building. You can get a better price for a better-looking building.

Turnovers cost money, so you want good tenants to stick around. To give them a feeling of privacy and ownership, I try to give every unit a separate exterior entry. I make sure interiors get plenty of daylight and are well-ventilated with quality bath and kitchen fans. I tie the bath fans to the bath light — to make sure they're used — and, in the kitchen, supplement the range hood with a ceiling exhaust fan that vents to the exterior. I tie this fan to the light as well. These touches make living more pleasant and reduce damage due to indoor humidity.

I include garages in my projects whenever possible. They really only need to accommodate one car, and can be either detached or attached; both configurations work well. I also include a laundry room in every unit, rather than try to maintain a common laundry facility with coin-operated machines.

Finishes. In an apartment, finishes need to be durable. Carpet may be initially less expensive than wood or laminate flooring, but it's harder to keep clean and doesn't last nearly as long. Even sheet vinyl and vinyl composition tiles last five times as long as carpet.

If you're angling for high-rent clients, a few tasteful details will go a long way. For example, granite kitchen countertops are a reasonably priced upgrade — and so is a wide bathroom vanity with designer faucets, a large mirror, and nice light fixtures.

To save on maintenance costs, I install painted wood window sills (drywall sills always get damaged). I avoid casement windows, because I don't like replacing cranks, and I avoid bifold and bypass closet doors so I'm not changing tracks at every turnover. I also furnish entry doors with a deadbolt and no locking knob, so tenants are forced to have a key in hand when they lock the door behind them. That way, I don't have to respond to 2 a.m. lockouts.

Multifamily buildings with more than five units — such as this 12-plex, which the author built in a desirable downtown neighborhood — have many more requirements and exponentially higher construction costs per square foot than buildings with fewer units.

Fernando Pagés Ruiz *is a developer and former home builder who lives in Boulder, Colo.*

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A Contemporary Box Newel

Pocket-screwed frames attached to an inner plywood column made for efficient assembly

by Gary Striegler

I've always enjoyed building box newel posts. They give a stairway a custom look, and give me a chance to showcase my woodworking skills. So I was intrigued when a client showed me a photo of the style featured here, which has a contemporary Craftsman flavor. To simplify construction, I built the newel in three sections, with moldings hiding the transitions. An interior post reinforces the assembly and provides secure attachment points.

I started by determining the height of the handrail and the exact location where it meets the post, then transferred the dimensions to a story pole. I also made a full-scale drawing on a piece of ¼-inch plywood to work out the details and make sure I was satisfied with the newel's size and proportions.

Tapered Frames

1. The tapered center section of the newel is made up of four frame-and-panel assemblies. I transferred the dimensions and angles for the stiles and rails from my full-scale drawing, cut them to width and length from ¾-inch poplar, and joined them together with pocket screws and glue.

2. I then cut a ⅜-inch rabbet around the inside of each frame with a router to accommodate the plywood panels, which I would make from readily available ¾-inch birch plywood.

Panel Cuts

1. To safely cut the tapered 3/4-inch plywood panels, I made a plywood sled for the table saw and used the drop from the first angled cut as a spacer for cutting the remaining edges.

2. Instead of squaring the corners of my rabbet in the back of the frame with a chisel, I clipped the corners of each plywood panel with the miter saw.

3. I applied yellow glue to the rabbets, dropped the panels in place, and secured them with headless pins while the glue dried.

4. In preparation for assembly, I ripped 3/4 inch from the 1 7/8-inch-wide stiles of two of the frames. I also cut a 15-degree angle on the bottom rail of each frame, using the table-saw miter gauge and the wedge-shaped spacer to hold the frame square to the blade.

Frame and Panel Assembly

1. I glued the four frames together, pinning them to each other with my 23-gauge headless nailer to hold the assembly in place while I set up my clamps.

2. The clamps provide the pressure, while the headless pins keep the panels aligned.

3. Setting the two wider frames slightly proud of the two narrower frames made it easier to flush-trim the joints with a router after the glue dried; this resulted in better-looking joints. I cleaned up the 26-inch-high assembly with a random-orbit sander and 120-grit paper.

4. While the tapered glue-up was drying, I made the four rectangular panels for the 9-inch-high upper assembly in the same way.

5. I again used headless pins to keep the panels aligned as I clamped them together.

Inner Post

1. Next I made the column that would reinforce the panel assemblies. I used 3/4-inch plywood and sized the column to fit snugly — keeping in mind that, because the plywood panels extend 3/8 inch past the inside of their frames, the overall clearance inside the upper assembly was reduced by 3/4 inch.

2. After flush-sanding the joints on the two panel assemblies, I slid them over the column and nailed them in place, starting with the tapered section.

3. I used the story pole to make sure the top paneled section would end up flush with the top of the inner column.

4. At the bottom, before nailing off the base of the tapered panels, I built out the column with plywood fillers.

5. The fillers will provide backing for the base detail once the newel post is in place, and are positioned so that the base will align with the bottom of the tapered section above.

Bullnose Trim

1. I made the trim that hides the joint between the two paneled sections with a large beading bit mounted in a handheld router.

2. After cutting the profile in 5/4 poplar stock, I ripped off the 3/4-inch bullnose.

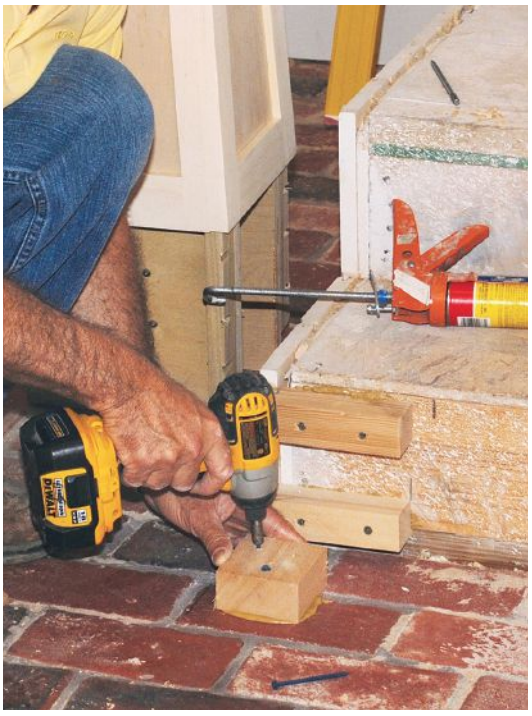
3. I ran the trim through a planer to clean up the surface, then glued and pinned it in place.

Post Cap

1. To make the cap, I glued up a 2-inch-thick block using two lengths of 4/4 poplar. I ripped the stock to equal half the width of the top of the post plus another 1/2 inch for the overhang. I then ripped a 35-degree bevel angle on one surface.

2. That is a potentially dangerous cut, so I used a feather board and push stick. On the miter saw, I cut four triangles from the block and assembled them to form the square cap.

3. I fastened the cap to the post with glue and headless pins.



1. Before setting the post, I marked the location of the center of the handrail on the landing, then lined up the center of the post with these marks. This helped me locate the blocking needed on the floor and riser for mounting the post.

2. After a dry fit, I covered the blocking with plenty of construction adhesive and slid the post into place, shimming it plumb and then fastening it to the blocking with long structural screws driven in from three sides.

3. Finally, I finished the post with a $9\frac{1}{2}$-inch-wide plywood base, mitering the corners and adding a chamfered cap to hide the joint.

4. Later, after I was finished installing the treads, handrail, and balusters for the landing, my painter added the finishing touches.

***Gary Striegler** is a builder in Springdale, Ark.*

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by Tom O'Brien

Weatherstripping Double-Hung Windows

Stop drafts and restore the operation of old wood windows with this straightforward approach

There's money to be made from replacing old windows, and sometimes a complete replacement makes sense for the homeowner, too, especially if the windows in question were never built to last. But in most cases, the hoped-for energy savings simply don't justify the expense of tearing out and disposing of an otherwise sound wood sash. In my experience, any window that's old enough to have weights and cords deserves an upgrade rather than a toss in the dumpster.

Homeowners considering a window replacement almost always bring up energy concerns, but their bigger beef is that the units operate poorly — usually because over the years too much paint has been applied in the wrong places. After I've cleaned and weatherstripped an old sash, it fits tightly, yet goes up and down with the touch of a finger.

Double-Hung to Single

Back in the days before A/C and active ventilation systems, double-hung windows promoted air circulation when the bottom sash was raised and the top sash lowered. Most of the older windows I encounter have top sashes that haven't moved in decades and storm windows that are only screened for the lower sash. So unless the owner insists on having two operable sashes, I simply make sure that the upper unit is square and secure. If it's loose, I toenail it in place with a pair of 3-inch trim screws driven upward through each side of the bottom rail, then caulk the edges.

Figure 1. A lead-safe work zone is needed when working with old double-hungs (A). A spring clamp prevents the sash cord from dropping into the pocket; on the window shown (B), the trim was in bad shape and was removed for replacement, allowing the author to insulate the cavity with XPS and spray foam. To improve the window's operation, old paint is removed from all running surfaces; here the author uses an infrared paint-stripping tool (C). Paint is also removed from the inside of the window frame and the edge of the stop (D); raw wood surfaces will be waxed.

Removing the Sash

Taking out a lower sash simply requires prying off one stop and disconnecting the cords, but I remove both stops because they will need to be ripped down slightly to accommodate the thickness of the weather seals. After I disconnect each sash cord, I attach a spring clamp to prevent the weight from falling to the bottom of the weight box (**see Figure 1**). If I'm working on more than one window, I mark an indelible code on each of the pieces to ensure that everything goes back in the right place.

Since old windows of this type typically have some lead paint on them, I set up a lead-safe work space around each of the window frames, and take appropriate safety measures while preparing the sash and stops for weatherstripping.

Sashes that are in rough shape — with extensive wood rot, flaking paint, separated joints, cracked panes, or crumbling glazing — need to be completely stripped and repaired. But if the sash is generally sound, I simply remove the paint from the surfaces that are to be fitted with weather seals or that are subject to abrasion. For this task I use an infrared paint remover

Figure 2. After years of weatherstripping old windows and doors, the author has settled on three seal profiles for most jobs: a polypropylene brush seal for the sides; a 1/4-inch tube seal (white or bronze) for the meeting rail, and a white 3/16-inch tube for the bottom (A). Slots for the seals are cut with a 3-millimeter slot cutter (B); the seals are installed with a screen tool or by hand (C).

(around $500 from Eco-Strip, 703/476-6222, eco-strip.com), which breaks the bond between the paint and substrate without releasing lead fumes. The tool is an investment, but worth it if you plan to do a lot of this work; nothing is faster.

After the paint is gone, I give the bare wood surfaces a light sanding with 100-grit paper in a random orbit sander attached to a HEPA vac.

Materials

Over the years, I've experimented with a variety of materials and techniques for weather-sealing double-hung windows. What's worked best for me is a combination of silicone-rubber tube seals on the top and bottom surfaces and polypropylene pile brush seals on the side rails (**Figure 2**). I use the brush seals because the side-mounted weather seals have to be able to withstand abrasion when the sash is raised and lowered. The other weather seals are only subject to compression. I've been weatherstripping windows and doors for decades, so I've built up a substantial inventory of shapes, sizes, and colors of seals that I can rummage through to fine-tune a fit, or solve a problem. It often doesn't matter what color you use, but it's nice to be able to put a bronze tube seal on the meeting rail

Figure 3. The bottom edge of the sash must be trimmed by about 1/8 inch to account for the thickness of the weather seal (above). After the cut, the end grain gets a treatment of epoxy consolidant to prevent rot infestation (left).

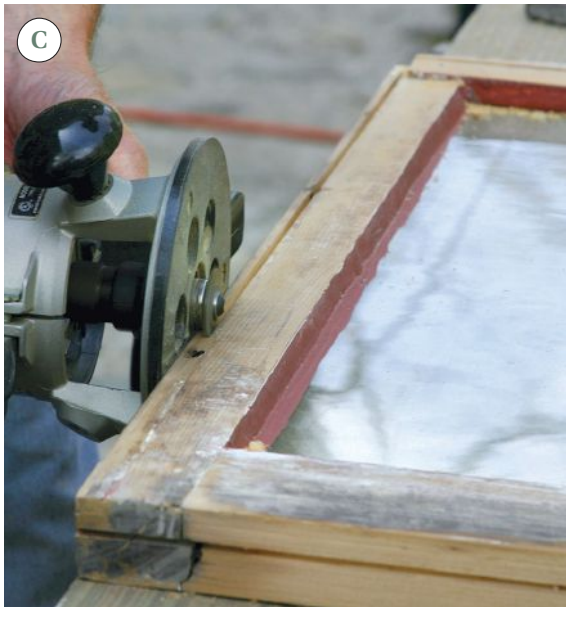

Figure 4. Using a plunge router, the author centers the slot for the bottom tube seal 5/8 inch from the face of the sash (A); the slot for the meeting-rail seal is centered 3/8 inch below the top edge (B). The side brush seals are placed as close to the edge as practical — 1/4 inch (C). Any closer and the thin strip of wood left behind may break off.

of a dark-colored window, so that it's not noticeable when the window's opened.

For most windows, I use a 1/4-inch tube seal (white or bronze) for the meeting rail, a white 3/16-inch tube for the bottom, and gray 1/8-inch brush seals for the side rails. All these products, as well as the router bit that carves the mounting slots, are sold by Resource Conservation Technology (800/477-7724, conservationtechnology.com).

Preparation

Weather seals are most effective — and least likely to bind — when they're gently compressed, not squeezed tight. So before I rout the grooves that will house the various materials, I trim the bottom edge of the sash by about 1/8 inch to allow for the tube seal that goes on the bottom (**Figure 3, previous page**).

Before the sash is reinstalled I'll make space for the seals that mount on the three remaining surfaces of the sash by ripping the stops and planing the face of the stool. Typically these cuts also remove about 1/8 inch, but if I notice before the sash is removed that it fits loosely in the frame, or if the tops of the meeting rails weren't flush, I'll modify the cuts accordingly.

Rot treatment. After trimming the bottom rail, I repair any damaged spots with epoxy wood filler and slather the vulnerable end grain with epoxy consolidant to prevent rot.

Installing the Seals

The weather seals have barbed tails that snap into a 3-millimeter groove that can be cut with a self-piloted router bit. The placement of each groove (relative to the edge of the window) is different for each type of weather seal. If I'm upgrading only a couple of windows, I'll chuck the router bit into a plunge router and adjust the stops to match the offsets. If it's a bigger job, I'll outfit three routers with separate bits and label them as to location, so all I have to do is reach for the one I need.

Layout. The placement of the top and

bottom slots isn't critical, but for the side slots it matters; too far from the edge and the weatherstripping won't line up with the stop; too close to the edge and the slotting bit leaves a narrow strip of wood that's vulnerable to breakage. So I center the slots on the sides exactly ¼ inch from the outside edge.

For aesthetic reasons, I center the tube on the meeting rail ⅜ inch below the top edge; this puts the top of the seal just below the top rail of the window, where it won't leave an unsightly gap. I center the tube under the bottom rail ⅝ inch behind the face of the sash.

Slotting. The router bit's top-mounted pilot makes it easy to control, even on face cuts (**Figure 4**). To ensure that all of the weather seals snap in without any fuss, I make two smooth, steady passes for each slot, then vacuum out the cavity. After the cutting is done but before installation, most of the window — except the gliding surfaces — gets primed and painted.

I measure each seal by laying it in position on the sash, marking the end with a Sharpie, and cutting it with scissors. It's important to avoid stretching the tube seals or they'll shrink and leave a gap. A plastic-wheeled roller makes it easy to firmly seat the weatherstripping in the groove, but you can also use a screen tool or just finger pressure.

Figure 5. Before the weatherstripped sash can be reinstalled, the stool must be scribed and trimmed to allow for the thickness of the brush seals on the face of the side rails. A 1/16-inch-wide gap, scribed with a carpenter's pencil, allows for expansion (top). A bullnose plane with a removable toepiece cuts away the excess stock with a minimum of dust (above).

Putting It All Back Together

Once the sash is ready to be reinstalled, I always take the time to double-check the condition of the sash cords. If they're frayed, or stiff from years of sloppy painting, they should be replaced. To ensure that all the moving parts glide smoothly, I lubricate the inner workings of each pulley with a squirt of Tri-Flow, and rub a block of paraffin wax (the kind that's used for canning) along all of the running surfaces, including the stops.

After attaching the cords, I temporarily place the sash in the opening and let it rest on top of the stool. While applying gentle pressure against the stops, I scribe the stool to determine how much stock must be removed to allow the window to close (**Figure 5**). In most cases, it's a hassle to remove the stool, so I trim it in place using a Veritas bullnose plane with a removable toepiece that lets me work right up to a corner (veritastools.com). A multi-tool and a detail sander work well too.

The final step is to replace the stops. I start by tacking each one in place on the top with a hand-driven 4-penny finish nail. Next, I close the window and push the bottom of the stop tight enough to gently compress the brush seal. Then I tack the bottom and drive two or three more nails in between. I don't set the nails until I'm satisfied with the fit and the operation of the sash. A properly installed sash lock ensures a tight seal at the top; the only place the stop must tightly engage the sash is at the bottom.

Tom O'Brien *is a* JLC *contributing editor and a restoration carpenter in New Milford, Conn. Photos by Jake O'Brien.*

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Products | by Tom O'Brien

Versatile LED. The 5-inch-aperture *Eco-Downlight* delivers 2,200 lumens of light from just 30 system watts of power, according to the manufacturer. It's available in new construction and remodeling configurations, with square or round trim packages. The Eco-Downlight is compatible with incandescent, electronic low-voltage, and 0–10v dimmers. It can produce a variety of beam patterns from 12 degrees to 85 degrees. Pricing starts at $780 for the downlight; trims start at $60.

Troy-CSL Lighting, 626/336-4511, csllighting.com.

Post Covers.

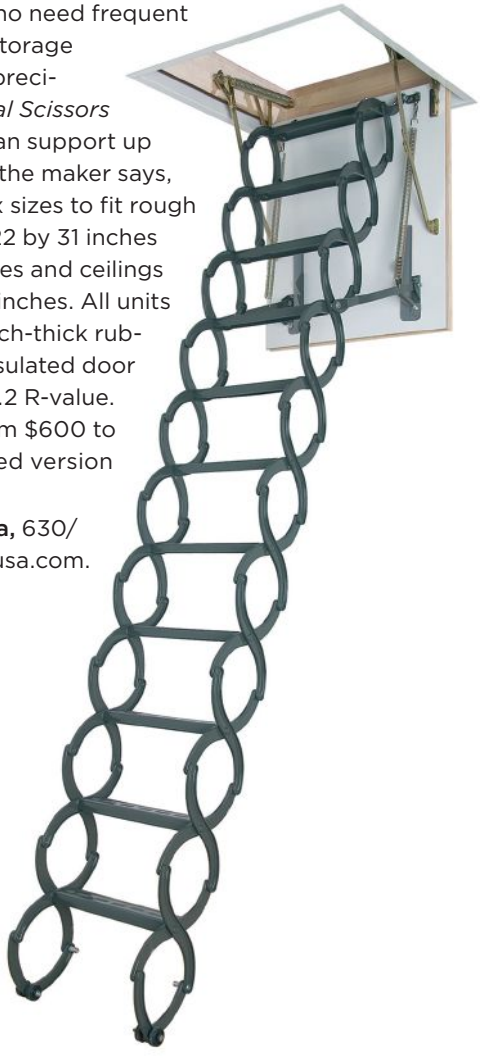
Trimming out wood or steel columns is now a snap, thanks to Fypon's *PVC Column Wraps.* The installer fastens a top and bottom cleat, surrounds the post with the two-piece wrap, screws it to the cleats, and caulks the joints — a 15-minute process, the manufacturer says. The wraps come in various tapered and non-tapered styles, including fluted, raised-panel, and recessed-panel. Caps and bases are also available. Prices range from $225 to $800 per column.

Fypon, 800/446-3040, fypon.com.

Heavy-Duty Pull-Down.

Homeowners who need frequent access to their storage space might appreciate the *LST Metal Scissors* attic ladder. It can support up to 300 pounds, the maker says, and comes in six sizes to fit rough openings from 22 by 31 inches to 25 by 54 inches and ceilings up to 10 feet 10 inches. All units include a 1 3/8-inch-thick rubber-gasketed insulated door that delivers a 5.2 R-value. Prices range from $600 to $780. A fire-rated version is also available.

Fakro America, 630/543-1010, fakrousa.com.



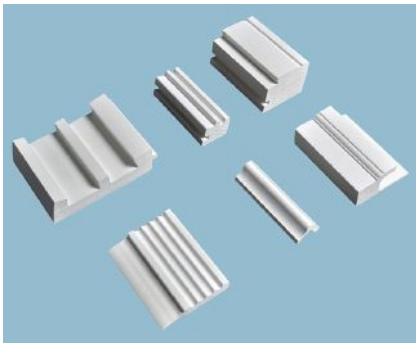
Prefab Cedar.

The Ecoshel *Smart-Shingle System* is designed to simplify cedar-shingle jobs. The shingles — suitable for roofing or walls — are squared and fastened to each other in 45-inch-long panels, then coded to ensure that joints are offset by at least 1 1/2 inches. Ridges on the shingles' backs create a drainage plain. Cost per square ranges from $240 to $470, depending on wood quality and coverage.

Ecoshel, 404/350-0540, ecoshel.com.

For more information about these products, go to http://jlc.hotims.com.

Products



More Moldings. Six profiles have been added to the *Versatex* lineup of exterior moldings: a full-size window sill, two sill noses, a garage-door stop, beadboard cap, and J-channel brick mould. Like the other 26 profiles in the collection, they're made from extruded cellular PVC that is supposedly impervious to moisture and insect damage. The new products come in 16-foot lengths (except for the brick mould, which is 18 feet long). Prices range from 60 cents per foot for beadboard cap to $4.60 per foot for window sill.

Wolfpac Technologies, 724/857-1111, versatex.com.

Expandable Drain Pipe. *Flex-Drain* curves around obstacles and holds its shape like a giant bendy straw, eliminating the need to cut pipes and insert fittings. The 12-foot product expands to 50 feet (shorter lengths are available as well) and comes in three versions: solid, perforated, and perforated with a removable polyester sock that serves as a debris filter. A length of solid or perforated Flex-Drain costs about $40.

Cleveland Tubing, 800/257-1722, flex-drain.com.

Self-Stick Housewrap. *Delta-Vent SA* is a vapor-permeable, water-resistive air barrier that requires no mechanical fasteners. It has a layer of adhesive (covered with a split-release liner) on its back that's designed to fully adhere to OSB, plywood, gypsum, concrete, and masonry substrates without interfering with vapor transfer. It also has a 2-inch-wide strip of adhesive on its top front edge to ensure a solid bond at the lap joint. Pricing runs about $1.15 per square foot.

Cosella-Dörken Products, 888/433-5824, cosella-dorken.com.

Plastic Wood. Wolf recently added two tropical-hardwood colors — amberwood and rosewood — to its collection of *PVC Deckboards.* The boards' PVC core is covered by a UV-resistant layer of ASA resin to prevent fading, says the company. Prices run from $3.40 to $3.65 per foot; the collection's original colors (Avalon sand and New England grey) cost about $3 per square foot.

Wolf, 800/388-9653, wolfleader.com.

Stair Spruce-Up. If your clients want to replace their carpeted stairs with hardwood but don't quite have the budget, *RetroTreads* might be an option. These solid hardwood treads — available in oak, maple, hickory, cherry, or poplar — have a full-size nosing and integral 1¼-inch cove molding, but the tread surface is only ⅝ inch thick, so the staircase rise won't be significantly affected. The treads come in lengths of 36, 42, 48, and 60 inches. A 42-inch red-oak tread costs $28 at Lowe's.

Young Manufacturing Co., 800/545-6595, youngmanufacturing.com.

Radiant in a Box. Although it may look like the control panel for a radiant heating system, the *Radiant Ready 30E* is actually the entire mechanical room — boiler, manifold, pump, expansion tank, valves, thermostat, and air vent — all preassembled in a unit that you hang on the wall and then plumb and wire. It can heat up to 2,000 square feet, the maker says, and comes equipped with a five-loop manifold that can be customized to receive up to three more loops. It costs about $6,000.

Uponor North America, 800/321-4739, uponor-usa.com.

Steady, Silent Heat. The *SoftSound VC 97 Variable-Speed Modulating Gas Furnace* is made with stainless steel heat exchangers and achieves a 97 percent AFUE rating, says the maker. It's designed to operate for longer periods and at lower heat levels than a single-stage furnace but to kick into high gear when temperatures drop. The furnace cabinet is insulated and sealed to reduce noise. The manufacturer declined to provide pricing.

International Comfort Products, 931/270-4100, comfortmaker.com.

No-Hassle Storm. Andersen's *Rapid Install* kit is designed to eliminate all of the cutting and most of the measuring typically required for the installation of a storm door. Features like an expandable drip cap, a pre-installed sweep and lock case, and a handle set that snaps into place make it possible to complete the job in as little as 45 minutes, the maker says. The kit is available for two of the company's storm doors — Contemporary Series Single Vent and Interchangeable Fullview — in eight colors, three hardware finishes, and a variety of glass options. Prices range from $200 to $300 per door.

Andersen Corp., 800/426-4261, andersenwindows.com.

For more information about these products, go to http://jlc.hotims.com.

Bosch Bulldog Xtreme Max SDS-Plus Rotary Hammer

by Kyle Dunkley

Over the past few years, I've used a Bosch SDS-Plus Bulldog Xtreme (11255VSR) rotary hammer to bore a thousand 3/16-inch to 1-inch holes in everything from 30-day to 30-year concrete. I've tossed the tool around in my truck and on site and exposed it to endless Pacific Northwest rains. Although it isn't the fastest model on the market, it has been a steady workhorse.

Last January Bosch introduced the SDS-Plus Bulldog Xtreme Max (RH228VC) rotary hammer, which is billed as a step up from the Xtreme. I recently poured a foundation that involved pinning some of the footings to bedrock with rebar dowels and drilling holes for anchoring the mudsills. The job gave me a chance to test-drive the Xtreme Max and compare it head-to-head with my older model. My first impression? The new tool works great.

Features

My Xtreme and the new Xtreme Max share many features. They're both D-handle models, which are longer than pistol-grip and L-shape models and well-balanced for the downward drilling I commonly do as a framer. By using the longest bits available, I can often start my rotary hammer at waist height and bend over slightly as the bit works its way to the desired depth. This makes the job easier on my back.

On some rotary hammers, you have to loosen the side handle to adjust the depth stop — but the Xtreme Max has a convenient release button. The tool delivers rotary-only, rotary-hammer, and hammer-only action.

Both models have rotary-hammer, rotary-only, and hammer-only modes; an internal clutch that slips when a bit binds or the tool overloads; and a rotating brush plate that delivers equal power in forward and reverse. Both also have a pivoting strain relief on the power cord for improved durability, and a comfortable side handle with a removable depth stop that you can adjust quickly by pushing a release button. And finally, both have a fold-out hook on the handle so you can hang the tool off a ladder, scaffolding, or sawhorses — a feature I really like. Neither model has a trigger lock-on button, which would be handy if you do a lot of chipping.

But the real story is the hammering mechanism inside the Xtreme Max. Like the Xtreme, the new tool uses a piston to launch a free-floating striker, which in turn hammers an impact bolt against the bit. An air space between the piston and the striker compresses and drives the striker forward as the piston advances, then vacuums it back as the piston retreats. The air space also acts as a shock absorber. The Xtreme Max has a longer piston, impact bolt, and air space than the Xtreme, which increases its power and drilling speed while reducing vibration.

Bulldog Xtreme Max Specs

Weight (by JLC): 7.5 pounds (including cord, side handle, depth stop)
Length: 17.4 inches
Amps: 8
Rpm: 0–1,230
Bpm: 0–5,460
Impact energy: 2.4 foot-pounds
Maximum spiral-bit capacity in concrete: 1 1/8 inches
Optimal spiral-bit capacity in concrete: 3/16 to 3/4 inch
Maximum thin-wall core bit capacity in concrete: 2 5/8 inches
Price: $250 (including side handle, depth stop, plastic case)
Warranty: 1 year with 30-day money-back guarantee

Bosch, 877/267-2499, boschtools.com

The D-handle tool has a long reach for easier downward drilling.

The Category

The terms SDS, SDS-plus, and TE-C all refer to the same class of small rotary hammers. The bits that fit these tools have identical slotted shanks (see photo, below); to install one, you align the shank so it enters the chuck and push until you hear a click. To remove a bit, you pull back the chuck collar and slide it out. The platform is popular with builders and remodelers because the tools can typically bore common anchor holes in concrete two to three times faster than hammer drills, delivering powerful air-cushioned blows that can pulverize hard concrete and aggregates. The rotary hammers also accept core bits for drilling larger holes in concrete and can be set for rotary-only drilling. Many add a hammer-only mode so you can use bull points and chisels for light-duty chipping, on such jobs as removing old tiles and mortar.

Whereas my Xtreme can handle spiral-fluted bits up to an inch in diameter in concrete with an optimal drilling range of 3/16 to 5/8 inch, the Xtreme Max can power 1 1/8-inch bits, with an optimal range of 3/16 to 3/4 inch.

Bosch also gave the new tool an internal counterbalance (to further offset vibration) and a metal gear cover.

Performance

I rode the Xtreme Max hard for several hours on my foundation job, using various SDS-plus Bulldog bits to bore anchor holes from 3/16 to 5/8 inch in diameter. To better compare the speed and handling of the old and new models, I poured an extra unreinforced pad with the leftover 25-MPa (3,626 psi) concrete and let it cure for 28 days. Then, using new Bulldog bits, I timed how long it took each tool to bore five 5/8-inch and 3/4-inch holes to a depth of 2 inches. The Xtreme averaged 12 seconds for the 5/8-inch holes and 19 seconds for the 3/4-inch holes. The Xtreme Max averaged 10 seconds for the 5/8-inch holes and 18 seconds for the 3/4-inch ones. Although the new model wasn't radically faster than the old one, the results were consistent. As for vibration control, the Xtreme Max was way easier on my body than the Xtreme.

The Bottom Line

There's nothing wrong with the Bosch Bulldog Xtreme rotary hammer I've been using. It's reliable and has no problem drilling common anchor holes in concrete and bedrock, though it's a bit of a rough ride when drilling the larger holes. But with the risk of cumulative trauma disorders just around the corner, I look for any excuse to give my wrists and hands a break. The new Bulldog Xtreme Max is faster than my Xtreme while neutralizing much of the vibration. If I were in the market for an SDS-plus rotary hammer right now, I'd buy the Xtreme Max.

The fold-out hook is deep enough to grab a 2-by or an extension-ladder rung.

A turret allows the cord to pivot where it exits the tool, improving flexibility and durability.

Kyle Dunkley is a carpenter based in Shawnigan Lake, British Columbia.

Toolbits | by Tom O'Brien

Enhanced Infrared. Flir has upgraded its *i7* infrared camera. The new model's 19,600-pixel resolution represents a 36 percent improvement over its predecessor and exceeds the proposed RESNET resolution standards for energy auditing, the company says. It also offers a wider field of view (29 degrees) so you can scan larger surfaces without loss of detail. The camera costs about $2,000. Prices for other cameras in the i-series start at about $1,200.

Flir Systems, 866/477-3687, flir.com.

Paint Brush for Low-VOC. Purdy says its new *XL Elite* brush makes it easier to produce a high-quality finish with a low-VOC paint. The bristles — a blend of DuPont Chinex and Orel polyester filaments — are stiffer and hold their shape longer with thick, fast-drying coatings than competing products, the company says. The brush comes in nine sizes and shapes and costs $9.50 to $13.50.

Purdy Corp, 800/547-0780, purdy.com.

Deep-Throated Brake. Roofers and other trades who fabricate large sheets of metal on site might be interested in the *Industrial Metal Master 20.* Its 20 3/8-inch throat is the deepest of any portable brake on the market, the maker says. The latest model features a reinforced top locking bar, ergonomic bending handles, and a better bending radius than its predecessor. It's available in 8′6″, 10′6″, and 12′6″ lengths. Prices start at $2,800.

Van Mark Products Corp., 800/826-6275, van-mark.com.

Adjustable Camera. The *M-Spector 360* digital inspection camera has a 2.7-inch high-resolution color LCD screen that rotates so you don't have to stand on your head to figure out what the heck you're looking at. Its .35-inch camera head is fitted with four LED light units and yields a pixel density of 640x480. Part of Milwaukee's 30-tool M12 lithium-ion line, the camera comes with a 3-foot or 9-foot cable; the 9-foot model — with battery, charger, and accessories — costs about $230. The bare tool costs about $130.

Milwaukee Electric Tool Corp., 800/729-3878, milwaukeetool.com.

For more information about these products, go to http://jlc.hotims.com.

New Life for an Old Bottle

by Kevin Serr

When it was built for the owner of a local dairy company in 1935, the Benewah Milk Bottle in Spokane, Wash., was a good example of literalism in advertising: It looked like what was sold inside. In September of 2011, the historic structure — along with the attached restaurant — was damaged by fire. The owners hired my company, Compass Construction, to repair the damage.

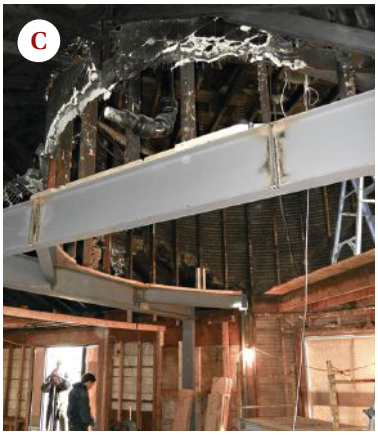
The project called for some creative thinking. The 38-foot-tall by 15-foot-wide bottle had a 2x4 stick frame with an overlay of lath and stucco; two-thirds of the frame's weight was supported by a steel I-beam that ran diagonally across the outer walls. The engineering report dictated that we find a way to stabilize the 33,000-pound bottle while we replaced the single existing beam with a more robust welded assembly. After much discussion we decided to do this with temporary beams and an array of pole jacks. Once the new steel was in place, the rest of the job was relatively straightforward.

The result is a big improvement over the pre-fire structure. In addition to upgrading the ventilation and other mechanicals, we restored the ceiling to its original 15-foot height and created an overhead rotunda ornamented with neon lighting and four custom milk-bottle-shaped lamps.

The day before the restaurant's official reopening in May, the owners hosted a thank-you party for our crew and the Spokane firefighters, with plenty of burgers and — you guessed it — milkshakes.

***Kevin Serr** is a remodeler and restoration specialist in Spokane, Wash.*

A. To temporarily bear the weight of the stuccoed bottle, a pair of 2x10s supported by pole jacks was bolted to each 16-inch on-center stud (note the curved bottom plate below the temporary 2x10s).
B. New steel beams were passed in through an opening in the outside wall (visible at lower left), raised into position, and welded together.
C. Clearing away the forest of temporary jacks left an open, unobstructed work space.



D. The restored interior was finished with drywall on steel studs. The circular opening that extends upward toward the bottle's neck is visible at rear.
E. Structurally reinforced and freshly painted, the landmark bottle is once again open for business.

We constantly bring new ideas to market. Our latest advancement is the first vented soffit available in cellular PVC. The Soffit System exceeds all local codes with 10 square inches of free air space per lineal foot. The premium 18' lengths reduce seams. Pair it with our Notched Fascia and Frieze Boards for a beautiful and easy installation. Like every Versatex product, it's built to last so you can trim smarter.

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Porter Cable framing nailers tout a staggering power-to-weight ratio. Delivering over 930 inch-pounds of impact energy at 100 psi, they easily drive 3-1/2" framing nails into engineered lumber with power to spare. Weighing only 7.3 pounds, their magnesium body design helps to make light work of a heavy workday. The tools also offer a low nail lockout, reversible rafter hook, and tool-free depth of drive adjustment to help achieve that perfect balance of contractor-friendly features.

Learn more about Porter Cable Framing nailers by visiting www.portercable.com or locating a distributor near you.

www.PorterCable.com

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