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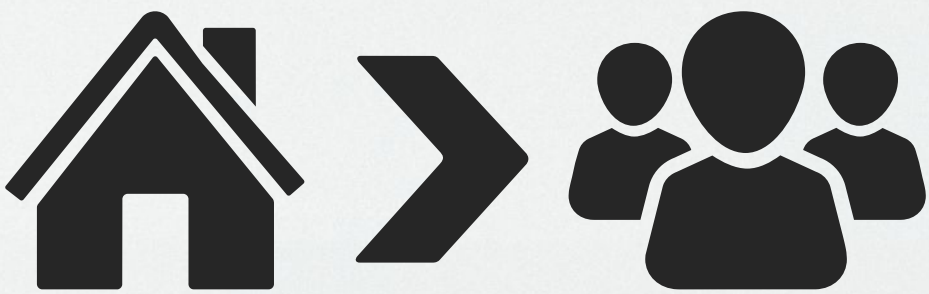

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"INSTALLING FLANGED WINDOWS: TWO STRATEGIES COMPARED," BY GENE SUMMY (JAN/16)

jkcllc (online, 1/21/16): Both of the methods [ASTM A1 and B1, covered in the article] assume that the weather-resistive barrier (WRB) is 100% effective. The comment "If taping the head flap in place, use short pieces with gaps between them so if any water gets behind there, it can drain out" (in step 9, online) indicates that it is assumed some water will find its way behind the WRB. What keeps that same water from finding its way behind the WRB wrapped into the jambs under the self-adhered flashing (SAF)? I like the "B" method, except that I would detail the rough opening with SAF applied directly to the substrate. The WRB wraps *over* the edge of the SAF and is sealed with either tape or more SAF. That way the framing is completely protected. I think with that minor change, the "B" method is bulletproof. My 2 cents!

Gene Summy responds: Thanks for the thoughtful response. In your strategy, you are still faced with placing the SAF before or after the window is set, after the WRB is in place. I say more power to you if you decide to place SAF on the rough opening before the housewrap is applied. I agree it is more protection for the framing in the event something fails. Most builders will not spend that kind of money or time. Additionally, it is not totally necessary. Remember the WRB is protection for the framing and the rest of the home. Flashing is supposed to help (strengthen) the WRB at locations where it faces the most challenges, specifically penetrations. Basically we are strengthening the WRB at penetrations. I believe the best way to do that is what is described in the article.

Regarding the tape at the WRB at the top of the window, I suggest considering that the WRB is in place for protection from weather. If, for example, a poorly applied fastener penetrates the WRB and leads to a water leak, the gaps in the tape simply provide a path of least resistance for water to escape.

A flexible butyl-based flashing material works well for flashing round-top windows, but the sill is tricky. In this case, the installer has left the bottom uncaulked and added shims to promote drainage.

"RETHINKING WINDOW FLASHING," BY HARRISON MCCAMPBELL (NOV/15)

Mike Schuler (email, 1/10/16): I have a job requiring installation of small (24-inch diameter) flanged circular windows. We have installed several already, using Dupont Flex-Wrap both at the head and in forming the equivalent of a sill pan for the lower half of the circular assembly.

First, we cut circular holes through the sheathing. We then blocked-in the framing for the bottom half of the window to form a round sill to match the shape of the opening. We angled the cut at the bottom so any water would drain to the outside. We then installed the window, applying sealant to the back of the top half of the flange. We slipped thin (1/16-inch) shims under the screws at the bottom, again to provide a way for water to escape. We followed with FlexWrap applied over the top half of the flange and stuck (mostly) directly to the sheathing (see photo, left). Next time, we will cut back the moisture barrier farther at the sides so every bit of

the FlexWrap is adhered directly to sheathing.) As a final step, we lapped and taped the moisture barrier over the FlexWrap.

What we did seemed logical to us, but it was a first attempt at this detail. Do you have recommendations for such installations similar to the one published in *JLC* for rectangular windows?

Harrison McCampbell responds: The details you propose sound right if I am understanding your approach correctly. In addition to the weather barrier and flashing details, an important detail you provided is to continuously caulk the top half of the circle, applying the caulk as the window gets installed. I would extend the caulk a little below the top half, but leave the bottom open. The shims at the bottom should help promote positive drainage of any water that leaks through the window unit, but I would still be inclined to create a raised edge along the inside of the sill (maybe 6 inches wide and ½ inch high in the center at the bottom of the window, which is the only place where this will matter on a circle window). This raised edge could be hidden with trim but would effectively act as a dam to prevent water that gets past the window from leaking inside.

oreganocrk (online, 10/26/15): Do these flashing rules apply with a peel-and-stick housewrap, such as WrapShield SA (vaproshield.com/products/wrapshield-sa)? Is it OK to wrap those types into the rough opening, or should the peel-and-stick flashing still adhere to the wood frame?

Harrison McCampbell responds: I'm not familiar with WrapShield SA, in particular, but it should still work. One thing I look for in any of the "peel-and-stick" membranes is whether or not they are asphalt-based compounds with a polymer modifier. Some of this genre are just a thin, polymer-based material that may or may not seal around a fastener where needed. One way to check is to take the membrane and stick it to your finger or, better yet, to a piece of paper and let it sit for a couple of minutes. If there is any asphalt, the oils will bleed out and leave a dark residue. Or, of course, you can read the manufacturer's literature.

Richard Bergman (email, 11/26/15) Great article. I am a green builder in Buffalo, N.Y. Window flashing is definitely a moving target, especially with Zip Wall and other systems that provide thermal blocking. I do not tape the bottom window flange. Should I? I wasn't clear on what you recommend.

Harrison McCampbell responds: Thank you for your interest. I would *not* tape or caulk along any sill, because that is where any water that gets past the

window should be able to escape.

Also, since you use ZipWall sheathing, the one question I have with that system is how to install through-wall flashing? I assume that this is to be done by adhering (only) a sheet flashing to the wall. However, how does one know, years down the road, that the adhesive on the tape is still stuck to the ZipWall? I've seen tape flashing used across windows fail on a lot of projects. In many cases, it starts to peel down along the top even before the exterior finishes are installed. This creates a "catch-all" for water coming down the outer face of the ZipWall sheathing. All face-applied membranes and tapes that can't be lapped shingle-fashion are at risk of this failure.

"BUILDING BARN DOORS," BY DAVID FRANE (DEC/02)

Mighty One (online, 1/18/16): The diagonals on the rustic doors are run in the wrong direction. They should be run from bottom to top. This keeps the doors from sagging at the ends as pressure from the top of the doors is transferred to the door frame through the hinge. Old timers knew what they were doing. Copy their work.

Clayton DeKorne responds: This was a hotly debated topic when this article first ran in the magazine and it continues to be now, online. The writer would be correct if this were a picket fence gate or lichgate, which is built like a box frame supported by hinges, with pickets applied to the face of the structure. In this case, you do want a diagonal acting in compression (low at the hinge side) to support the frame. Wood works well in compression to support this instance.

But on a barn door like this, the door is a slab and the diagonals are face applied. There is no frame, just a slab stiffened by face-applied members. The diagonals are providing racking resistance to support the slab solely on the basis of the fasteners that hold the horizontal and diagonal braces to the door slab, regardless of which direction the braces are positioned. Force is transferred to the diagonals by the fasteners, plain and simple. You might think it's positioned to better handle tension (as shown in the illustration in the article) when compression is needed to support gravity. But all that is illusion. It's the shear strength of the fasteners that matters.

If you want to copy the old timers, they usually made barn doors with diagonals running in both directions to form an X on the door. This provided more surface area for more fasteners and more shear resistance to resist sagging.

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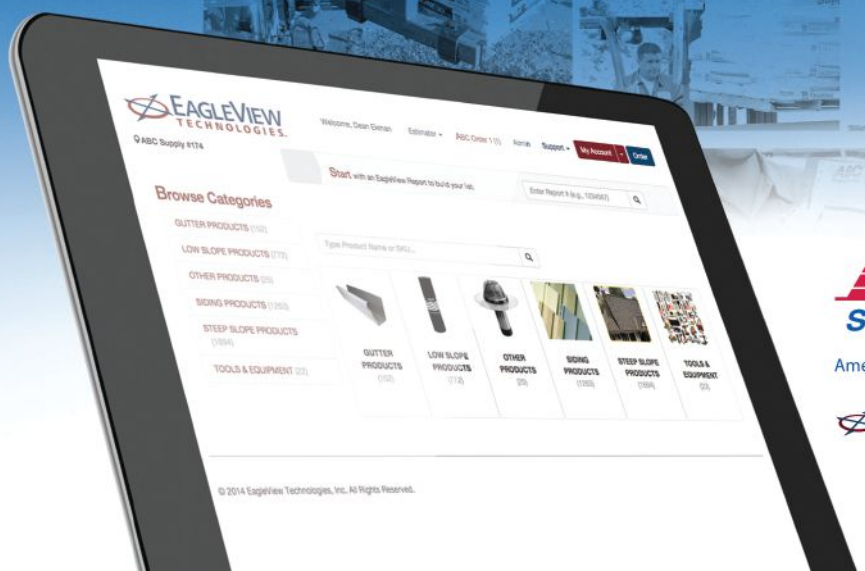

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Q The flooring article ("Installing Prefinished Strip Flooring") in the November 2015 issue showed the boards being installed tight to the baseboards. Shouldn't there be an expansion space around the perimeter?

A Howard Brickman, a wood-flooring contractor and consultant based in Norwood, Mass., responds: Over many decades of installing wood flooring as well as studying the science of building materials and wood technology, I have come to realize that many of the "rules" regarding wood flooring are based on a deeply ingrained (pun intended) mythology and not necessarily on fact.

The first myth is that wood is a "living and breathing" thing, so wood flooring needs plenty of expansion space. The underlying truth to this myth is that wood shrinks and swells when it loses or gains moisture. But this movement does not define life.

The second myth, which builds on the first one, is that wood and water don't play nicely together. But water is an integral part of all wood. (And once the use of water-based finishes became widespread, this myth lost a lot of its mojo.) Here's a fun fact: A 10-foot-square oak floor at 8% moisture content (MC) contains 2.7 gallons of water. For a more robust explanation of the relationship between wood and moisture, read *The Wood Handbook* (free online at fpl.fs.fed.us from the Forest Products Laboratory) or Bruce Hoadley's book, *Understanding Wood* (not free, but more fun to read).

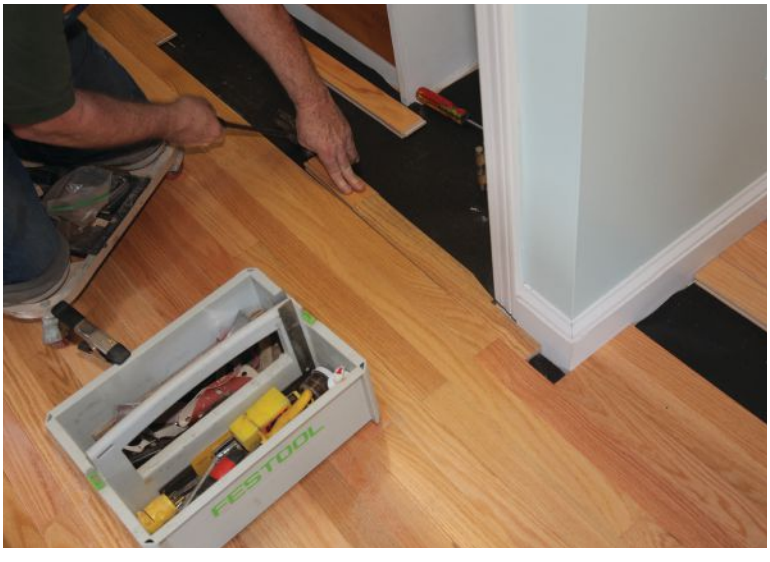

Photo by Roe Osborn

Proper moisture content in wood flooring and in the subfloor, along with adequate nailing, lets the flooring be installed without an expansion space.

PREVENTING MOVEMENT IN WOOD FLOORING

Setting the myths aside, there are three things we can do to prevent solid tongue-and-groove wood flooring from moving.

The first is to control the moisture in the house. In the U.S., most single-family residences are wood-frame construction with plywood or OSB structural subflooring fastened to solid-wood or engineered joists. The wood flooring is then blind nailed with cleats or staples directly to the structural subfloor. Because flooring can swell if exposed to excessive moisture, it's critical not only that the building interior is dry when the flooring is installed, but also that the subfloor is dry. In a perfect world, wood flooring with an 8% MC performs best when installed on a subfloor that also has an 8% MC. If there is a difference in MC, the bottom of the flooring and the top of the subfloor will start to swap moisture as soon as the flooring is nailed down. The solution is not to stop the swap, but rather to dry out the subfloor before the installation. Every percentage of difference in MC increases the risk that the floor will not stay flat over time.

The next strategy involves fasteners. The blind nails that you drive into T&G flooring stay in place by the friction between the nail surface and the surrounding subfloor material. As you know from experience, pulling a nail out gets easier once it starts to move. Any lateral movement of the wood flooring will loosen the nails, resulting in a loose and noisy floor. So the second way to prevent lateral movement is to use lots of fasteners. I recommend driving nails every 4 to 6 inches.

OK, we've dried out the subfloor and nailed the heck out of the flooring, but dang, the surface of the new floor still became cupped and wavy—not smooth and flat—even though no visible water had gotten on the floor. This is because water exists as a gas suspended in the atmosphere, described with the term "relative humidity" (RH). If you expose wood to a higher RH, given enough time, its MC will increase and the floor-

ing will swell. Conversely, if you expose wood to a lower RH, the MC will decrease, and the flooring will shrink. But there is a "Goldilocks" MC for your climate zone: halfway between the winter low and the summer high. In the Northeast, that's 7.5%. It's a bit higher in the South and a bit lower in the arid, high-altitude regions of the West. So the third factor is to make sure the flooring is at the right MC for your part of the country.

EXPANSION SPACE OR NOT?

So what about the expansion space? The angle of the nails keeps the flooring from pushing back toward the starting wall, so no space is needed there. Wood doesn't shrink or swell much along the longitudinal axis, so no space is needed at the ends where they butt up against the wall. And if you use enough fasteners to prevent lateral movement, then little or no expansion space is needed along the finishing wall. A dry subfloor plus correct flooring MC plus a lot of fasteners equals the best wood-floor performance. The simple fact is that when wood flooring is exposed to excessive moisture, the floor will cup—even if left with a quarter of a mile of expansion space.

Q When cutting trim, guys I work with always add a "skosh" for a tight fit at the corners. How much should I add?

A Gary Katz, owner of Katz Road Show, editor of ThisIsCarpentry, and a presenter at JLC Live, responds: Until I saw your question, I never knew how to spell the word "skosh," probably because I've only used the word on jobsites and never in an article.

Most carpenters I know also add a "hair" or a "skosh" to their measurements. I do, too, but it needs to be said that I don't cut my material long just to make it long—if that were the case, I'd have to re-cut almost every piece. I start by measuring and cutting as precisely as possible and then add a "skosh" to those precise measurements. This is something I learned from watching a finish crew install baseboard for $.15 a foot. How big a "skosh" depends on how long the molding is. For example, if I'm installing a piece of baseboard or crown molding that's more than 8 feet long, I add as much as ⅛ inch. I install the board by springing the middle away from the wall and letting it snap in tight against the wall, closing up the corner joinery watertight.

For boards shorter than 8 feet, I add about 1/16 inch. For some shorter boards, it's just a matter of "leaving the line"—cutting to the side of the pencil mark instead of in the middle. And for really short or small pieces, like a 1-inch piece of baseboard, I subtract a "skosh," just to be sure the piece will fit the first time. Over time, you'll get a feel for how much to add to each board you're installing.

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BY EMANUEL SILVA

Photos by Emanuel Silva

Supporting a Ledger From Above

Installing a deck ledger on an older home where the door onto the deck is only a few inches above a skinny 4x6 sill can be challenging enough. Set that sill on top of an old rubble stone foundation that's impossible to anchor anything to, and some guys might be wishing they hadn't taken on the deck job in the first place. That was the situation I ran into on a recent project.

In the past, I've anchored ledgers to solid concrete or brick foundations using specialty fasteners such as Tapcons, but the foundation stones on this house were large and nearly impossible to drill into. Also, the mortar around the stones was in bad shape. I couldn't have anchored a ledger to the foundation even if I'd wanted to. The worst thing about the foundation was that it stuck out past the sill and the plane of the wall by a few inches.

Drawing from a technique I had seen a respected carpenter use to solve a similar problem, I decided to fasten through the top of the ledger to catch the sill. Then, to support the bottom of the ledger, I would secure it to the house wall with Simpson Strong-Tie LSTA Strap Ties; these 18-gauge galvanized steel straps have a load rating high enough to hang the ledger solidly without my having to worry about it—and the deck—falling down.

PREPARING THE LEDGER

I first tore off the original deck that served as the entry platform for the house. Then I peeled back the bottom 2 feet of siding from the two walls adjacent to the deck, exposing the original board sheathing. To protect the walls from water and potential damage, I applied Grace Ice and Water Shield flashing to the sheathing, letting it wrap around the bottom of the door **(1)**. Next, I applied a thin coat of mortar with a bonding agent to the foundation walls that would be below—and hidden by—the deck, to seal and stabilize the mortar around the stone. I was then ready to prepare the ledger.

With the deck being only about 8 feet square, pressure-treated 2x8s would be big enough for the ledger, the rim, and the joists. Because the foundation jutted out past the wall plane, spacers would be required to pad


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out the ledger so that it could hang beyond the foundation. The wall with the door needed a pad at least 2¼ inches thick, while the adjacent wall needed only a 1½-inch pad. For the door wall, I sandwiched a length of Azek between the ledger and a pressure-treated 2x4. A 2x4 alone was sufficient to pad out the adjacent ledger.

Knowing the dimensions of the ledger and pads, I was able to determine the length of the straps I'd need. For a strap to wrap completely around the ledger and extend up the wall far enough for me to anchor it to solid framing, it needed to be 36 inches long.

I measured the length of the ledgers on both walls and located and marked the wall framing where the straps would attach. Then I was ready to cut and assemble the ledger units.

ASSEMBLING THE LEDGERS

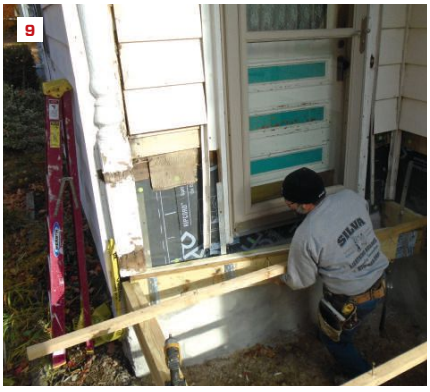
I started by cutting the ledger and spacer stock to length. I laid out the strap locations on the stock and then cut a series of shallow dado grooves on both sides of the spacers and on one side of the ledger, making sure the grooves weren't too close to the straps. These grooves will help channel any moisture down from behind the ledger-and-spacer assembly. I sealed all the cut ends and the dadoes with a wood preservative to help prevent rot **(2)**.

To prevent any reaction between the treated wood and the metal straps, I applied a strip of adhesive-backed membrane to the ledger at each strap location **(3)**.

Then I screwed the spacers to the back of the ledger. On the door-wall ledger, I secured the Azek spacer to the ledger first, using a few structural screws; next I used longer structural screws to secure the 2x4 spacer to the Azek-and-ledger assembly **(4)**. A membrane strip wrapped around the spacers would help isolate the treated wood from the metal straps.

STRAPS GO ON THE LEDGER

I had decided that the best way to suspend the ledger was to bend the metal straps around the ledger assembly in the shape of a giant hook. Forming the 18-gauge strap around the ledger wasn't difficult. I started



at the top of the ledger on the side that faced away from the wall. Using a layout square as a guide, I drove Simpson screws through each hole in the strap **(5)**.

Next I bent the strap around the bottom of the ledger and screwed that section **(6)**. As I went around the ledger, I bent the strap and tapped it flush with a hammer before securing it with screws. The only tricky part was at the inside corner formed by the ledger and the spacer; here I used a 2x4 scrap to help bend the strap into the corner **(7)**. The back of the spacer was supposed to lay flat against the sheathing, so I used nails in those holes—the nail heads had a much lower profile than the screw heads, so they wouldn't interfere with the ledger assembly fitting tight against the wall.

INSTALLING THE LEDGER TO THE HOUSE

The inside corner where the ledgers joined wasn't square, so I needed to install the outer rim joists to make a square outside corner before attaching the ledgers permanently. I started by snapping a level chalk line for the ledger height along both inside corner walls and hung the side-wall ledger with a couple of screws through the tails of the straps. (I drove screws through all the holes in the straps once the perimeter deck framing was complete.) The screws were long enough to penetrate through the sheathing and into the wall framing **(8)**. I then installed both outside rim joists, squaring them up and leveling them on temporary supports.

The second ledger slid into place fairly easily **(9)**. I simply lined up the tops of both ends flush with the adjacent members and permanently secured the straps to the wall using at least six Simpson screws for each one **(10)**. To stabilize the ledger assemblies and to secure them tight to the house, I drove galvanized lag screws through the ledgers and into the sills. When I was happy with the placement of the perimeter framing, I then permanently attached the straps on the side-wall ledger.

With one ledger assembly thicker than the other because of variations in the foundation wall, I used different-size lag screws for each ledger: 7-inch lags for the ledger assembly under the door and 5-inch lags for the adjacent ledger. Because the sill was only a 4x6, I staggered the lag-screw locations to discourage a stress crack from forming along the length of the sill.

I measured 4 inches in from the end for the first lags and then spaced them 2 feet apart. I drilled ½-inch holes through the ledgers at each location and tapped the lags into place **(11)**. Then I tightened them with a socket wrench, taking care not to crush the surface of the ledgers **(12)**. To keep the ends from twisting, I installed corner brackets in each corner. With the rims and ledgers in place, I finished the framing for the floor of the entry deck, followed by the framing for the rest of the porch.

When the inspector arrived to check the work, he was impressed with how I'd resolved the challenge of securing the deck ledgers to this older home.

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

BY MELANIE HODGDON

Strategies for Increasing Your Markup

Eventually, most contractors come to the somewhat intimidating conclusion that if they want to create a sustainable and profitable business, they need to price their work high enough to cover production and overhead costs as well as to contribute to profit. This realization is frequently accompanied by feelings of panic and dread. After all, isn't there a risk that all your work will dry up if your prices are too high?

The solution, of course, is to perfect your marketing (or to start marketing, if you currently rely mostly on word of mouth) and to get some sales training. The chicken-and-egg situation then becomes one of trying to pay for sales training and marketing costs when you're barely making enough to cover production and put a few dollars in your pocket at the end of the year.

But let's say that you've already embarked on these marketing and sales ventures and are committed to raising your prices incrementally. Next, you might have the sinking feeling that you just sold a job or two at a markup you now recognize is too low. What can you do?

COME UP WITH A PLAN

First, come up with a strategy to transition from the markup figure you're using now to the new figure that you will eventually use to reach your target margin. However you design your strategy, you need to consider two key contributors to your margin: the markup you apply to your estimated costs; and the size of the job. With these figures in hand, you will be able to project the results of your strategy.

There are a few different ways to make this work. You could decide you'll mark up all jobs from now on at an additional X%. Or, if marking up larger jobs is intimidating, you may commit to increasing your markup on jobs between $X and $Y by one amount, and on jobs between $Y and $Z by another amount. Or, you could increase markups by X% on all jobs every month or increase markups by X% on each of your next jobs (see charts A and B).

In all cases, you need to identify three things:

1. Your anticipated sales volume (for a year)
2. The markups you intend to apply
3. The target margin you wish to achieve over a designated period of time (say, a year)

To create the examples in the charts, I used a simple calculator that yields the results of selling successive jobs at increasing markups. This allowed me to project what the markup on future jobs must be to achieve a particular target margin. Please note that the markup and margin figures I am using are based on actual figures from clients and do not represent my recommendations. Some benchmark figures for margins can be found in industry reports, but these figures may or may not be relevant depending on whether certain costs are classified as production costs, which affect your gross margin, or as overhead, which does not.

A. Increase Markup by 3% on Each Job

Anticipated total sales volume: $875,000
Target margin for the year: 19%

Job	Sale Price	Markup Used	% of Target Sales	Theoretical Margin	Margin Running Balance
Job 1	$175,000	12.50%	20.00%	11.11%	11.11%
Job 2	$175,000	15.50%	20.00%	13.42%	12.27%
Job 3	$175,000	18.50%	20.00%	15.61%	13.38%
Job 4	$175,000	21.50%	20.00%	17.70%	14.46%
Job 5	$175,000	24.50%	20.00%	19.68%	15.50%
Totals	$875,000		100.00%		

INCREASE MARKUP BY 3%

In the first example **(A)**, target sales for the year is $875,000; target achieved margin for the year is 19%; and current markup is 12.5%. The strategy here is to increase the markup by 3% on each job sold, irrespective of the size of the job.

For the sake of simplicity, in this first example, all the jobs have the same selling price. That means that if Job 1 has a selling price of $175,000 using a markup of 12.5% and Job 2 has a selling price of $175,000 using a markup of 15.5%, the costs to produce Job 2 are smaller.

Notice that the theoretical margin increases for each job (from 11.11% on the job with the 12.5% markup to 19.68% on the job with the 24.5% markup). Still, the running balance of the margins—15.50%—fails to meet

the target—19%—even though the projected sales volume of $875,000 is met.

VARIABLE JOB SIZE

Let's see what happens when the same conditions are in effect as in the first example, except the job sizes fluctuate significantly **(B)**. In this instance, because the higher markups were applied to larger jobs, the overall achieved margin—17.14%—is closer to the target 19%.

HIGHER VOLUME, MORE AGGRESSIVE INCREASE

Now assume we have a larger company with a higher sales volume and a more aggressive markup increase strategy **(C)**. This company's target sales for the year is $2,000,000; its target achieved margin for the year is 19%; and its current markup is 12.5%. In this case, the strategy is to increase the markup by 5% on each job sold, regardless of the size of the job.

To keep things simple, we'll assume all the jobs were sold at the same price. Notice that with greater markup increases (5% instead of 3%), this company comes closer to meeting its target margin, with an achieved margin of 18.46%.

EFFECT OF ONE LARGE JOB AT A LOW MARKUP

This is the same company as in the third example, but see what happens when it sells its largest job of the year at the old markup (12.5%), and the remaining projects that year are smaller **(D)**. This time the company doesn't come close to meeting its target margin.

BOTTOM LINE

If you have committed to increasing your prices to create a sustainable company (and maybe even get your life back), you can use a simple calculator—available as a download at jlconline.com/margin-calculator—to experiment with the results of increasing your markup. Remember that the size of the job to which the new markup figure is applied, in addition to the markup itself, will determine how quickly you can achieve the target margin you're aiming for.

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

B. Variable Job Size

Anticipated total sales volume: $875,000
Target margin for the year: 19%

Job	Sale Price	Markup Used	% of Target Sales	Theoretical Margin	Margin Running Balance
Job 1	$50,000	12.50%	5.71%	11.11%	11.11%
Job 2	$85,000	15.50%	9.71%	13.42%	12.56%
Job 3	$225,000	18.50%	25.71%	15.61%	14.47%
Job 4	$175,000	21.50%	20.00%	17.70%	15.52%
Job 5	$340,000	24.50%	38.86%	19.68%	17.14%
Totals	**$875,000**		**100.00%**		

C. Increase Markup by 5% on Each Job

Anticipated total sales volume: $2,000,000
Target margin for the year: 19%

Job	Sale Price	Markup Used	% of Target Sales	Theoretical Margin	Margin Running Balance
Job 1	$400,000	12.50%	20.00%	11.11%	11.11%
Job 2	$400,000	17.50%	20.00%	14.89%	13.00%
Job 3	$400,000	23.50%	20.00%	19.03%	15.01%
Job 4	$400,000	28.50%	20.00%	22.18%	16.80%
Job 5	$400,000	33.50%	20.00%	25.09%	18.46%
Totals	**$2,000,000**		**100.00%**		

D. One Large Job at a Low Markup

Anticipated total sales volume: $2,000,000
Target margin for the year: 19%

Job	Sale Price	Markup Used	% of Target Sales	Theoretical Margin	Margin Running Balance
Job 1	$750,000	12.50%	37.50%	11.11%	11.11%
Job 2	$500,000	17.50%	25.00%	14.89%	12.62%
Job 3	$375,000	23.50%	18.75%	19.03%	14.10%
Job 4	$225,000	28.50%	11.25%	22.18%	15.08%
Job 5	$150,000	33.50%	7.50%	25.09%	15.84%
Totals	**$2,000,000**		**100.00%**		

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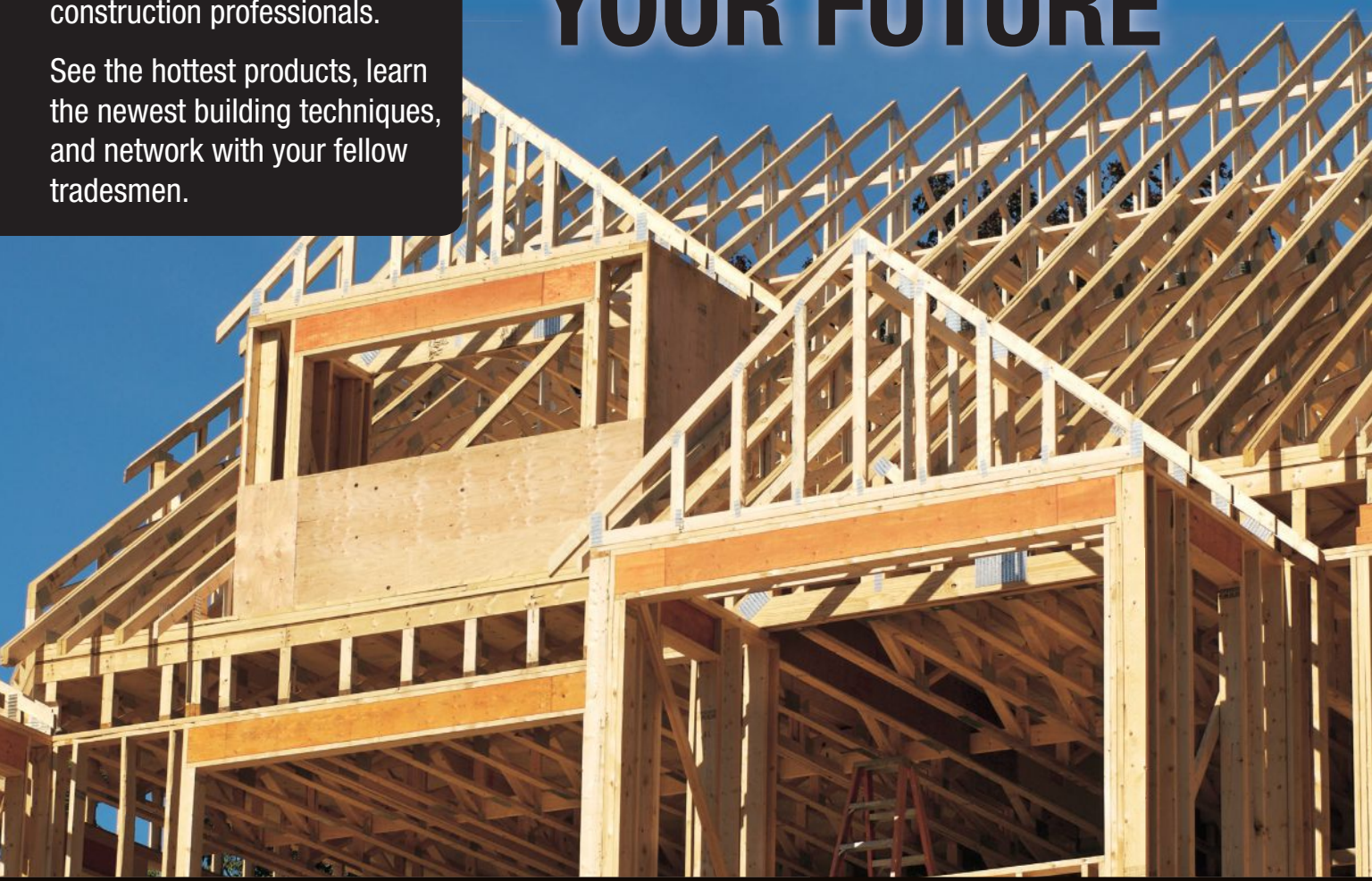

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STAY CONNECTED

BY TED CUSHMAN

Solar at the Crossroads

This winter has brought some big news for the solar power industry in the United States. In December, a budget deal in Congress renewed solar tax credits for another five years, which also renewed the optimism of companies who install photovoltaic (PV) panels on roofs. But state policy is a whole other playing field—and in state after state, regulators are making decisions that could make or break the market for solar panels on homes.

At the state level, the big political football is the rate utility companies are required to pay residential customers for the surplus power that flows into the electric grid any time solar panels produce more juice than the house is using at that moment. Also in play is the "net metering" regime that determines how production is weighed against consumption (if production is accounted for month by month, homeowners may get nothing for surplus power they feed into the grid during summer months; if the rule is "annual net metering," homeowners can trade off their June and July production against their December and January consumption).

States typically apply a cap to the total quantity of rooftop output that utilities have to net-meter in their service areas, and as one utility after another reaches that limit, regulators often reassess the costs and benefits of the jurisdiction's whole net-metering program. When it comes to net-metering policies (and the real dollars they represent), the controversy is hot and the future is murky.

Photos by Ted Cushman

Phil Coupe, of Revision Energy, in Portland, Maine, scopes out sun paths on a roof. Maine's Public Utilities Commission is reviewing policies for reimbursing homeowners for surplus power produced on their roofs.

POWERFUL PLAYERS

Here's the background: As solar panels have gotten cheaper, companies large and small have started to make money installing solar arrays on single-family roofs. But as the solar industry takes off, it's facing a backlash from utility companies who see solar as a threat to business as usual. Profits for solar-power players—just like profits for conventional generation companies and utility grid operators—depend heavily on rules set by government, and the political, technical, and economic issues involved aren't simple. But big utilities have been playing the political game—and counting the money—for a hundred years. And as solar providers muscle into that game, conventional power producers and power transmission companies aren't about to step away from the table.

And the power companies do have a case. Most solar-equipped houses, the utilities point out, aren't really self-sufficient. Even if they produce more power than they consume in a year, they still need a utility connection at night and on cloudy days. But net-metering rules in many states require utilities to buy excess power from rooftop panels at retail rates, even if the utility could get its juice cheaper from a conventional source. Utilities reason that solar-equipped customers aren't paying a fair share for all the power plants, transformers, and transmission lines that bring power to their homes

when the sun's not shining. And they say that the costs solar owners don't shoulder show up in the power bills of customers who don't have solar on the roof—an argument that allows big power companies to position themselves as Robin Hood heroes, defending poor customers who can't afford solar panels against exploitation by better-off homeowners who can.

Washington Post reporter Joby Warrick has seen this battle coming for years. In a 2014 report, Warrick wrote: "Three years ago, the nation's top utility executives gathered at a Colorado resort to hear warnings about a grave new threat to operators of America's electric grid: not superstorms or cyberattacks, but rooftop solar panels. If demand for residential solar continued to soar, traditional utilities could soon face serious problems, from 'declining retail sales' and a 'loss of customers' to 'potential obsolescence,' according to a presentation prepared for the group. 'Industry must prepare an action plan to address the challenges,' it said."

That action plan is in top gear now, at the federal level and in states around the country. The utility industry's first tactic—fighting solar incentives and subsidies in state legislatures—fizzled, according to Warrick's report: It turned out that support for solar panels on houses was strong among conservative and liberal voters alike. So utilities took their battle to more favorable ground: They started pushing their case in state utility commissions, lobbying for new monthly fees on solar-equipped houses. In that arena, outcomes have been mixed. But the battle rages on—especially in "sunshine states" like California, Nevada, Arizona, and Florida, where solar power has the potential to displace a lot of conventional generation. Let's take a closer look.

Utility workers maintain a power pole in Boston, Mass., in 2014. Power companies say homeowners with rooftop solar panels aren't paying their full share of the operating cost of the power transmission grid, even though they often draw power from the system.

NEVADA

Utility companies scored a big win in December and January in Nevada, a state with plenty of sunshine—and a state where major companies have been betting big on solar. Nevada, don't forget, is the state where Elon Musk, the founder of electric-car company Tesla Motors as well as of solar-electric-giant Solar City, decided to build his "Gigafactory" to manufacture batteries for the Tesla (and, now, for the home electric storage batteries called PowerWall).

Nevada politicians offered Tesla more than a billion dollars in tax incentives to build the $5 billion battery plant in their state, hoping to reap many times that amount in the form of jobs and economic activity. But this month, the Nevada Public Utility Commission (PUC) delivered a disincentive to Musk's other brainchild, Solar City, voting to increase the monthly service charge paid by homeowners with rooftop solar panels, and to reduce the rate the utility pays for extra power the panels supply to the grid (the rate homeowners earn is now slated to decline from full retail price to the wholesale price over four years). The new fees and rates won't just apply to future buyers of rooftop panels, but are retroactive on homeowners who relied on the existing arrangement when they purchased their PV systems.

In reaction, Solar City announced it was ending rooftop PV sales in Nevada (as did competitors Vivint and SunRun) and laying off more than 500 workers in the state. Solar-equipped homeowners filed a class action lawsuit against NV Energy, the state's power utility, over the fee increase. The state's consumer protection advocate petitioned the PUC to stay its decision and hear an appeal; the commission refused.

CALIFORNIA

Regulators in Sacramento heard the same arguments that regulators in Nevada did, but in December, they arrived at a different conclusion. California's power utilities had asked to stop paying the retail price for power supplied by rooftop panels, instead offering to pay homeowners the wholesale rate. But California regulators decided to keep the existing net-metering arrangement in place. Some fees are set to increase for California owners, however: They'll now pay a one-time interconnection fee of about $150 (which conventional power consumers also pay), and they'll have to pay a two- to three-cent surcharge per kilowatt-hour (kWh) on

Technicians for Revision Energy install PV panels for a grid-tied system on a Portland, Maine, roof in 2014. A panel array this size might supply all the power a house needs on a net annual basis, but still requires a grid connection to balance surplus summer production against nighttime and winter power needs.

the power they draw from the grid (the money is earmarked for low-income-assistance and renewable-energy programs). Previously, solar owners paid the surcharge only on the net power they used (which could be nothing); now they'll pay it on any power they take in, even if their excess production balances their intake and their net bill would otherwise be zero.

ARIZONA

The Salt River Project (SRP), an Arizona power cooperative owned by landowners in its service area, decided in 2014 to apply demand charges averaging about $50 a month on residential customers with rooftop solar panels. Solar City has sued SRP on antitrust grounds, saying the utility applied the fees to discourage competition from power sources it doesn't control. In December, a federal judge ruled that the case could go forward.

Meanwhile, the Arizona Corporation Commission, which regulates the state's utilities, is considering allowing similar charges by other Arizona power companies. SunRun has filed bias charges against two commission members, arguing that the officials' objectivity is in doubt because of "dark money" campaign funding believed to have come from the power companies they regulate. But commission members say they want to get past the politics, and they are reportedly talking to Solar City executives in search of a compromise on net-metering rates and monthly grid-connection charges.

FLORIDA

This may come as a surprise to some, but the so-called "Sunshine State" is thirteenth in the nation in terms of the per capita power it draws from the sun. The reason? Advocates of solar say it's because power utilities have a lock on the state's legislature. "Big energy's campaign cash keeps solar down in Florida," was the headline on April 5, 2015, in the *Miami Herald*; reporter Eric Barton, of the Center for Investigative Reporting, wrote: "Lawmakers and lobbyists say that anyone who has attempted to expand the rooftop solar industry has been ostracized. The reason, some lawmakers say, is that Florida's largest utilities have invested heavily in state political campaigns to fend off competition."

Companies like Solar City aren't allowed to lease rooftop panels to homeowners in Florida (residents have to work directly with their utility company), and Solar City doesn't operate there. Proponents of solar power, frustrated in the state capitol, are collecting signatures for a ballot initiative to amend Florida's constitution to, in essence, allow Solar City's business model there. Not to be outdone, a utility-backed group is trying to get a measure on the ballot to keep things the way they are.

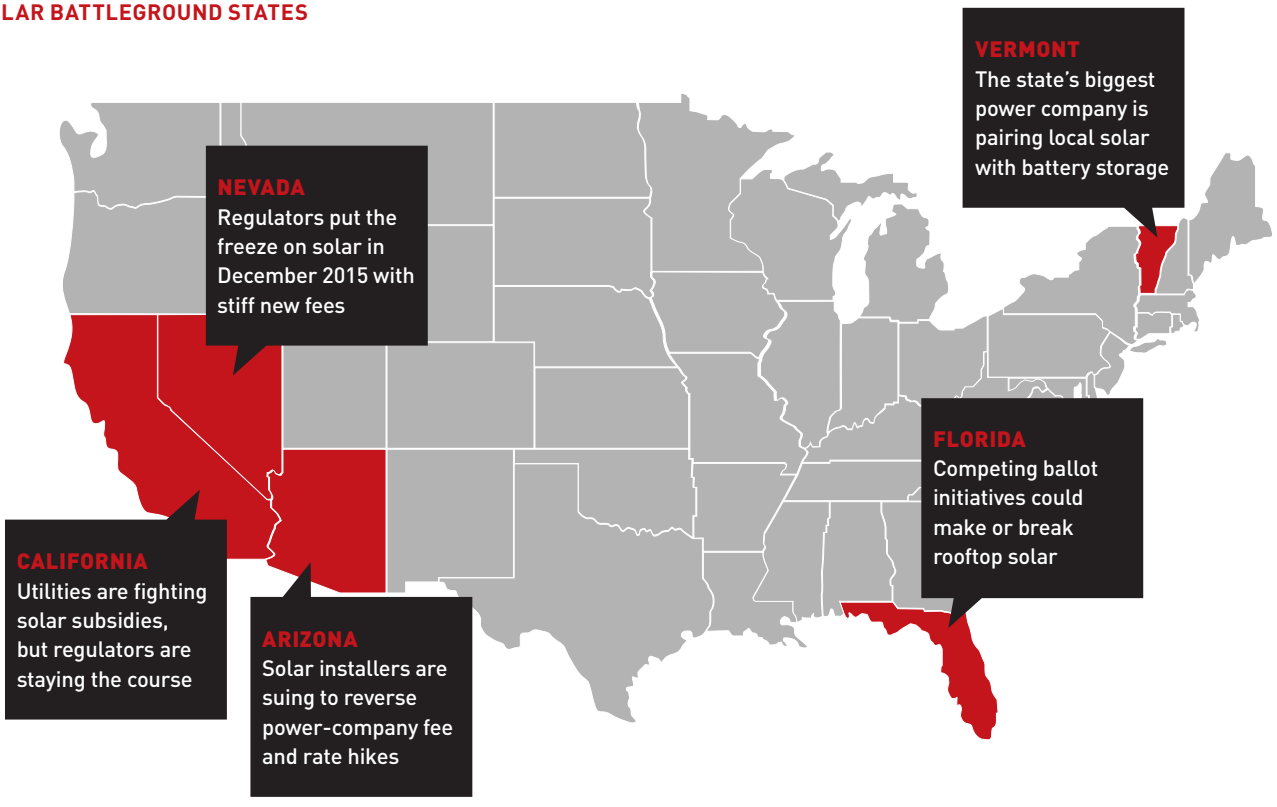
NEW YORK ... MAINE ... AND VERMONT?

The Sun Belt states aren't the only places where the solar action is hot. New York has net metering, and regulators voted in October to lift the cap on the total generating capacity permitted in the net-metering program, after one state utility hit its existing limit at 62 megawatts of rooftop generating capacity.

In Maine, utility Central Maine Power petitioned the state's Public Utilities Commission (PUC) to review the state's net-metering arrangements—as provided for in existing regulations—because the utility has reached the threshold for that move: One percent of CMP's capacity is now in the form of rooftop solar. Maine legislators directed the state's Public Utilities Commission (PUC) to hold hearings and devise an alternative to net metering for the future. Maine's Public Advocate office has suggested creating a "Solar Standard Buyer" (SSB) to consolidate the solar energy market statewide.

Vermont's biggest utility, Green Mountain Power (GMP), hit its net-metering cap in 2015 when alternative production (including both solar and wind) topped 15% of the company's capacity. GMP stands out among the nation's utility companies for its strong stance in favor of distributed generation and renewable power sources. GMP has asked Vermont's Public Service Board to extend the

SOLAR BATTLEGROUND STATES



net-metering program, and in the interim, is continuing to accept net-metering applications for systems of 15kW and less.

SOLAR ON A ROLL

Utility resistance to solar's expansion could hamper the developing small-scale solar industry in many markets. But globally, solar appears stronger than ever. The extension of federal tax credits gives the industry a strong tailwind for the next few years. But the technology's advancing capability and declining cost are independent factors that indicate a bright future. Worldwide investment in clean energy topped $329 billion dollars in 2015, according to a special report from *Bloomberg New Energy Finance*. That's up sharply from just a year earlier, and it comes in spite of plunging prices for oil and natural gas.

If the solar industry can succeed in the face of tough price competition from fossil fuels, it seems likely that it can also hold up against challenges in the regulatory arena—especially since some utilities, such as Green Mountain Power, have decided that embracing renewables is a better path than trying to beat them. Even the Arizona Public Service Co.—the utility that has locked horns with Solar City and SunRun over net metering in the state—is exploring ways to integrate solar into its electricity production portfolio. In January, the Arizona Corporation Commission authorized the utility to develop a pilot program looking at ways to use battery storage to shift the supply curve for solar power—storing surplus solar energy in batteries for use later in the day or the week, when demand for power peaks. That strategy could solve the utility's power management problem with solar and convert solar panels from an enemy into a friend.

Vermont's GMP, however, is way ahead of the Arizona utility. In December, GMP became the first utility in the nation to offer Tesla's PowerWall home battery system to individual ratepayers. GMP President and CEO Mary Powell called the proposal "a game changer that will help fully leverage solar to the benefit of all." GMP has already started installing the first of 500 PowerWall units in homes.

And it could be battery storage that resolves the battle among big power producers, grid operators, and residential-scale solar providers. The power grid's big problem is how to connect the variable demand for power with power sources that are hard to ramp up and down. Introducing the highly variable supply of rooftop solar into the equation has made that problem more complicated for everyone. But if enough battery storage can be deployed onto the grid, batteries could smooth the curve back out again—solving with a technical fix what political and legal systems couldn't solve.

Ted Cushman is a senior editor at JLC.

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Fire Separation Walls

These code-required assemblies can complicate construction, but they can also help the structural design

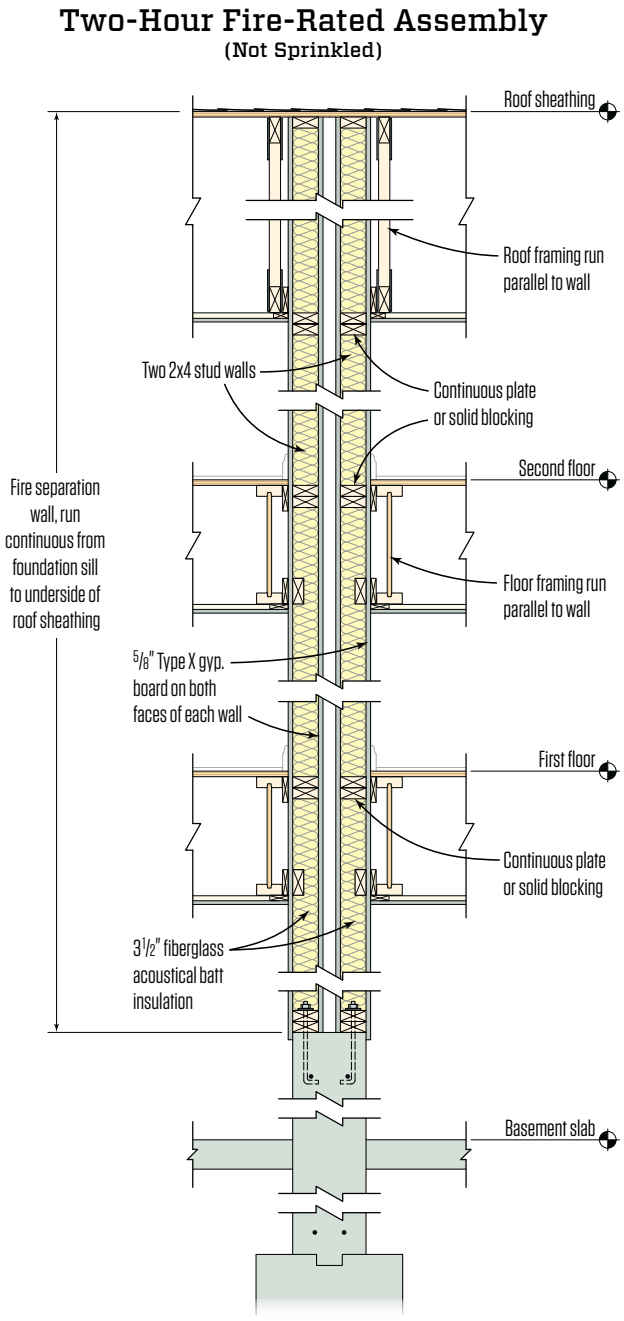
BY ANDREW P. DIGIAMMO

Photos by Ted Cushman; illustrations by Tim Healey

I'm an architect and builder working in coastal New England. As a design-build contracting firm, my company has the good fortune to be able to control both the designs for our projects and the process of construction. Of course, we have to comply with the same code requirements as everybody else. But with thoughtful design choices, we can sometimes turn those code requirements to our own advantage, or at least make sure they don't create unforeseen construction problems.

Fire-related code provisions are a good example of this. In wood-framed residential work, the requirements are fairly simple, but a few code rules do apply. If you build two-family or multifamily buildings, you have to provide what are called "fire-resistance-rated assemblies" for the walls that separate adjoining units. In the International Building Code (IBC), the wall between two condo units or apartments is referred to as a "fire partition." The term "fire partition" doesn't appear in the International Residential Code (IRC), but in practice it's the same thing: Whichever code applies to your building permit, walls between two adjoining units in a low-rise wood-framed multifamily structure generally need to be documented as having either a one-hour or a two-hour fire-resistance rating, depending on the case.

The requirements for fire partitions aren't as strict as they generally are for a "fire wall" as defined in the IBC. True fire walls serve to divide structures into pieces that the code treats as separate



This classic example of a two-hour fire-rated assembly has two independent stud walls, each with fiberglass in the stud bays and 5/8-inch gypsum board on both sides. Neither stud wall carries any floor load, but floor sheathing and ceiling wallboard are tied into furring secured to blocking in the wall.

buildings; and in fact, the classic example of a fire wall would be the wall of a building sited right on the property line and touching an adjacent building on the neighboring property, owned by somebody else. Fire partitions that separate two units in a single two-story wood-framed building with a common owner are quite a bit simpler. But they still need to be done right, and they can still make trouble for you.

Initial concept is important in design. You don't design the space first, and then figure out how to separate it. It's better to start the design work with the fire-protection considerations already in mind. That way, you don't have to resolve conflicts late in the design process (or worse yet, during construction).

DIGGING INTO THE CODE

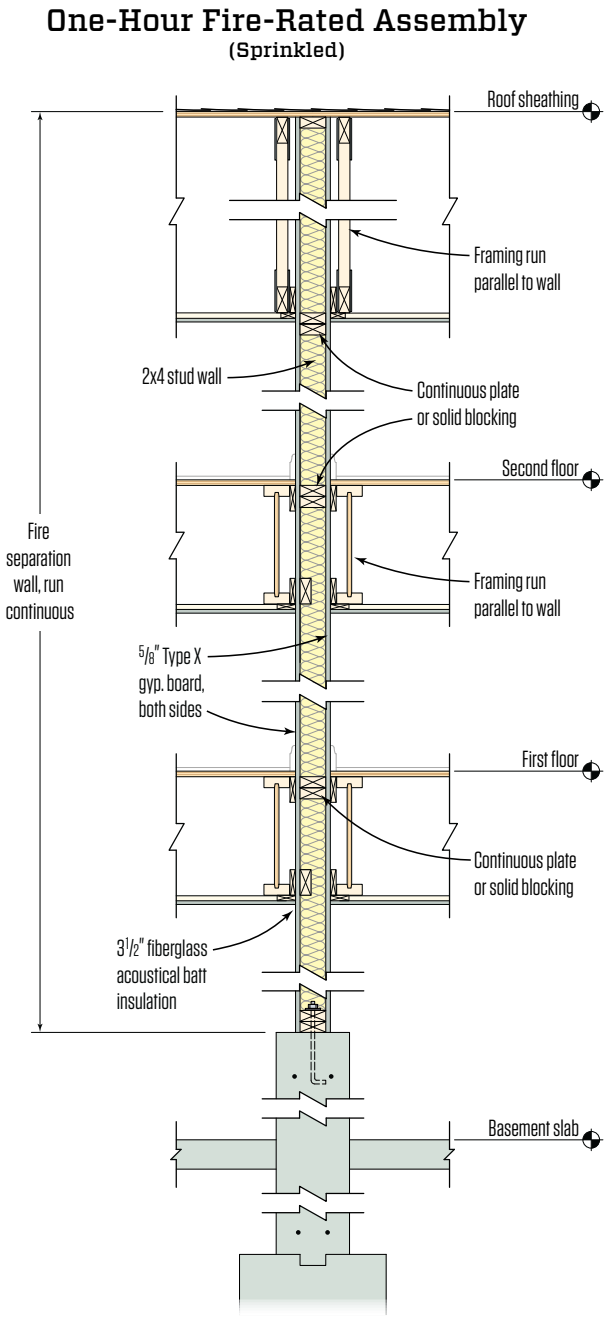
When it comes to fire-related aspects of the code (as with other kinds of requirements), there are huge differences that divide non-residential construction from typical one- and two-family projects. The code issues in commercial work are far more complicated, and the fire-related rules are much more demanding.

When I'm approaching a commercial project—even if it's just a small office or strip-mall building—I usually undertake a formal building code analysis using the International Building Code (IBC). I start with Chapter 3 (Use and Occupancy) and identify the project's "Use Group": Is it residential? Is it storage? Is it mercantile? Then I check Chapter 4 (Special Detailed Requirements Based on Use and Occupancy) to see if there are special requirements that apply. I'll also dig into Chapter 6 (Types of Construction) and consider the type of construction my project involves: Is it noncombustible (such as concrete and steel), or heavy timber construction, or something else? And then I look at Chapter 5 (General Building Heights and Areas) to make sure that my project fits within the allowable size for the type of construction I'm considering. When I submit my plans to the building department with my permit application, I usually include a sheet that lists and explains all the relevant code issues from my analysis (they like to see that).

You can build one- and two-family houses without consulting the IBC. Those projects fall plainly within the IRC. The scope of the IRC also covers "townhouses," which the IRC defines as single-family attached dwellings, three stories or less, with every unit having at least two exposed walls that provide fire egress into open space (typically, that's the front and back yards, but corner units could also qualify). But it's rare for a multi-family project to fall under the scope of the IRC; in Massachusetts, I never see it. If a residential design involves three or more attached dwellings, I always refer to the IBC.

Consulting the law. It is important to remember that your code analysis doesn't complete your due diligence for a project. You also have to consider local and state laws. According to Massachusetts state law, for example, multifamily buildings with three or more units must have fire sprinklers. That requirement isn't part of our building code, but it is part of our general law.

On the other hand, when you do sprinkle those buildings, the code, for its part, allows you to reduce the fire rating on the unit



This typical one-hour fire-rated wall assembly uses just a single 2x4 stud wall with fiberglass in the stud bays and 5/8-inch gypsum board on both faces. A one-hour fire-rated unit separation wall is allowed for duplexes, or for multi-unit buildings that are equipped with approved fire sprinklers.

separation walls from two hours to one hour. So when I build in Massachusetts, I can use just a one-hour fire-rated wall between condo units, but I have to install sprinklers. If I build the same project in other states, I might have to construct two-hour fire-rated walls between the units, but I might not have to install sprinklers.

Practicality and cost. As the builder, I need to control costs. That's why as the designer, I try to keep things simple. If you're a builder who doesn't control the design, you need to watch out for situations that can have an impact on your costs, your schedule, or even the feasibility of the project. Here are a few red flags:

- Offsets. If you see the party wall jog at all, instead of being a straight line, you could be looking at trouble. If a plan for a duplex, for instance, is laid out as two L shapes that come together to form a rectangle, it can be costly and difficult for the builder to detail the wall corners, as well as the intersections between the walls and the floor and roof framing.
- Horizontal separations. If two adjoining units are separated by a floor instead of by a wall—that is, one unit is upstairs from the other—you'll need a fire-rated floor assembly. Those are much tougher to build than fire-rated walls.
- Horizontal-to-vertical jogs. The king of them all is a horizontal separation that turns into a vertical separation. Constructing horizontal and vertical fire-rated assemblies that intersect out in the middle of nowhere could become a logistical nightmare on the job.

If I'm designing a row house, I avoid all those configurations. But if designers aren't thinking about the fire separation issues, they'll do that stuff all day long: They'll jog the wall between units or bring an upstairs room over a downstairs space belonging to the other unit, stepping the unit separation walls over from one story to the next, just to solve a floor-plan problem.

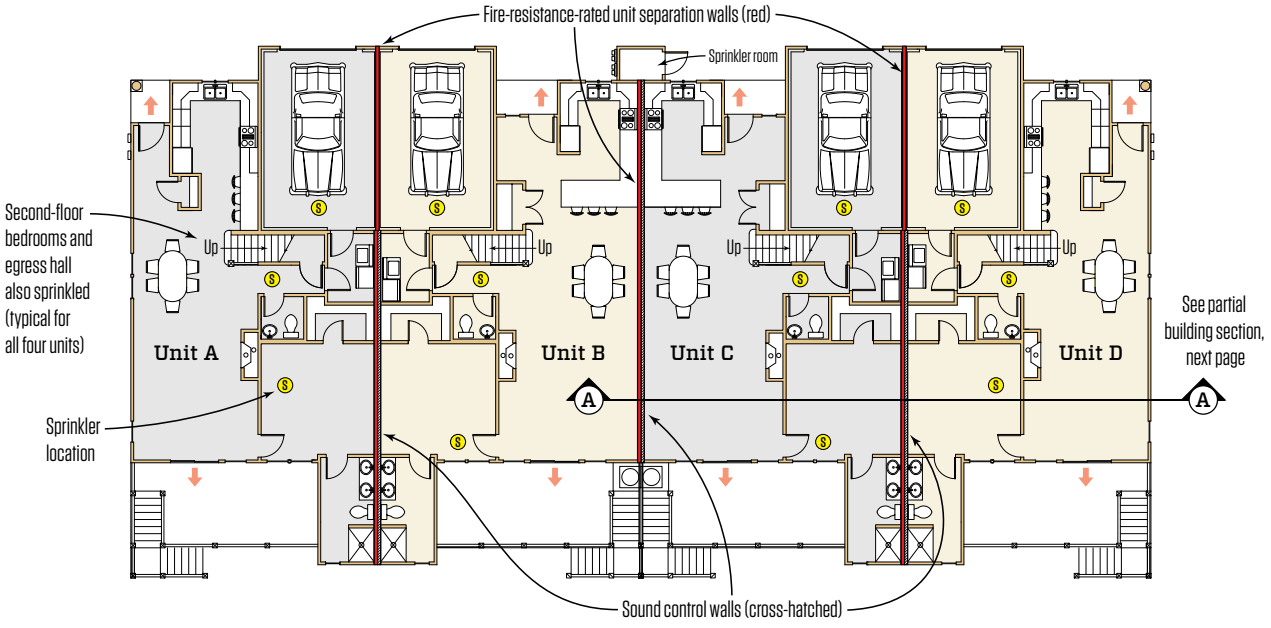
As the builder, if you see a plan with any of those situations, you need to get clarification from the designer right away. Even if the architect supplies a well-drawn detail, the builder will have increased costs and complications. And you definitely don't want to get into construction and then figure out how to deal with complex fire separation requirements, because when the inspector shows up, you'll be tearing something apart.

THE SIMPLE SOLUTION

Keeping the design concepts simple makes it easy to stick with listed fire-rated assemblies that have been laboratory tested for fire performance. When I design a building plan requiring a fire-rated assembly, I always choose a fire-rated assembly that's listed by Underwriters Laboratory (UL). I call out the UL number in the plans, and then we build the assembly the way it was drawn in the UL catalog. This is for prudence; it's an iron-clad solution that can't be second-guessed. If you're a builder who's not the designer on a project, you shouldn't hesitate to ask the architect for a UL number for any fire-rated assemblies in the scope of work, for your own protection.

The wall sections shown on the facing page and at left are two versions of a typical unit separation wall for a wood-framed

Simple Unit Separation Walls



To preserve views for other buildings in the development, the author designed several four-unit townhouses (see floor plan, above) with sloping rooflines at the building ends. Roof and floor loads are borne by the fire-resistance-rated unit separation walls. Because the building has fire sprinklers (mandated by Massachusetts law), the wall separating the dwelling units needs only a one-hour fire rating. The wall is constructed with 2x4 studs, fiberglass batts, and 5/8-inch Type X drywall on both faces. Engineered wood ledgers support the floor framing running from wall to wall.

multifamily building with three or more units. (These are conceptual sketches, of course, not working drawings—as I said, in the real world, it's best to strictly follow the details of a UL-listed assembly.) The "Two-Hour Fire Rated Assembly" illustration (on page 32) consists of two 2x4 stud walls side by side (or back to back), with 5/8-inch gypsum wall board on both faces of each wall and fiberglass batts in the stud cavities. The section illustration on page 33 is a typical one-hour fire-rated wall sufficient for a sprinklered building—just a single stud wall with 5/8-inch gypsum board on both sides, and batts in the cavities.

The batts in these assemblies, by the way, may have been included for sound control rather than fire resistance. UL-listed fire-rated walls usually carry a Sound Transmission Class (STC) rating as well as a fire rating. Regardless of that, I always include the batts in the actual wall in order to conform with the specification.

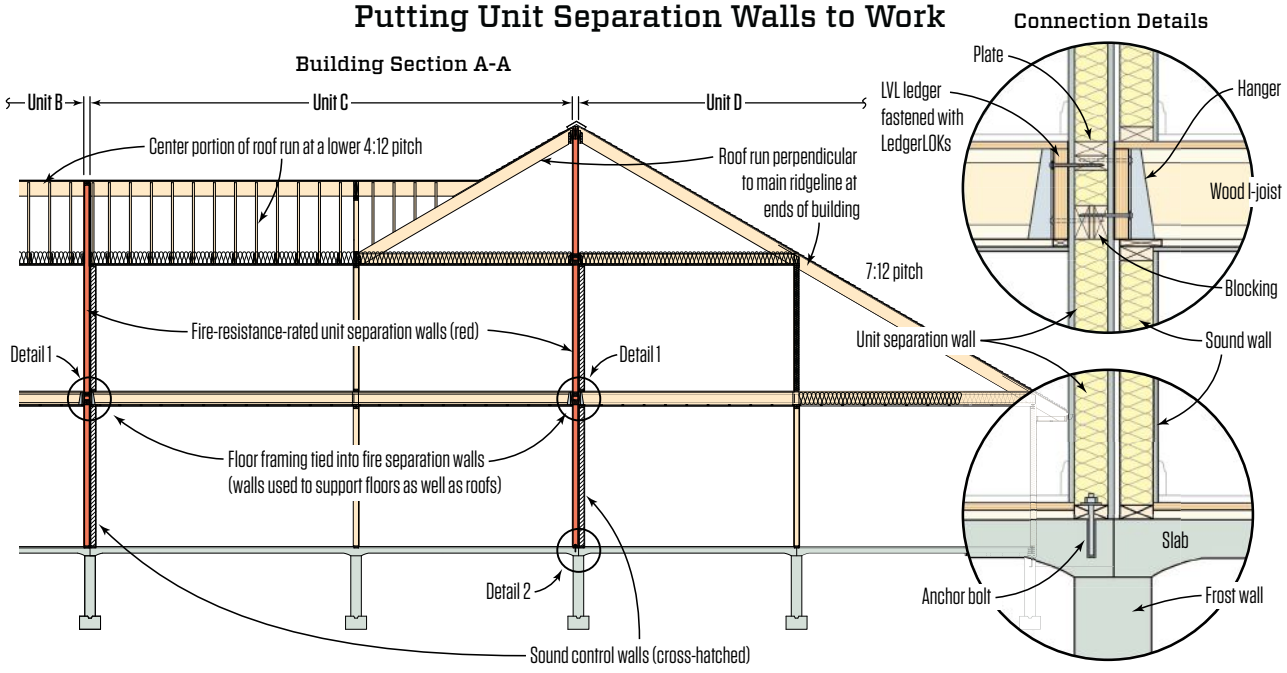
As required by code, the fire-rated walls are continuous from the foundation sill all the way up to the underside of the roof sheathing, and there's a continuous plate (or a line of solid blocking) at all floor levels.

In a typical scenario, the fire-rated separation walls don't do anything but provide fire and sound separation between the apartments or condo units in a building. They're not supporting the floor or roof system, and they're not handling any lateral load (that is, they're not shear walls, or "braced wall lines" as defined in the IRC). The floor framing for the building runs parallel to the fire separation wall, and it bears on the front and back walls of the building. This is the simplest and most economical way to build fire separation walls.

The floor is typically supported at mid-span locations by partition walls and girders. To stay on the safe side, I always design those mid-span girders and their supporting posts to be independent from the fire-rated wall, not buried into it.

I've seen cases where a builder has used posts framed into the fire-rated wall to support floor girders pocketed into the wall. To maintain the fire protection, they line the girder pocket with the same gypsum board used to cover the wall.

Your building official may allow it, but I wouldn't advise it, because if the floor were to collapse in an actual fire, the falling girder could tear a hole in the fire-rated wall and allow fire through into the unit next door. Recessing the beam end into the unit separation wall could also be considered a deviation from the UL specification for the fire-rated assembly.



Here's a section view of the same four-family building shown in the plan view on the facing page. The unit separation walls support gable roof framing that allows a "view triangle" between buildings for the units behind them and further up the hill, away from the water. Joist hangers attached to LVL ledgers lagged into the wall from each side support the wood I-joist floor framing. The weight of floors and roofs reduces the hold-down requirements for the unit separation walls (which function as shear walls in this design, resisting the high coastal wind loads).

WORKING WALLS

Properly detailed, however, a fire partition wall can be used for floor or roof bearing. A substantial fire separation wall in light wood-frame construction is typically beefy enough to be useful as a bearing wall. So, even though it's more complicated to build, I sometimes use the fire-rated wall between units to handle jobs in addition to fire separation. The illustrations above and on the facing page show an example where we built a unit separation wall to carry floor and roof loads, in order to help meet the design objectives of the project.

This building was sited in a coastal location with a 110-mph design wind speed, so it needed shear walls. The unit separation walls were about 60 feet long with no openings, so they supplied a lot of bracing. In fact, they had enough shear capacity to manage the wind loads without plywood, based only on the lesser shear capacity of the gypsum board.

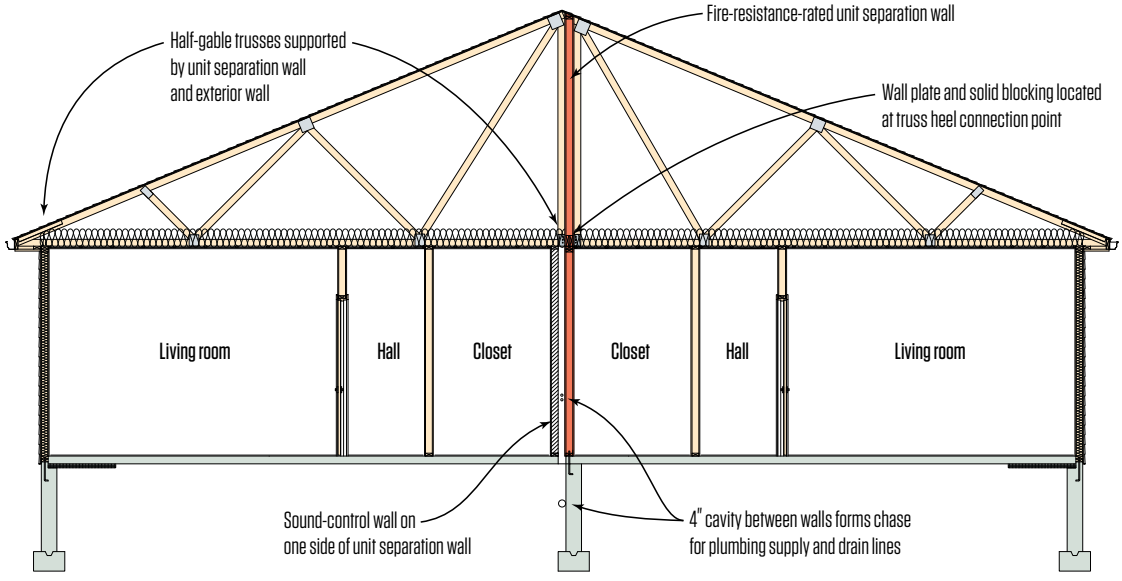
As is typical with a waterfront building, views were also a consideration. This building was one of eighteen on the site. Five were sited right on the waterfront, and the rest were positioned further back and a bit uphill. My concern was that the buildings closer to the water not block the view from the others on the site.

The design shown here is for the buildings that were closer to the water. If we had built a typical townhouse configuration, with trusses parallel to the unit separation wall, the ridgeline would have blocked the view from the buildings uphill. So instead, we stick-framed the end roofs at a 7/12 pitch with sloping gables perpendicular to the main ridgeline, facing the water, so the roofs for the units at the ends of the buildings formed a "view triangle" between the ends of the buildings. The center portions of the roof, over the two center units, were stick-framed at a lower 4/12 pitch. The low rooflines and the end gables allow residents of the uphill buildings to enjoy good views of the water.

Floor support. We also tied the floor systems into the unit separation walls, using those walls to support floors as well as roofs. This connected the floor diaphragms to the shear walls. Besides that, the weight of the floors and roofs partially counteracted the uplift forces on the shear wall that develop out of the wind load. That meant we didn't have to install expensive hold-downs in the shear wall—we could just use conventional anchor bolts.

The section drawing above shows the connection details where the floors tie into the fire separation wall. The wall needs to run continuously from the foundation to the underside of the roof

A Two-Family Solution



Duplex houses require only a one-hour fire-resistance rating in the wall separating the two units. In this example, because of the shape of the building lot, the author chose to run the unit separation wall down the length of the building. The wall was framed from slab to ridgeline, and supported a roof frame constructed with half-gable trusses. Following a UL-certified fire-rated assembly specification, the wall was framed with 2x4 studs and 5/8-inch Type X gypsum board on both faces. A second wall, framed from the slab to the ceiling in just one unit, provided enhanced sound control.

sheathing, protected by gypsum board the whole way. To carry the floor system, we attached engineered-wood ledger boards to the wall, fastening the ledgers to the walls with FastenMaster LedgerLok screws.

I have to perform a load calculation on the screws in this application, because there's a capacity reduction for the fasteners associated with the gypsum board that falls between the structural ledger and the framed wall. In principle, that gypsum board has no capacity to support the screw—so the screw is in effect cantilevering through the 5/8-inch thickness of the gypsum board, and it takes more screws to do the job than it would if they were applied through solid wood.

Sound-control walls. In the four-family building illustrated on pages 34 and 35, there are two walls dividing each pair of units—one that's continuous from foundation to roof sheathing, and one that only runs from floor to ceiling in each story. The second, shorter walls are there for sound control. Sound transmission can kill a multifamily project; if people can hear their neighbors through a common wall, they are not going to buy that unit—or they are going to be very unhappy. The second wall helps to dampen any sound.

Code allows ductwork, plumbing, and wiring to be located in fire partitions, but the requirements for specialized components and the restrictions on the location of penetrations get complicated (the rules are in Chapter 7, "Fire and Smoke Protection Features," of the IBC).

I like to avoid putting anything like that in these walls. But the walls do need electrical outlets—and even if they're installed in compliance with Chapter 7 of the code, outlets in common walls between rooms are a typical way for sound to get through a wall. By providing two back-to-back walls between the neighbors, we create separated wall cavities so that the receptacles don't create a connected path for sound.

The shorter walls in the four-family solution aren't necessary to support the floors, and the gypsum board on one face doesn't contribute any significant bracing. But it's easy enough to frame up a second wall, and it's well worth it for sound control. This extra wall also adds an extra layer of fire protection in the event of a fire, increasing the amount of time firefighters or sprinklers would have to suppress a fire before it spread to the unit next door. It's not a factor in code compliance, and it's nothing you could document, but it adds generally to the quality of the building.

The author's crew frames a duplex building with units arranged back-to-back (see illustration, facing page). Working from a rolling scaffold on the floor slab, the crew first attaches 5/8-inch Type X gypsum board to the unit separation stud wall (above left), then sets trusses for the roof (above right).

BACKBONE FOR A DUPLEX

By code, even a one-story duplex house needs a one-hour fire-rated separation wall between the two halves of the house. Usually that's a very simple structure to build. In a conventional side-by-side flat duplex, you simply frame a stud wall and set a pair of gable end trusses on top of it. It's easy to attach 5/8-inch Type X gypsum board to both faces of that wall and the trusses to achieve your one-hour rating. Then the trusses for the two halves of the flat—the two ends of the building—just span from the front wall to the back wall of the structure.

But in the example I show here, we were limited by the narrow dimensions of the lots. So instead of dividing the houses crosswise to the ridge, like a typical one-level duplex, we split them back to back down the spine of the building.

This made the process of framing more complicated. The fire separation wall had to continue up to the ridge of the building. So the crew had to frame the stud wall all the way to the ridge, brace the wall off, apply gypsum board, and then set roof trusses against the wall.

In the photos above (and also on page 31), my crew is at work on a rolling scaffold. Working their way along the wall, they hang the 5/8-inch Type X drywall from floor to ridge, and tape all the seams and screws. Then they set their trusses, move the staging, and start the next section of wall. We built these houses in 2001. If I were to build them again, I might do things very differently; but the principles haven't changed.

Like the previous four-family example, this fire-rated separation wall is just a single stud wall. But as in that case, we built a second wall on one side of it for purposes of soundproofing. The floor plan was also laid out with sound in mind: Along the common wall are hallways, utility rooms, closets, and baths (rooms that don't need a view). This helps to further isolate the main living spaces in each unit from sounds generated in the adjacent unit. At the same time, this layout affords all the main living areas a good view of the outdoors.

Details that block fire and smoke also help to prevent sound transmission. One of the ways I know that we did a good job on this fire separation wall is that we haven't had one noise complaint from the occupants of these buildings, 15 years later.

Architect and builder Andrew P. DiGiammo owns and operates Residential and Commercial Master Builders of New England, based in Assonet, Mass.

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Fiberglassing an Exterior Deck

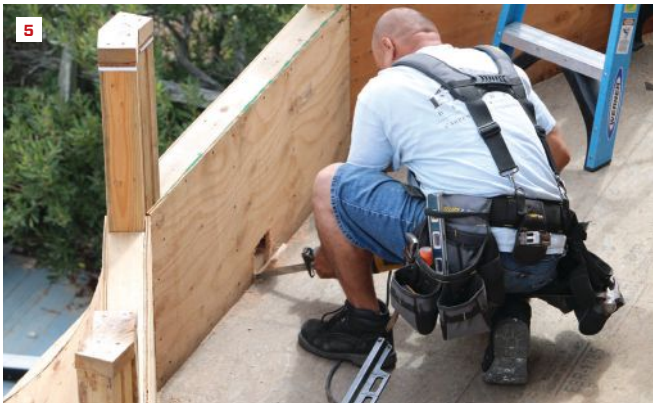
An easy-to-install weatherproof deck surface that you can walk on

BY NATHANIEL ELDON

Photos by Nathaniel Eldon

Fiberglass is a common material for decks in my region of coastal New Jersey, especially when the deck is installed over living space, or when the client wants a porch roof that provides maximum protection from the weather. But when I talk to builders from other parts of the country, I find that this practice is almost unknown beyond the Jersey shore.

Fiberglass decks would easily work elsewhere, though. As with most fiberglass work, the process is messy, but straightforward. The materials are readily available because many of them are also used in boat building and boat repair, a local industry for any area that has access to recreational or commercial boating. And the detailing of the sub-surface is not much different from that for an EPDM membrane or other flat roofing material. The deck in this project was a porch roof with parapet walls.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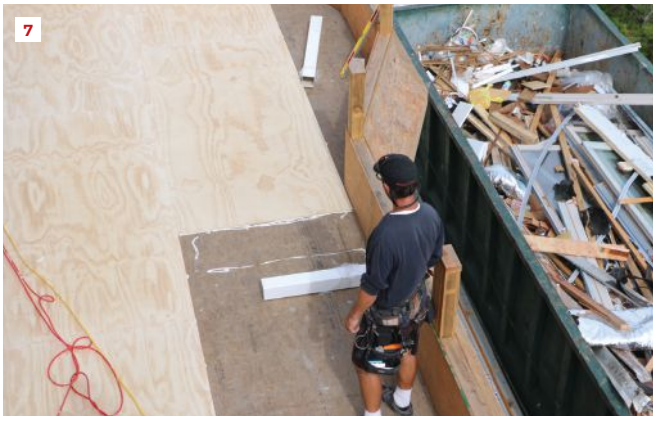
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BEGIN WITH A GOOD FRAME

A good product needs good bones. I sized and spaced the beams and posts as I would for any traditional deck design. I sized the joists in a similar fashion, while taking into account that the joists had to taper to pitch the deck surface enough to shed water off; a slope of ¼ inch per foot is optimal. To create the taper, we stacked the joists on sawhorses and snapped a chalk line across each joist's crowned edge **(1)**. Once the lines were all snapped, a crew member ripped all of the tapers with a circular saw **(2)**.

The deck for this project was more complex than most. It consisted of three sections that stretched across the front of the house. The two end sections were framed with a dropped beam, with the joists landing on top of the beam and extending past it. The center section had a flush beam, with the joists hung off the side of the beam and the tops of the joists flush with the top of the beam **(3)**. The pitch of the floors was the same across all the sections, and the floor surface was flat and unbroken. Additional complications were that the end sections would be faceted where they overhung the porch below, and a parapet would run around the entire perimeter of the deck and act as a base for the railing.

Once the framing was completed, it was time to prepare the horizontal surfaces of the deck. Although this project was a renovation, we treated the deck the same way that we would new construction, gluing and nailing ¾-inch AdvanTech T&G subfloor to the sloped joists **(4)**.

The parapet walls were next, along with the framing for the overhang details. We framed the parapet walls with 2x4s, letting the framing extend up at each corner and facet to create posts, then we sheathed the walls with ½-inch CDX plywood.

To allow water to drain from the deck surface, we cut holes for scuppers into the sheathed parapet walls **(5)**. The actual scuppers are made from 4x4 square vinyl sleeves (the same ones used to cover posts in the railing and fencing industry). These sleeves are set flush with the inside of the parapet wall sheathing and rest on top of the subfloor. We set the scuppers at a slightly increased pitch and let them extend through the parapet wall just beyond the edge of the roofing **(6)**.

At this point, we started closely watching the weather forecast. It is critical to the process that we have dry weather for a couple of days in a row.


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DAY ONE

Once we could see a weather window, we scheduled our fiberglassing contractor, Brian Scheeler, with Atlantic Shores Fiberglass. We needed the better part of a day to prepare for his arrival. We first put down an underlayment layer of ½-inch AC plywood on top of the subfloor with the sanded side up, staggering the joints of the plywood between courses **(7)**. We glued down the AC plywood with construction adhesive and nailed it into the joists through the subfloor using ring-shanked nails.

Next, we milled 1½-inch-by-1½-inch cant strips by ripping 2-by material at a 45-degree angle. Fastened along the corner where the flat deck and any of the vertical walls (house and parapet) intersected **(8)**, the cant strips ease the 90-degree bend for the fiberglass mat that will eventually cover the deck, softening the transition and preventing voids from forming between the mat and the layers below.

We paid close attention to the detailing of the tops of the parapet walls. They were to be fiberglassed, but for added protection, we ran aluminum coil stock along the top of the parapets, inside and out **(9)**.

After the fiberglassing was complete, we would tuck felt paper under the coil stock on the inside. On the outside, we'd run adhesive-backed membrane up and under the aluminum before applying the exterior finishes.

BRING ON THE FIBERGLASS

Once we'd completed the preparation details, the fiberglass contractor could begin his work. For those who aren't familiar with fiberglass, you should know that it tends to be nasty stuff in many regards. To avoid skin contact with the fiberglass resin and catalyst, it's always a good idea to wear gloves. And to avoid breathing the vapors of fiberglass resin, wear a respirator with an organic vapor cartridge, especially when working in tight, confined spaces. Because Brian was working a stone's throw from the ocean with its steady prevailing winds, he opted not to use a respirator when he did this project.

Fiberglass (polyester) resin and catalyst are also highly combustible and should always be treated with extreme care.

The fiberglass resin and the gelcoat (finish coat) that we use on these decks are a two-part mix. These materials are mixed with a


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hardener or catalyst. When a catalyst is added to the polyester resin, an exothermic reaction occurs, producing heat and curing the fiberglass. Typically, 1.5 to 2 ounces of hardener are used for each gallon of resin, but that is only a general guideline. The ratio can vary with air temperature and humidity, and it takes a little practice to know how much catalyst to add to a mixture in various weather conditions. When too much hardener is added, the mixture can become so hot that it starts smoking—and it will burn your skin if you touch it. I wouldn't jump into this type of work without some experience mixing and applying fiberglass.

Before mixing anything, Brian used a rotary grinder outfitted with an abrasive disc to soften and clean up any sharp or rough plywood edges **(10)**. Then he mixed up a batch of polyester putty—similar to auto-body filler—and covered the nail holes as well as the plywood joints **(11)**. He also puttied around the scuppers, filling in any gaps between the sleeves and the plywood.

The next step was "hot coating" all the deck surfaces by applying resin with a thick-nap paint roller. Working with fiberglass calls for many single-use tools—once the resin cures, paint rollers and brushes become rock hard. So Brian uses disposable products: cheap paint rollers, disposable paintbrushes, and 5-gallon-bucket liners. For detail work, he also uses plastic or aluminum rollers that are reusable and that are made specifically for fiberglass work. These tools can be cleaned with acetone before the resin cures, but it's challenging and the fumes are dangerous.

Working from the top down, Brian began by coating the top surface of the parapet walls, rolling the resin 8 inches to 10 inches up each post **(12)**. At the base of the parapet walls, he rolled the resin over the cant strip and up the walls about 10 inches **(13)**.

On some projects that he's worked on with us, he has applied a strip of the fiberglass mat along the transition between the deck and the walls at the hot-coating stage—the mat strips help to reinforce and ease the transition between the horizontal and vertical surfaces. He skipped that step with this project, opting to extend the mat up the walls at the next step, on the second day.

At the thresholds of the doors leading onto the deck, he applied resin up the framing and sheathing. Finally, he put a liberal coat of resin over the entire flat surface of the deck. It should also be noted that Brian mixes only a little resin at a time. The working time of mixed resin is limited and a large volume of material will usually

"kick" more quickly. Smaller batches ensure that the resin does not begin curing before it is applied.

Once the hot-coat resin cures, the deck is temporarily sealed. A rainstorm would not be ideal, but it wouldn't ruin the project, at this stage.

DAY TWO

On the second day, Brian started by grinding all the hot-coated surfaces, again using a small grinder fitted with an abrasive disc. This process removes irregularities and abrades the surface for the next coat. When finished, he blew the dust off the deck with an electric leaf blower.

Next, he laid out 1.5-ounce chopped fiberglass mat over the deck surface. He let the mat extend up the parapet walls about 6 inches and lapped it about 4 inches into the scuppers **(14)**. He used smaller scraps to complete the mat layer around the scuppers, both inside the parapet walls and where the scuppers exited on the outside.

He cut strips of mat about a foot wide for the tops of the parapet walls and let the strips extend up a few inches at each post and down the sides of the parapet, overlapping onto the coil stock. At the door thresholds, we added temporary dam strips to protect the floors inside. Brian ran the mat up onto the dam strips, again adding small strips to complete the corners of the mat layer. At the seams in the field, the mat sections overlapped by 4 inches to 5 inches.

When all the pieces were cut, Brian began soaking the mat with the mixed resin, starting with the tops of the parapet walls **(15)**. For the larger surfaces, he again used a disposable paint roller. For tighter details like inside corners, he soaked the resin into the mat with a disposable brush **(16)**. When completely soaked with resin, the mat becomes transparent.

After finishing the tops of the parapet walls, he turned his attention to the door thresholds. This time he used a specialty roller to push the resin into the mat **(17)**. The roller also helps to work out any voids or air bubbles under the mat.

Next, Brian worked on the base of the parapet walls, using a paint roller to soak the resin into the mat where it extended up the walls **(18)**. Finally, he poured resin over the main surface of the floor and pushed it around with a paint roller until the entire mat was saturated and transparent **(19)**.


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DAY THREE

Once the fiberglass-impregnated mat has cured (usually within a few hours), the deck surface is virtually watertight—think of the hull of a fiberglass boat. The horizontal surfaces are completely sealed, and the sealed surface extends up the vertical surfaces as well. But fiberglass boat hulls are smooth and opaque. The main task on the third day is applying the gelcoat, the protective finish that also protects the fiberglass from UV degradation.

The first step was to grind all the surfaces once again to roughen the surface and to smooth out any unevenness in the mat **(20)**. As before, Brian used a grinder with an abrasive disc, and he blew off the dust with a leaf blower.

When the surface was abraded and dust-free, he applied the fiberglass gelcoat to the surface, beginning with the detail areas such as thresholds. The gelcoat is a two-part product that has the consistency of paint. Brian used a disposable paintbrush to make sure that all the nooks and crannies received a liberal layer of the gelcoat **(21)**.

As with the resin layers, Brian used a paint roller to coat the tops of the parapet walls and the transition between the inside parapet walls and the horizontal deck surface **(22)**. Then he rolled the main deck surface and his job was done **(23)**.

We waited overnight for the gelcoat to fully cure before we finished the carpentry details. At the door thresholds, we removed the temporary dam strips and cut the rough, turned-up edge of the fiberglass flush with the top of the finished flooring inside the house. The fiberglass on the thresholds and jambs acts as solid pans, eliminating the need for additional flashing pans under the doors.

The parapets on this project were finished with white cedar shingles on both sides. We covered the tops with minimal flashing and then we glued down an Azek board as the cap.

For many decks we've built, the gelcoat over the fiberglass mat is the final surface. Once it cures, it can be walked on and used long term; it makes a nice, hard surface underfoot and is resistant to scratching and scuffing. For clients who don't like the look or feel of the fiberglass, we glue pressure-treated wood sleepers to the fiberglass and then install wood or composite decking.

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

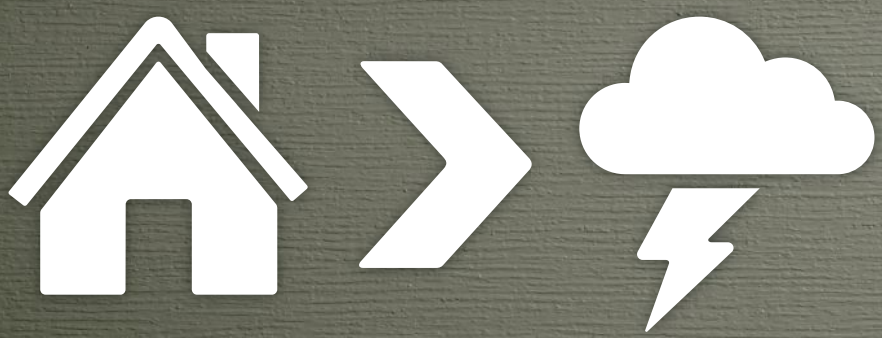

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Photo: Chris Ulster

Ten Common Code Violations

Pay close attention to these to avoid failing inspections

BY CHARLES WARDELL

About 45% of residential field inspections result in a code violation. That's according to the Common Code Violations survey released in 2013 by the International Code Council (ICC) and the National Association of Homebuilders (NAHB). Researchers polled code officials across the U.S. about the items most likely to be flagged during construction.

The survey found overall compliance improving. Although inspectors are flagging a few specific items—most notably foundation anchor bolts, guardrails, and stairs—more often than in the past, in general they reported far fewer failed inspections than in a similar survey published in 2006.

Competitive pressures have certainly contributed to that improvement; failed inspections and re-do's cost time and money. But state-mandated contractor training has also played a role. "The educational requirements for licensing have helped a lot," Vaughn Wicker, ICC's vice president of government relations, said. "A lot of states now require training to get or keep a license, so builders in general have better code knowledge than in the past."

But even though things are getting better, 45% is still a big number, leaving plenty of room for improvement. With that in mind, *JLC* looked at published lists of the top code violations from various municipalities across the country and contacted building inspectors to find out what items have been giving builders the most trouble. Our findings confirmed those of the ICC and NAHB researchers.

Here is a list of the most common reasons that a builder or remodeler will fail inspection. Paying extra attention to them should make for fewer items that need correction.

MISSING DOCUMENTATION

The most common reason a builder fails an inspection is the simplest (and least expensive) to remedy: not having all the required documents on site. This was at the top of nearly every municipal list we looked at and cited by every code official we contacted.

"The first thing I look for is the documentation," Glenn Mathewson, a Westminster, Colo. building official and a regular *JLC* contributor, said. "If I show up and they don't have the plans I need for that inspection, then there's no hope of passing." In his city, that includes an engineer's foundation letter, the structural plans, the truss drawings, the plan for the HVAC ductwork and gas piping, and the energy code documentations. These documents will, of course, vary by jurisdiction, but it's up to the builder to know what they are and to have them available.

Darryl Byle, a former building inspector and structural engineer from Kalispell, Mont., said that his city came up with a quick fix for the problem: The building department decided to put a stop work order on any project where the drawings weren't on site. "That got the drawings on site pretty fast," he said.

IMPROPERLY PLACED ANCHOR BOLTS

When it comes to footings and foundations, we expected the biggest offense to be improper rebar placement. We were wrong.

Although some inspectors mentioned rebar, the error everyone cited was surprising: missing or improperly placed foundation anchor bolts. The ICC study also listed this as one of the violations that's become more widespread, though it's not clear why.

A common mistake Byle sees is bolt locations that don't work with the mudsill joints. "You need a bolt on each side of every joint on the sill," he said (see "Anchor Bolt Placement," right). "But a lot of concrete guys just put bolts every 6 feet, rather than asking the framer where the joints will be." The problem could obviously be avoided by better coordination between the framing crews and the concrete crews. Mathewson pointed out that anchor bolts are a lot harder to fix than some other problems, so it's worth the effort to get them right the first time.

It's worth noting, too, that the 2015 IRC now requires the anchor bolts to be placed in the middle third of the width of a foundation plate. This complicates bolt placement even further. For a 2x4 plate, that means you've only got about 1 3⁄16 inches of tolerance to get it in the right spot.

BRACED WALL ERRORS

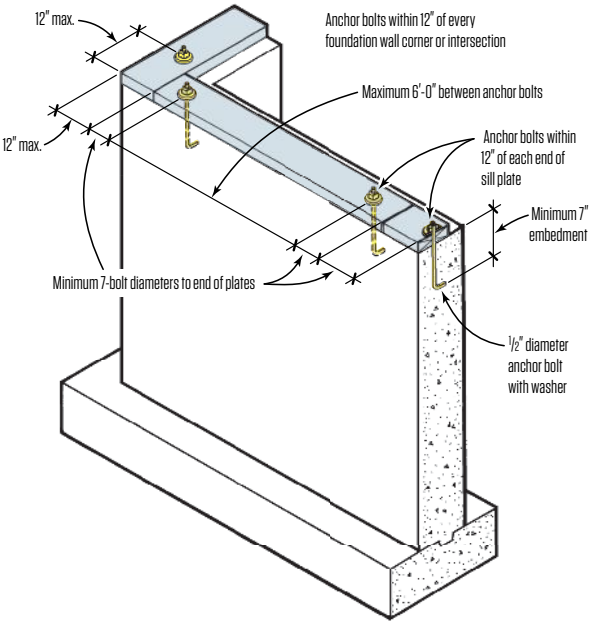
Code-mandated braced-wall requirements can be a head-scratcher for someone encountering them for the first time. "The requirements are new to a lot of builders and a lot of them are still climbing the learning curve," Shapiro said. (See "Bracing Walls for Wind," Jul/13.) But even when the bracing requirements are spelled out clearly on the plans, it's the little details that often escape framers. The most common oversight Shapiro finds is missing blocking for braced wall panels. Code requires nailing along all panel edges, and that may require blocking between studs on tall walls or when panels are run horizontally. Fortunately, blocking is usually easy to add.

The problem Mathewson sees most often—overdriven nails in bracing panels—can take a bit more work to correct. "If you overdrive a nail, you can reduce the strength of a 7⁄16-inch panel to that of a 3⁄8-inch or 1⁄4-inch panel," he said. (As an aside, he pointed out that this is a problem with nailing off hangers as well. Overdriving a nail dimples the steel, causing it to lose strength.)

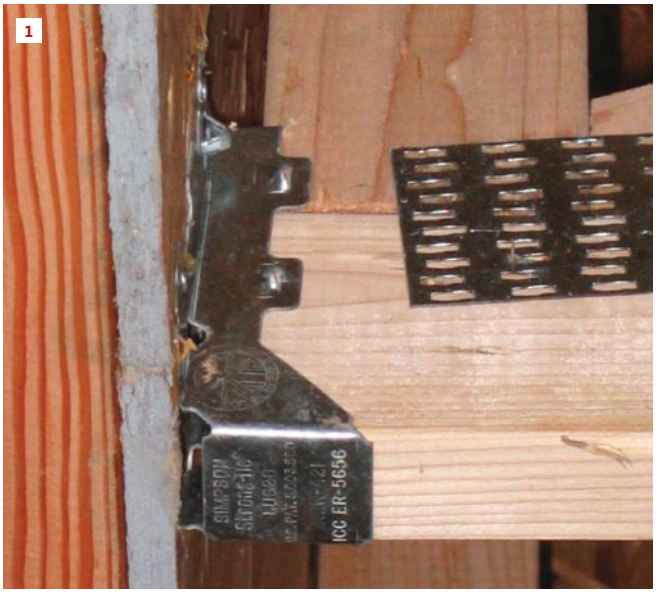
WEAKENED JOISTS AND BEAMS

Inspectors see a lot of beams that aren't sized for the load or that lack proper bearing. This is more common in remodels than in new construction. It often comes up when a contractor cuts through an exterior wall to add a sliding door or removes an interior bearing wall to create a more open living space. "If it's a load-bearing wall, they often think they can just open it up and throw in a double 2x8," Mathewson said. "But you need to do a structural analysis to

Anchor Bolt Placement



Given the anchor-bolt requirements (these conform to the 2012 IRC), it's often easier to use epoxy anchors. J-bolts require coordination between framing and concrete crews.



The gap at the end of the floor truss is a tell-tale sign of a framing violation. Any truss or joist must have full bearing on the hanger seat. This hanger may be undersized, as well, for the size floor truss it supports.

Racking resistance is a structural key to a deck that will resist failure over time. This photo shows an effective way to brace deck posts. Running the diagonals in both directions provides much-needed racking resistance.

to determine how much load the beam will need to support, especially if there are floors above." He also pointed out that newer homes have more complicated load paths. "You really need to pay attention before you start poking holes in the structure."

One of the biggest problems Mathewson sees is gaps at the ends of joists or trusses supported by hangers **(1)**. It doesn't take much: Gaps can be caused by a girder truss that's slightly crooked or out of plumb, making the time required to use a string line and level well spent.

Manufacturers of structural hangers usually specify a maximum gap of ⅛ inch between the end of the joist and the girder. Anything bigger will put moment arm on the hanger and drastically reduce its load capacity. When hangers are double-shear nailed (toenailed), large gaps leave the nails completely missing the carried member. "People get upset over this because they think I'm being punitive," he said. "It's not me, it's the manufacturer's load requirements."

DECK LEDGERS AND BRACES

Byle isn't far from Polson, Mont., where a 2004 deck collapse at a casino injured 52 people after the connection between the deck and the building failed. The culprits included hangers that were too small for the joists, improper fastening, and inadequate flashing that set the ledger up for rot.

Despite more attention paid to decks, including the requirement in some jurisdictions for lateral connectors, he and other inspectors still see lots of issues with deck connections. On retrofits, he often recommends that the contractor build a freestanding deck with the deck frame an inch or so away from the house and the structure independently supported on posts . This eliminates the difficulty of properly flashing and fastening the ledger to the house.

He also finds builders falling down on deck shear-bracing requirements. Typically, diagonal post bracing is required **(2)**. To further resist racking, builders can also use flat-framed 2-bys run diagonally on the underside of the joists . "Racking is a source of failure over time. If the deck isn't properly braced, fasteners will work loose," Byle said. He added that it doesn't take much: "Something as simple as kids running around and banging into rails can put stress on the fasteners."

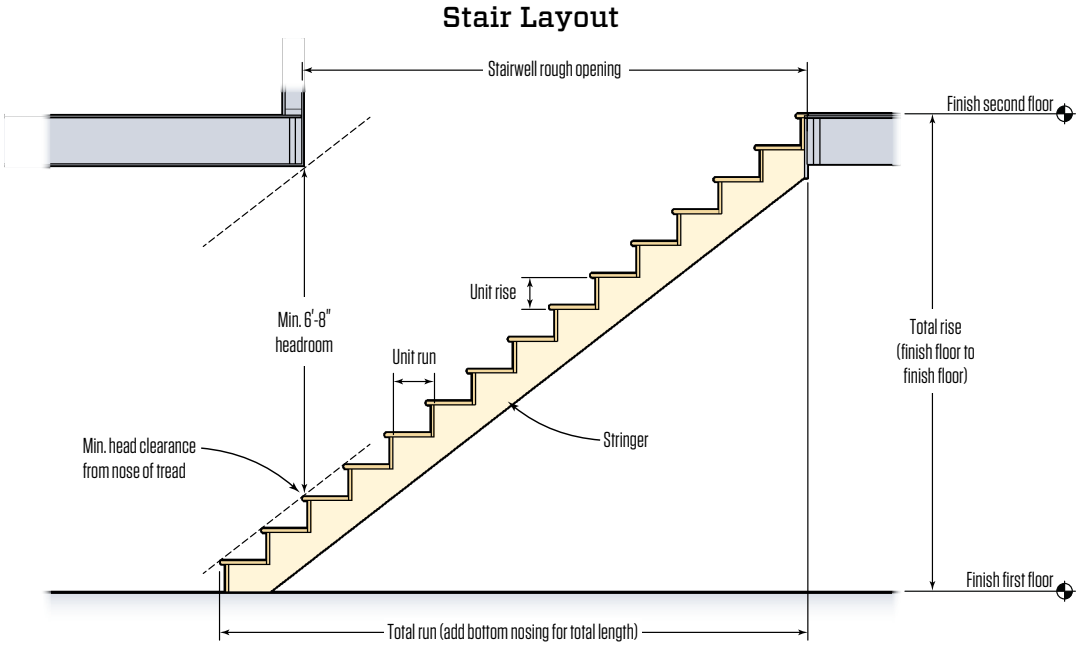
STAIR RISE/RUN ERRORS

Rise/run problems can arise where the builder doesn't have enough horizontal space for a planned stairway. Headroom is a limiting factor (see "Stair Layout," facing page), and Byle has seen a lot of builders try to squeeze the stairs in by simply pitching the stairway a little more steeply, resulting in a rise that may be too high or treads that are too narrow.

Another common problem Byle sees is that builders, who may get the correct riser heights and tread depths, often don't adjust for the added thickness of the flooring at the bottom. That leaves them with a bottom step that doesn't match the rest of the stairway.

In Hampton, Va., building official Steve Shapiro finds a lot of rise/

Photos: 1, Jim Mattison; 2, Jim Findlay



Headroom is often the limiting factor for a given stair opening. Building codes require a minimum 6 feet, 8 inches from the tread to the ceiling. Shortening the stairs only works if you can maintain tread and riser requirements. The steepest residential stairs allowed by code has 7 3/4-inch risers and 10-inch treads.

run errors on stairs leading up to porches from sidewalks. "I get the impression that people start at one end and work their way up or down," he said. "Then they end up with a top or bottom riser that's too short." Some builders may assume that the inspector will overlook this on an exterior stair, but Shapiro pointed out that the riser and tread requirements apply equally to the interior and exterior of a home.

Keep in mind that liability associated with stairs goes beyond inspection failure. Byle, who also works as an expert witness, said that stairs come up again and again in construction litigation cases: "If the stair isn't dimensioned correctly and someone falls, the jury is going to side against the contractor regardless of whether the stair actually caused the fall."

STAIR HANDRAILS AND GUARDRAILS

In some cases, stair handrails and guardrails are the wrong height as measured from the tread. By code, they must be a minimum of 34 inches, and no more than 38 inches high. In other cases, the connection to the stair isn't secure enough. The latter problem is often because the builder has skimped in the blocking needed to make a secure connection.

Another common oversight is at the return at the top and bottom of a handrail. The rail can't just end, but has to die back into the wall or post, or terminate in a manner the code calls a safety terminal. Otherwise, the end of the railing could catch on things like pants pockets or purse straps, causing a fall. The terminal requirement is relatively new to residential construction but has long been a feature in commercial buildings, where it's meant to protect firefighters in stairwells. "There were cases where a firefighter was running up a stairway with a hose and the hose got caught on the end of a handrail, pulling the firefighter down," Mathewson said.

Fortunately, stair manufacturers now make a variety of volutes and other termination pieces that make this requirement a lot easier to meet than in the past.

MISSING OR INADEQUATE FIRE BLOCKING

Fire blocking must be installed at code-mandated locations in concealed cavities (see "Typical Fireblocking Locations," next page). The blocking prevents these cavities from acting as draft chimneys, thus slowing the spread of flame and smoke during a fire. This delay buys the occupants time to get out of the house.

Fire blocking must cut off the concealed draft openings between

all vertical and horizontal cavities, essentially compartmentalizing the areas from each other. And because they're often obscured by complex elements such as soffits, they're not always obvious, making it easy for the framer to miss spots that need to be blocked. "In my field inspections, I find that a lot of people fall down on this," said Aaron Johnson, a Palm Beach County, Fla., fire inspector who runs a website called TheCodeCoach.com. He added that builders who understand what areas need to be blocked often use the wrong materials. "One of the most common mistakes I see is not using the proper [fire-rated] caulking," he said.

Of course as a fire inspector, Johnson would naturally look for blocking problems, but everyone else also cited it as one of the top reasons for inspection failure. "A day doesn't go by when I don't see a home with this issue," Mathewson said.

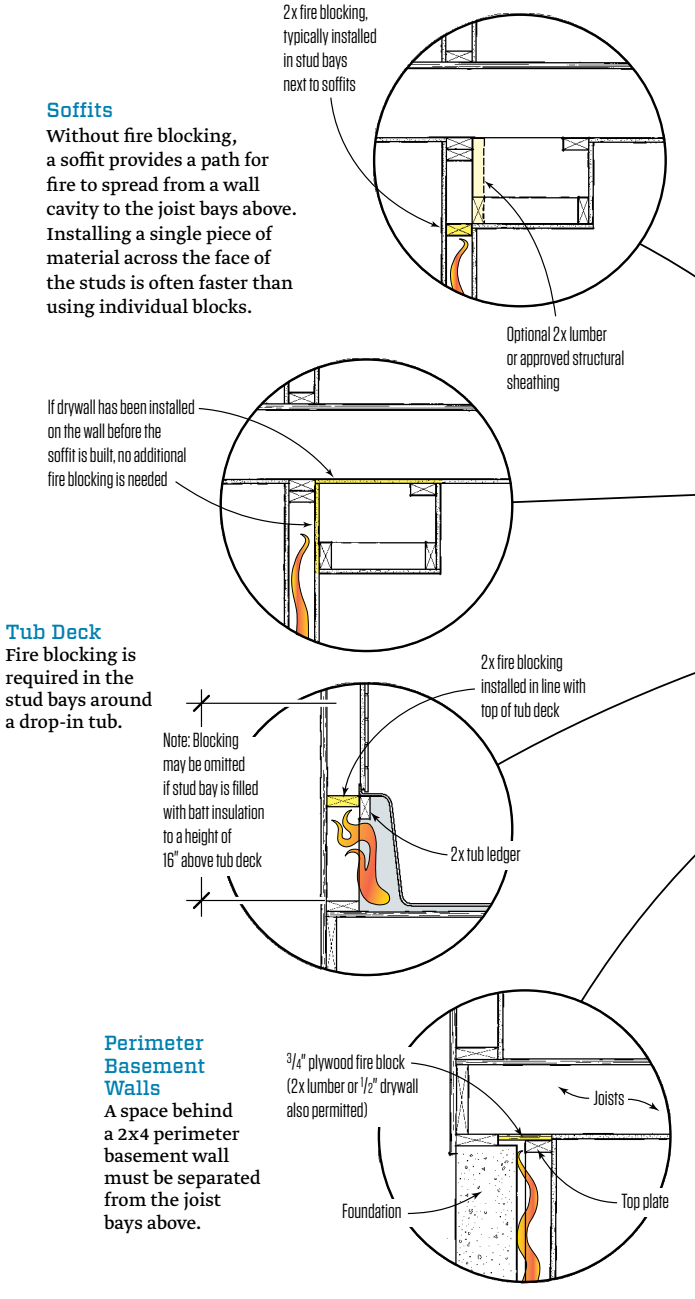
Often, a builder will use the right material but use it incorrectly, according to Mathewson. For instance, some foam sealants are rated for use as fire blocking, but can only be installed up to a maximum thickness, which they're often not. He also sees many cases where builders try to get away with 7⁄16-inch OSB as fire blocking, rather than the 23⁄32 inch required by code. They usually have to add a second layer.

AIR-BARRIER GAPS

With more jurisdictions adopting energy codes, air-barrier gaps have become an issue. As is the case with fire blocking, these are often in hidden spots, such as behind bump-outs for gas fireplaces. "In the old days, the fireplace was just a hole in the wall," Mathewson said. "Now you have to wrap the thermal envelope around the back of it."

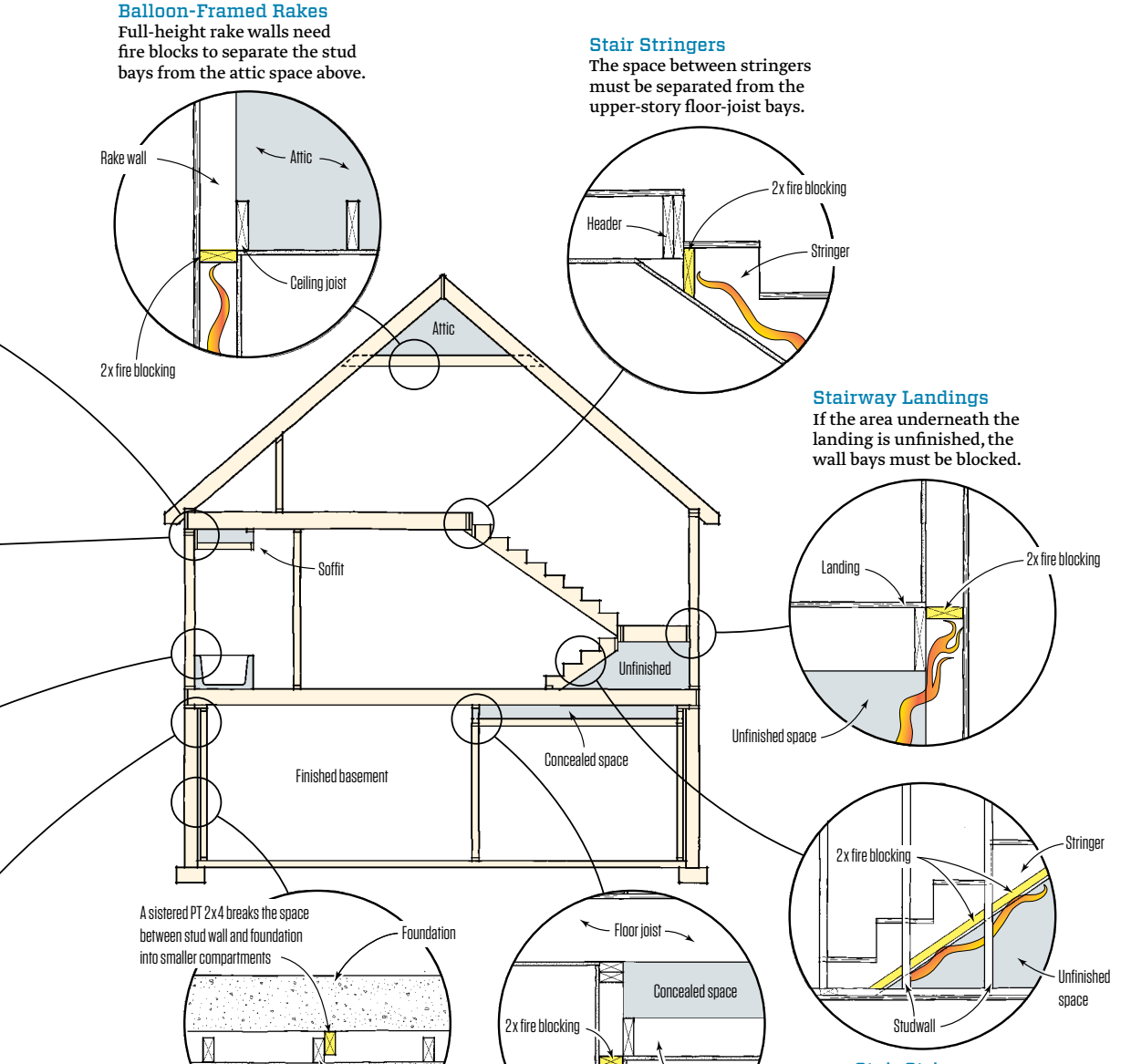
While IRC Section R302.11 does describe a few specific locations for fire blocking, to address all the required locations, it's key you understand the intent and purpose of fireblocking: "to cut off all concealed draft openings ... and to form an effective fire barrier between stories, and between a top story and the roof space."

Typical Fire-Blocking Locations



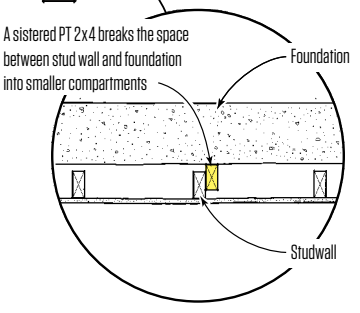
Balloon-Framed Rakes
Full-height rake walls need fire blocks to separate the stud bays from the attic space above.

Stair Stringers
The space between stringers must be separated from the upper-story floor-joist bays.

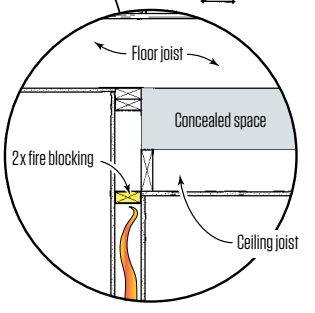


Stairway Landings
If the area underneath the landing is unfinished, the wall bays must be blocked.

Stair Stringers
If the area below the stair is unfinished, fire blocks are required in the stud bays alongside the stringer. If the area beneath is finished with minimum ½" drywall, this blocking is typically not required.

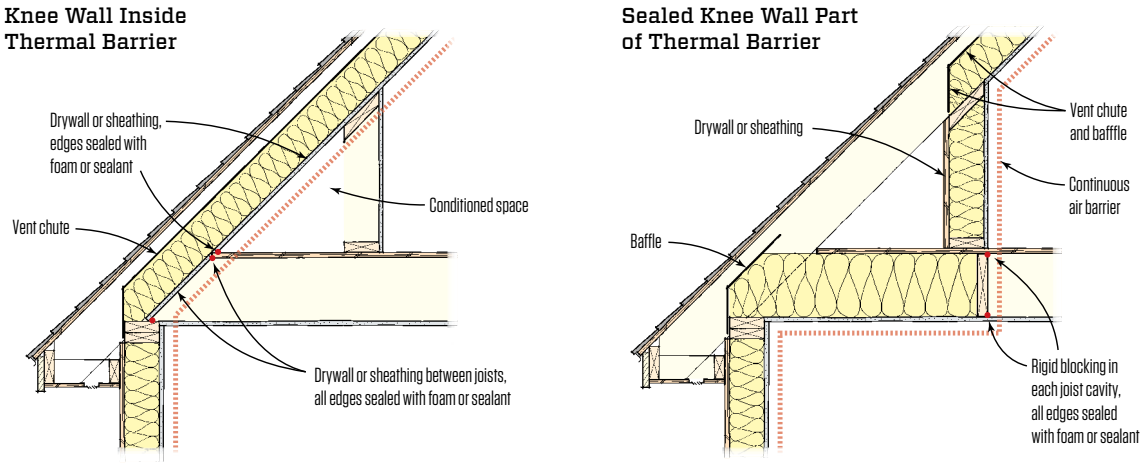


Concealed Spaces in Walls
When a wall is not drywalled or sheathed on both sides (which is typical of furred-out basement walls and double stud walls) there must be a full-height fire block every 10 feet horizontally.

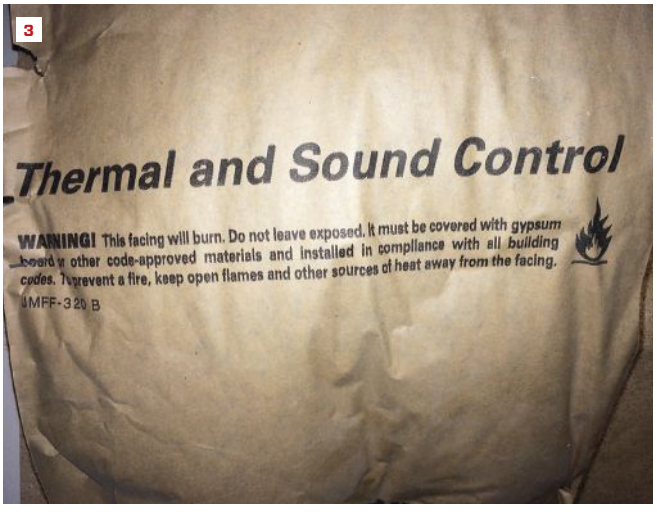


Dropped Ceilings
Dropped ceilings can be blocked in the same way as soffits.

Air-Sealing Knee Walls



Air-sealing needs to be part of the framing stage; it's not something that can be done as an afterthought. Knee walls are one of the framing locations where it's often done wrong. The best way to handle them is to move the thermal barrier to the roofline and stand up the knee walls after the ceiling has been drywalled. For production builders who may have less control in scheduling trade partners, the knee wall can serve as the thermal barrier, as long as sheathing is installed on the back side.



The warning label on paper-faced insulation batts clearly states: "This facing will burn ..." It cannot be left exposed but must be covered with drywall or other type of sheathing permitted by code. This applies in concealed framing cavities, in knee-wall areas (even if the knee-wall area is inaccessible) in attics, and in crawlspaces.

He also sees a lot of missing air barriers behind HVAC chases and attic knee walls. On a knee wall, this can be corrected by putting a rigid material like drywall, OSB, or Thermo-Ply on the back of the wall (see "Air-Sealing Knee Walls," above), but a lot of framers aren't doing it.

EXPOSED KRAFT-FACED INSULATION

Speaking of knee walls, the backing is more than an air barrier; it's also needed to cover kraft-faced insulation batts. These are often left exposed in knee-wall areas and in basements.

Big mistake. "You can't leave the paper exposed," Mathewson said. In fact you can't even leave a gap between it and the wall covering. "The paper is coated with a bituminous material and is highly flammable," he said. "You don't want airflow over the surface that could feed a fire." The label printed on the insulation clearly states that the facing will burn and that it must be contact with the wall or ceiling covering **(3)**.

That brings us back to the point we made at the beginning of this article: A lot of failed inspections could be avoided if builders actually read the manufacturers' instructions and the documentation provided with the building permit. The time saved by not doing so can cost a lot more time later. As Mathewson put it: "It's a lot easier to fix errors with a pencil than with a Sawzall or a sledgehammer."

Charles Wardell is a contributing editor to JLC.

Photo: Glenn Mathewson

TOP CODE VIOLATIONS

The Common Code Violations Survey, published by NAHB and ICC in 2013, asked building officials nationwide to rank violations in 16 different categories. The responses were too many to include here, so we have listed the top three in each category. They're in descending order, with the most common violation at the top. Use this as a checklist when preparing for an inspection or, better yet, download the report to see the full list for each category.

Grading and Site Drainage
- Erosion control measures not in place
- Grading
- Downspouts/ drainage controls

Foundation
- Improper reinforcement or support of rebar
- Standing water/mud in footing or on rebar
- Improper anchor bolts

Wall Framing
- Missing fire-blocking
- Stud cut or notched to an impermissible depth
- Missing hold-downs, straps, etc.

Floor Framing
- Notches in areas not permitted
- Missing anchor bolts
- Sheathing nails missing joist

Trusses
- Bracing not installed
- Improperly connected to wall plate
- Impermissible alteration leading to additional load

Roofing
- Missing nails or fasteners
- Over-driving of nails through shingles
- Absence of felt, or incorrect type

Window and Door
- Improper flashing
- Inadequate fire rating
- Improper door weather-stripping

Handrail
- Improper height or spacing
- Improper graspable surface
- Missing handrails

Guardrail
- Guardrail opening too large
- Height criteria not met
- Not properly fastened or installed

Stair
- Stair rise and run violations
- Stair headroom
- Improper stair construction

Plumbing
- Improper notching or boring of framing
- Missing or improper nail plates
- Pipes improperly supported

Mechanical
- Inadequate combustion air or makeup air
- Improper notching or boring of framing
- Inadequate clearance to combustibles

Electrical
- Grounding issue
- Labeling of circuits
- GFCI Protection

Energy
- Improper sealing of penetrations through exterior walls
- Improper duct sealing
- Improper installation of insulation around wiring and plumbing passing through stud cavity

Decks
- Improper or inadequate ledger connection to house
- Improper guardrail or handrail installation
- Deck does not conform to approved plans

Life Safety
- Failure to install correct glazing in required hazardous locations
- Inadequate egress
- Improper installation of smoke detectors

Source: Common Code Violations Survey, Feb 2013.

Habitat for Humanity®

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Our goal for June 6-10, 2016, is to build, renovate or repair 300 homes across the nation.

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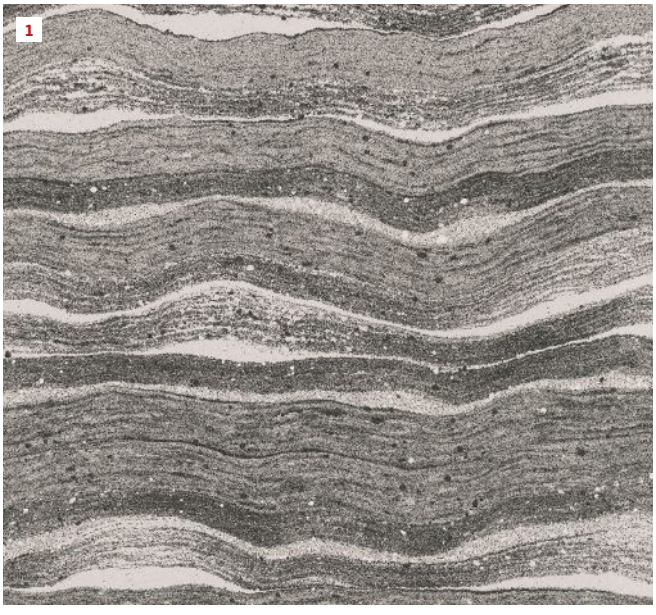
BY LAUREN HUNTER

1. Seascape

New to Cambria's Oceanic Collection of surfacing, bold Roxwell and Oakmoor patterns are infused through the thickness of each natural quartz slab. Roxwell (shown) has gray waves dappled with white, black, charcoal, and a touch of sparkle for the effect of surf on a beach. Oakmoor's muted cream, tan, and caramel tones with echoes of graining offer an aged driftwood look. Pricing will vary. cambriausa.com



2. Efficient Boiler

The CB Series Combination (Combi) Boilers from Noritz use high-efficiency condensing technology to deliver hot water to both plumbing and hydronic-heating applications. With 95% AFUE, the Energy Star–rated appliances can qualify for some state energy rebates. A flow-control valve delivers up to 9.2 gpm of domestic hot water at a consistent temperature, regardless of incoming water temperature. The CB Series also delivers water for space heating with radiators, baseboards, radiant systems, and air handlers. The compact, wall-hung package weighs just 90 pounds, allowing for space-efficient installation by one installer. Two models are available for different levels of demand. noritz.com

3. Anchors Away

Habito is CertainTeed's new high-density 1/2-inch wallboard that doesn't require threaded drywall anchors or nailing into wall studs for hanging fixtures up to 30 pounds. The material's strength also provides better impact resistance and sound insulation than traditional drywall. Available in spring 2016, Habito will work best for specific applications rather than for drywalling a whole house. A multi-room upgrade will cost $300 to $500 more than standard drywall. hellohabito.com

4. Stone Face

The Artistry Stone Masonry Veneers line from Oldcastle Architectural's Echelon brand now includes Kensley Stone Thin Veneer. With three colors that can be blended in the field, a traditional ashlar style, and a 3/8-inch mortar joint, Kensley blends an upscale limestone look with minimal installation time and cost. The lightweight, non-bearing stone veneer has higher compressive strength than similar products and is resistant to salt and freeze-thaw damage. Check with your dealer for pricing. echelonmasonry.com


5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5. Reflect on This

Addressing issues with darker siding colors, Mastic Home Exteriors by Ply Gem introduces "Solar-Defense Reflective Technology" to protect against fading and panel distortion. No painting or caulking is needed, and the material is backed by a "No Fade, No Distortion Promise" and a limited lifetime warranty. The SolarDefense line features five rich colors: red brick (shown), mahogany, brandy wood, natural slate, and Newport Bay blue. Check with your dealer for pricing. mastic.com

6. Lightweight Shear

Kett Tool's KD-1495 Fiber-Cement Shear helps promote a cleaner, healthier working environment. The handheld shear has durable steel blades and cuts fiber-cement siding and backerboard up to $^{5}/_{8}$ inch thick, while leaving behind virtually no airborne dust compared with cutting with a circular saw. Its 5-amp pistol grip, 2,500-rpm variable-speed electric motor cuts at speeds up to 26 inches per minute. The tool weighs just 4.5 pounds and has a cutting radius of 10 inches for maximum maneuverability. It's priced at $345. kett-tool.com

7. Smart Security

Yale's Linus lock operates on the "Works with Nest" program. Featuring reinforced hardware, bank-level encryption, and a keyless touchscreen, the device lets homeowners lock and unlock doors from anywhere, create passcodes for family and guests, and receive alerts based on passcode use. In homes with Nest Protect, the lock can issue voice and visual alerts if smoke or carbon monoxide is detected. Linus can also direct a Nest thermostat to switch to Home or Away mode and can turn Nest Cam cameras on and off. The lock can be operated manually with the touchscreen, as well. Pricing is being determined. yale2you.com

8. Get in the Zone

The Aqualogic Ozone Faucet from Lenova incorporates a small ozone generator to sanitize without chemicals or residues. Because ozone oxidizes microorganisms on contact, it helps eliminate pesticides and bacteria from foods faster and more effectively than chlorine can. Available in polished chrome or brushed nickel, the Aqualogic is UPC, NSF, and FDA certified. The faucet retails for $1,400. lenovasinks.com

9. Sleek Windows and Doors

Enhancements to Weather Shield's Contemporary Collection give the product line a greater resemblance to commercial steel and aluminum windows—a trend gaining appeal in the architectural and design community. The new features include a flush frame design, and a slimmed-down 3 1/4-inch bottom rail on doors, including the bi-fold (shown). Both updates help minimize the exterior profile. Squared-off hardware reinforces the contemporary aesthetic. Finishes include eight anodized or metallic paint options for exteriors. Pricing will vary with size and options. weathershield.com

10. Whisk Water Away

Typar's new HouseWrap DW is engineered with continuous, multi-directional spacers that provide a drainage gap between sheathing and cladding. The high-performance housewrap provides 96% drainage efficiency as measured by ASTM 2273 and exceeds AC 38 drainage specifications. The design results in fast drainage for drier exterior walls, particularly in regions with significant annual rainfall. The maker says HouseWrap DW can remove 100 times more bulk water than standard housewraps. Check with your dealer for pricing. typar.com

11. Two-in-One Sealant

Suitable for window and door installations and other through-wall penetrations, Moistop Sealant and Liquid Flashing is Fortifiber's newest multitasking material. The two-in-one product helps eliminate gaps and the risk of problems caused by moisture intrusion. It's part of Fortifiber's complete moisture protection system, which carries a newly extended 15-year warranty on materials and labor. Fortifiber says the product is "priced competitively." Check with your dealer for details. fortifiber.com

12. Engineered Siding Introduction

Trespa North America is introducing Trespa Pura NFC (natural fiber core) exterior siding to offer the look of wood with a longer life and less maintenance. The sustainable material comprises up to 70% natural fibers, impregnated with thermosetting resins. This, plus a nonporous surface, helps ensure weather resistance. The innovative material doesn't need to be painted, cleans easily, and resists stains, scratches, and rot. Available in six natural wood tones and easy to handle and cut, Trespa Pura NFC can be installed horizontally or vertically, side-by-side or in lap style. Look for pricing around $12 per square foot. trespa.com

BY TIM UHLER

Field Tested: Paslode's Cordless XP Framing Nailer

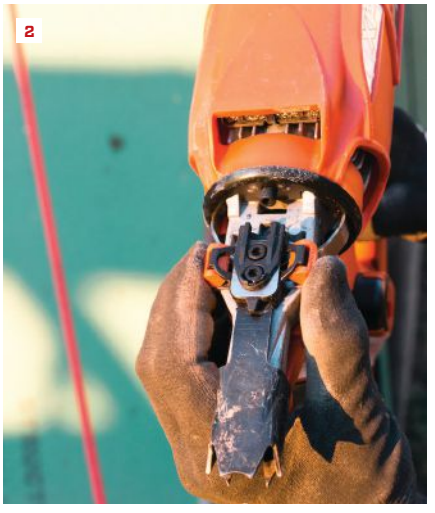
In 2012, I reviewed the Paslode and Bostitch fuel-powered framing nailers for *Tools of the Trade*. At the time, I could take or leave cordless framing nailers and didn't end up using them after writing the article. In 2014, I also reviewed the DeWalt cordless framing nailer. This gun doesn't use an internal combustion engine, but the rotor of the brushless motor acts as a flywheel. You can also see the battery level, which is an obvious plus. We ended up using this gun quite often, especially for pick-up work. So I was curious to see how the new cordless Paslode compared.

FEATURES

Paslode recently re-engineered the vent design for its cordless framing gun, which increased power, and the company also reformulated the fuel used in its cordless guns to allow them to function in colder weather.

The XP comes with a 7-volt lithium-ion battery, which Paslode claims can last long enough to shoot up to 9,000 nails before needing to be recharged. The battery registers into two slots, allowing for standby and ready modes **(1)**. The belt hook is large enough to hook on 2-by material (when it's positioned opposite the battery) and is also adjustable. The depth of drive can be adjusted quickly and without any tools by squeezing

Photos by Tim Uhler



the two buttons on the nosepiece **(2)**.

The nosepiece is aggressive and makes it easy to toenail accurately, even in engineered woods like LSL. We found we could fit only one strip of nails at a time in the magazine unless we cut a stick in half, but the trade-off is that this gun will fit into a standard 16-inch-on-center stud or joist bay. It's impossible to dry fire the gun, too, because of the nail lockout on the magazine.

I was happy with how this gun performed. While shooting through three boxes of nails and two gas canisters, we did not have one jam or misfire. We purchased the gas-and-nail-combination boxes at Lowe's and have found that the gas lasts a little longer than the box of nails, so over time we've accumulated gas canisters.

We had no trouble shooting into LVL and often had to back the depth of drive off when shooting into Doug fir. This gun also shoots pretty quickly; not as quickly as our Max High Pressure guns, but plenty fast for pick-up work, blocking, and other light framing (nonproduction).

For us, this gun has proved to be useful, and we've used it every day since we got it. More and more we are able to go cordless—and now hoseless—and it's making life a lot easier. For example, we recently framed a 500-square-foot deck on a site that was covered in mud and deep puddles. We framed the whole thing using the Paslode XP and didn't have to drag hoses through the mud.

We are currently using this gun and the DeWalt to frame a 2,100-square-foot floor. Because there is a lot of blocking and nailing I-joists over girders, we don't need a fast gun—and working hoseless in the rain is a bonus.

FAST AND LIGHTWEIGHT

After using the DeWalt and the Paslode side-by-side for the last month, I slightly prefer the Paslode. It is lighter and a bit faster, and I would highly recommend it to any framing crew. It's great for rolling trusses, pick-up framing, blocking—any framing task where dragging a hose is a nuisance or a liability.

To be clear, the Paslode only barely edges out the DeWalt because of its lighter weight and faster firing speed. The DeWalt is convenient, though, and we continue to use it, as well.

I found the Paslode online for $400. That includes the company's two-year "Service Promise" guarantee that provides free service and repair.

Tim Uhler is lead framer for Pioneer Builders, in Port Orchard, Wash.

PORTABLE DIESEL POWER

With a weight of 247 pounds (empty), the Generac XD5000E may be less "portable" than other jobsite generators, but its heft makes up for itself in features. The diesel-powered Yanmar LW air-cooled direct-injection engine provides significantly longer runtimes—Generac estimates 32 hours at 50% load (compared with eight to 10 hours for gas-powered models). Harmonic distortion runs at less than 6%, for cleaner operation of sensitive loads like smartphone chargers, laptops, and testing equipment. When the unit runs low on oil, it automatically shuts down, and a 120/240V selector switch provides power for any of your jobsite tools. A single-touch electric start means you won't have to put your coffee cup down to fire it up. Advanced emission technology ensures Tier IV compliance from the EPA so it burns diesel cleanly too. An integral lifting eye allows the unit to be moved by machine, or a wheel kit can be purchased separately. The price tag is a hefty $3,700, but according to Generac's product manager, Matthew Moose, the longer runtimes and long service life mean more readily available power, so no downtime. It comes with a two-year limited warranty. *—Chris Ermides is a senior editor at* Tools of the Trade.

Inflatable 'Shims' Work

BY CHRIS ERMIDES

I recently had the opportunity to test out Calculated Industries' new leveling tool, the AirShim **(1)**. This little inflatable bag is designed to support up to 300 pounds and span gaps from 3⁄32 inch to 2 1⁄2 inches **(2)**. A hand pump fills the bag, and a push-button valve deflates it, allowing the user to regulate the bag's thickness as needed. An almost identical tool—the WinBag—is offered by Red Horse USA; it's designed to support up to 220 pounds and span gaps from 3⁄32 inch to 2 inches.

It's called a shim, but it functions more like a pry bar. Unlike pry bars, however, this handy tool doesn't leave a mark on the workpiece, because it's made of a proprietary synthetic material that stays slightly pliable as it's inflated. One of the nicest features of the AirShim is that it fits snuggly into a tool pouch and doesn't add any noticeable weight. When you're on a ladder, this is particularly helpful.

I used the AirShim to set several large casement windows on a remodeling project; for this application, I found the inflatable bag to be impressively accurate and easy to use. When setting windows, I always start with ¼-inch shims beneath the sill to leave room for low-expanding spray foam, and then I add shims as needed to level the window. Leveling larger windows this way can be fussy because the weight of the window makes it challenging to micro-adjust and often requires a pry bar to relieve the weight as I add shims.

With the AirShim, I simply set the window and had a helper inside place the shim under the low side of the sill. As one of us read the level, the other stood inside and inflated or deflated the bag as needed. Inflating in small increments was easy to control with a squeeze of the hand. I expected the bag to kick the window out of plane with the wall as it was inflated, but the bag stayed flat and true so this never happened. Deflating the bag was easy as well; all it required was pushing a small button to incrementally release the air, lowering the window **(3)**. Once the window was level, we nailed it off from the exterior to keep it in the desired position, added wood shims as needed, then deflated the bag.

Along with setting windows with this inflatable bag, I plan on setting cabinets with it, but there are many other ways I can see this tool being used. Framers, remodeling contractors, trim carpenters, plumbers—and anyone else who owns a level and a pry bar and who uses shims—will find this a welcome addition to their tool arsenal.

AirShim Specs
Size: 6 inches by 6 1⁄2 inches
Weight: 3 1⁄2 ounces
Rated: 300 pounds (SGS certified)
Cost: $23
airshim.com

WinBag Specs
Size: 6 inches by 6 1⁄2 inches
Weight: 3 1⁄2 ounces
Rated: 220 pounds
Cost: $20
winbagusa.com

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

Photos by Chris Ermides

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Classifieds

BY CLAYTON DEKORNE

1. "Cabinet Makers," 1946, was Jacob Lawrence's first attempt to capture what he later described as "a dance to see people moving around, moving tools about."

2. A year later, Lawrence painted his first "Builders." In 2008, the White House Acquisition Trust purchased it for $2,504,000.

3. About "Builders," 1980, Lawrence said, "I like the symbolism of the builder. I think of it as man's aspiration to build harmony."

The Builders

No other storied American painter has celebrated the building trades quite like Jacob Lawrence (1917-2000). From the 1930s to 2000, he created more than 60 paintings and countless studies titled "Builders" that capture, in a style often called "visual blues," his admiration for "people, forces in the world that build community."

The "Builders" works were inspired by Lawrence's experience as a teenager hanging out at a local cabinet shop. "When I was fifteen or sixteen," he's reported as saying, "I was exposed to the workshop of these three brothers in Harlem, cabinetmakers ... They worked with tools that were aesthetically beautiful, like sculpture."

The cabinet shop was one of several workshops and artists' studios in a building at 306 West 141st St.—a three-story stable converted into shared work space by painter Charles Alston and sculptor Henry Bannarn. Lawrence was just a kid in the neighborhood with no formal training but tons of enthusiasm to paint what he experienced. He had been taking after-school art classes from Alston at a nearby library when Alston—after winning a grant from the Works Progress Administration—moved the classes to "306." Once it became an official WPA Workshop, 306 flourished as a meeting and work space for a wide range of artists and writers, including printmaker Robert Blackburn; writers Ralph Ellison, Langston Hughes, and William Saroyan; cartoonist William Steig (originator of *Shrek*); and painters Gwendolyn Knight (who would eventually marry Jacob Lawrence), Romare Bearden, and Norman Lewis.

Among the who's who of the Harlem Renaissance at 306, the cabinetmakers Addison, John, and Leonard Bates opened their shop to Lawrence for his first solo show of paintings, in 1935. In an interview in 1998, at age 81, he said "I didn't realize what an impression they were making as cabinetmakers. I didn't realize at the time that this would be one of my life subjects."

Photos courtesy Jacob and Gwen Knight Lawrence Foundation (www.jacobandgwenlawrence.org)

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