# Rain-Screen Walls: a Better Way to Install Siding

## Spacing the siding away from the housewrap promotes ventilation and drainage for long-lasting siding and paint

BY MARK AVERILL SNYDER

I sensed trouble as soon as I saw the house. I was there to bid on painting the eight-year-old, multimillion-dollar home. What first struck me was the sheets of paint dangling from the cedar siding (photo below left). Even more alarming, the paint peeling from the walls was from the house's third paint job.

When I learned that the previous paint job was done only two years before, I knew that the problem ran deeper than the paint. Jittery about hiring yet another painter, the homeowners agreed when I suggested calling in a consultant, Joseph Lstiburek.

When Joe saw the house about a week later, he said, "I'll tell you in two minutes what's wrong if we can pull one clapboard." Pulling off one clapboard revealed tea-colored Tyvek housewrap, soaked like blotter paper (photo below right). Both the clapboards and the plywood sheathing were saturated. I was stunned.

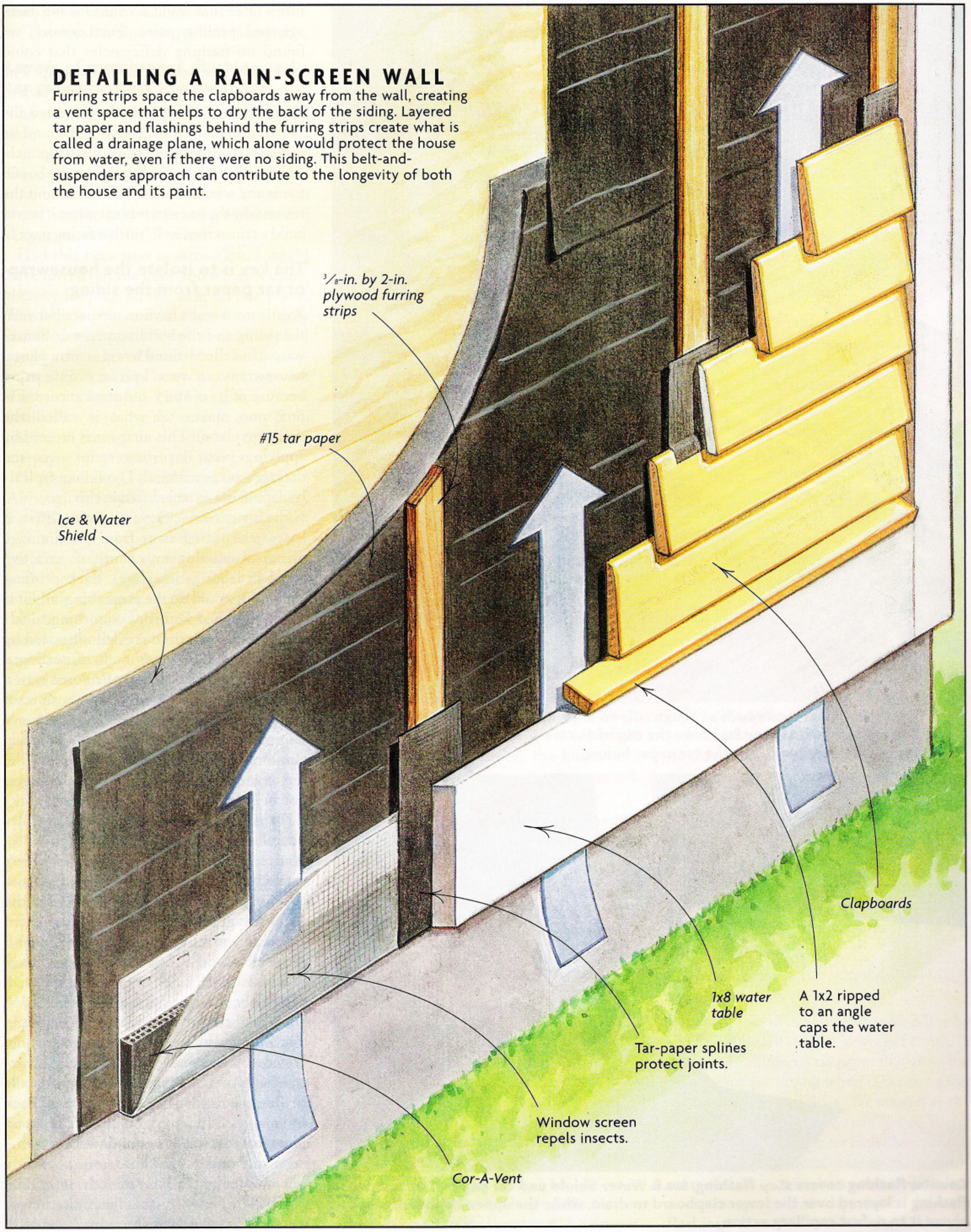
Joe and I checked for possible moisture sources, from the attic to the basement. There was no evidence of any interior mois-

THE PAINT ON THIS HOUSE NEVER STOOD A CHANCE

Tannins leaching from the back of the cedar siding, which had not been back-primed, ruined the housewrap's water repellency. Any rain that got past the siding soaked the sheathing, creating a reservoir that kept the siding wet and the paint peeling. See sidebar, p. 89, for more information about housewrap failure.

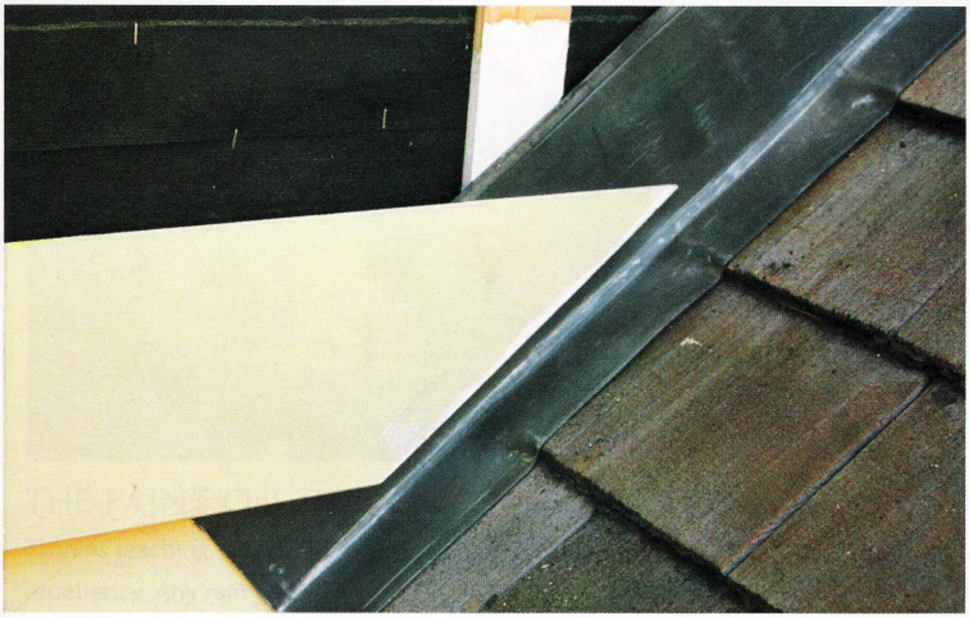
# DETAILING A RAIN-SCREEN WALL

Furring strips space the clapboards away from the wall, creating a vent space that helps to dry the back of the siding. Layered tar paper and flashings behind the furring strips create what is called a drainage plane, which alone would protect the house from water, even if there were no siding. This belt-and-suspenders approach can contribute to the longevity of both the house and its paint.




Drawings: Rick Daskam

**First, flash vulnerable spots such as rough sills to drain water. Note how the tar paper to the right of the opening laps over the top of the Ice & Water Shield flashing. In turn, the Ice & Water Shield laps the tar paper below.**



**Counterflashing covers step flashing, Ice & Water Shield and tar paper. The counterflashing is layered over the lower clapboard to drain, while the upper clapboard stops above it to defeat capillary action.**

ture source that could account for the damage and peeling paint. Furthermore, we found no flashing deficiencies that could lead rainwater behind the housewrap. The pattern of wetting, coupled with the lack of any interior moisture source, indicated the source of moisture to be rain that found its way past the siding and the housewrap.

None of this surprised Joe, who explained to me the science behind the failure and the reason why the one sure way to correct it was to build a rain-screen wall (sidebar facing page).

## The key is to isolate the housewrap or tar paper from the siding

Rain-screen walls have an airspace between the siding and the building paper or housewrap. (Installed behind a rain screen, plastic housewraps can work. I prefer #15 tar paper because of its century-old track record. Either one makes up what is called the drainage plane). This airspace is created by applying vertical furring strips over the drainage-plane material. The siding, typically clapboards, is nailed to these strips.

The airspace does several duties. First, it spaces the siding away from the drainage plane, minimizing any chance of extractive bleed (sidebar facing page). Back-priming the siding would do the same thing, and it is a good practice. But it does nothing to address capillary action. As demonstrated by the grade-school experiment of putting a stalk of celery into a glass of colored water, capillary action can draw water upward along a continuous surface. Water can move long distances in this way, so a raindrop climbing the back of one clapboard to the top of another, then to the wall sheathing, is not an imaginary event.

The airspace in a rain-screen wall provides a capillary break, stopping water driven behind the siding by capillary action from ever reaching the drainage plane. Vented top and bottom, the siding has a way to dry from the water that gets behind it. Finally, this vented airspace helps to equalize the air pressure on each side of the siding, reducing the chance of wind-driven rain being forced or drawn behind the siding.

You might argue that rain should never get past a properly detailed, standard siding job. I once would have argued the same. However, when my crew stripped this house's walls of their trim and clapboards, we stood back and marveled (photo right, p. 86). The worst damage was around door and window openings and under clapboard joints, exactly where water had leaked under the unprimed siding. The funny thing is that even though we looked carefully at the siding's installation, it was hard to see how water had leaked in. The workmanship was perfectly acceptable.

### Layers of membranes, flashing and tar paper protect the sheathing

The existing clapboards, trim and housewrap of this house had to be removed, and damaged sheathing and framing repaired. Once these tasks were done, the only difference between this job and a new house was that I was locked into existing window and door trim, and soffit details.

Had this been new construction, I would have furred out the door and window units, thereby keeping all the trim on one plane. The 84 windows and 18 doors were already installed with their 5/4x4 casings applied against the original housewrap. The homeowners drew the line here; they did not want these units removed. The best that my crew could do was to pry the casings away from the house enough to slip double-thick #15 tar-paper splines under the casings.

"Be the raindrop," an old-timer once told me. Although this phrase might sound like a hazy bit of Eastern philosophy, imagining the path of a raindrop is key to understanding waterproofing details. Basic to this idea is starting at the bottom, and layering upper flashings and drainage planes over those below.

On a new home, the first layer would be a pan of self-adhering bituminous membrane at the rough sills of doors and windows. I use Grace Ice & Water Shield (Grace Construction Products; 800-444-6459; www.graceconstruction.com). There were only a few doors on this house that had to be taken out to repair the surrounding framing, so we could use this detail only in these places (top photo, facing page).

We also adhered a 3-ft. wide course of Ice & Water Shield to the sheathing at the bottom of the walls, all the way around the house, to guard against dripping water splashing back to the house.

Other spots that we covered with Ice & Water Shield were walls that rose above an intersecting roof. On a new house, we would have extended half the width of the Ice & Water Shield onto the roof deck and half up the wall. This option was closed to us on this house because we weren't tearing off the roof. The best that we could do was to bend down the existing step flashing to expose the wall sheathing, which we then covered with Ice & Water Shield.

The next layer in the rain screen is the cap flashings above windows, doors and other wall penetrations such as dryer vents and light-mounting blocks (photos p. 90). These flashings are installed with vertical flanges over the tar-paper splines that we slid behind the casings directly against the wall sheathing.

I used copper and lead flashings. Where the flashing would show, I used copper. Where it wasn't particularly visible or where I needed a flexible flashing, I used lead.

### Tar paper has worked for a century; why change?

The final step before nailing up the furring strips was to wrap the house in #15 tar paper. Recently, I've switched to Shingle Mate by GAF (800-234-4285; www.gaf.com), a fiberglass-reinforced tar paper that stays flat and doesn't pucker up when it becomes wet as regular tar paper does. We started at the bottom, covering the layer of Ice & Water Shield. We applied the tar paper horizontally, lapping each succeeding course a minimum of 4 in. over the lower course. This layer of tar paper also laps both the step flashings at roof intersections and the cap

## How housewraps and building papers fail

by Joseph Lstiburek

**The primary function of a housewrap (Tyvek and Typar are two common examples) or building paper (#15 or #30 tar paper) is to drain rain that penetrates the siding through leaky joints or capillary action. Marketing claims to the contrary notwithstanding, housewraps do very little to reduce any air infiltration.**

**The problem with housewraps, and building papers to a lesser extent, is loss of water repellency. Contaminants referred to as surfactants (to learn how surfactants work, visit www.chemistry.co.n2/surfactants.htm) degrade the water repellency of building papers and housewrap, allowing the wetting of the housewrap or building-paper surface by water. Water-soluble extractives in wood, such as tannins and wood sugars in Douglas fir, redwood and cedar, as well as detergents and soaps, are surfactants. Once the surface is wet, pores in the housewrap or building paper fill, allowing liquid-phase water to pass through. Once water penetrates the housewrap into a wall, peeling paint and rotten siding often follow.**

"Marketing claims to the contrary, housewraps do little to reduce air infiltration."

**Back-priming wood clapboards and trim helps to isolate surfactants in the wood from the housewrap or building-paper surface. Similarly, providing an airspace between wood trim and siding and the housewrap or building paper using furring strips (Cedar Breather is a commercial product for this application; Benjamin Obdyke Inc.; 800-346-7655; www.obdyke.com) reduces the potential of surfactant movement. I recommend both practices.**

**Stucco should never be installed in direct contact with any plastic-based housewrap. Stucco can adhere or bond to the housewrap surface, allowing housewrap pores to become wetted and subsequently establish capillary flow. Also, many stuccos add surfactants to improve workability and freeze-thaw resistance. A drainage space between stucco and housewrap is essential to control water.**

**Stucco does not typically bond with building papers. However, most stucco applications over building paper result in insufficient drainage. I recommend using at least two layers of building paper under stucco to allow some drainage between the two layers.**

**Plain dirt can also cause housewrap to leak, just as Scotchgard-coated fabric that becomes dirty must be cleaned and re-treated to re-establish water repellency. Don't let your housewrap become muddy or dirty.**

*—Joseph Lstiburek is a principal in Building Science Corporation (www.buildingscience.com) in Westford, Massachusetts, and the author of* Builder's Guide to Cold Climates *(The Taunton Press, 2000).*

**Cap flashing protects door and window casings.** Note how tar paper covers the furring strip by the side casing, and how the cap flashing and tar paper are all layered to drain down.

**If siding leaks at joints, let it drain.** The tar-paper splines under this light-mounting block both cover the furring strips and extend over the next lower clapboard to drain water away from the house.

flashings over doors, windows and the like (photo left).

We made the furring strips from 3/8-in. AC fir plywood. We ripped most of the strips 2 in. wide, plus a few 6 1/2 in. wide for under corner boards. (The corner boards were to be 3/4 in. by 5 in., so that left 1 1/2 in. of furring strip to support the abutting siding.) On new construction, we would have furred out the windows and doors, but as I said before, the owners didn't want us pulling and reinstalling all those units.

As luck had it, the door and window casings were of 5/4 stock. This good fortune allowed us to add the 3/8-in. spacer parallel to the side casing and still have the clapboards be flush with the casings. For added protection, we covered the furring strips next to the window casings, a spot we knew from the tearoff to be vulnerable, with tar paper (top photo).

To provide the greatest possible chance for water behind the siding to dry out, the tops and bottoms of the channels between the furring strips were left open to the air. We screened these channels' bottoms and tops to prevent bugs from entering. This step was a simple matter of stapling 12-in. wide strips of screen along the bottom edge of the building so that 6 in. of it hung below the bottom of the sheathing (drawing p. 87). We then nailed the furring strips, with their bottoms flush to the bottom of the sheathing, over the screen. The furring strips were nailed to the house directly over studs with stainless-steel 7d ring-shank nails.

I wanted to back up the water table so that it didn't flex if someone leaned on it, yet still allow ventilation. To accomplish this, we filled the spaces between the furring strips' bottoms with Cor-A-Vent (800-837-8368; www.cor-a-vent.com), a plastic roof vent that resembles corrugated cardboard. We ripped the Cor-A-Vent to 3 in. wide and peeled its layers apart so that they matched the furring strips' thickness.

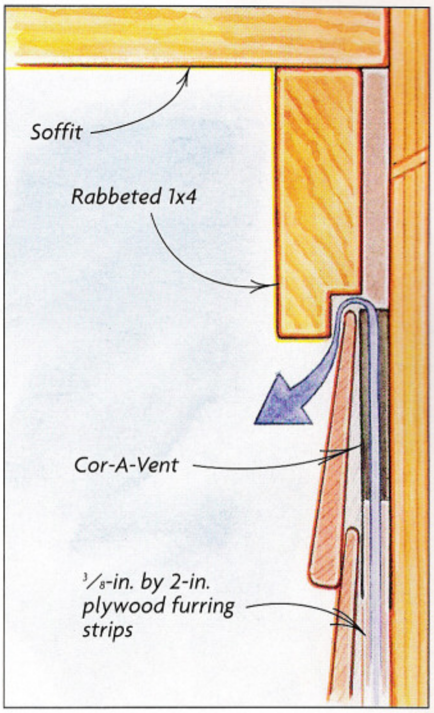
We repeated this detail at the tops of the walls, finally folding the screen over the furring strips and Cor-A-Vent, top and bottom. The Cor-A-Vent fills the void between furring strips; it's rigid and waterproof, and it supports the screen so that bugs can't crawl in.

Above the windows and the doors, we ran a horizontal furring strip over the flange of the cap flashing. To vent these spaces, the vertical furring strips stop 1/2 in. shy of the horizontal strip.

The final step on this job before beginning to nail on trim and clapboards was to install counterflashing where roofs met sidewalls. We used 8-in. wide lead, nailed to the furring strips and bent 90°, to go 3 in. over the

## VENTING THE TOP OF A RAIN-SCREEN WALL UNOBTRUSIVELY

The air from below (drawing p. 87) needs to exit somewhere. Rabbeting the trim board that caps the siding completes the path.




cedar roof shingles. This flashing was crimped down over the butts of the shingles to minimize the intrusion of wind-driven rain (bottom photo, p. 88).

### Even on a rain screen, back-priming is good practice

After we built the rain screen, skimping on the trim and the clapboards made no sense. I have found that of the commonly available woods, only two are suitable for harsh climates such as New England's: cedar and redwood. With a minimum amount of maintenance, these two woods will last a lifetime. We chose cedar.

I sanded and dusted all six sides of every trim board that I used. This task may seem to be overkill—it's certainly tedious—but I accomplish several ends at once. The process allows me to read the boards for cups and cracks, dings and dents; it removes dirt and wax film from the board; it levels planer marks; and it scuffs up the surface for superior paint adhesion.

After sanding, I primed all surfaces of every board with an alkyd primer, Pratt and Lambert Suprime 8 (800-289-7728; www.prattandlambert.com). Alkyd primer takes at least 48 hours to dry on cedar, so I always needed to be two to three days ahead of the installation crew.

Because I could buy clear, preprimed cedar clapboards, I avoided the tedium of sanding them. To be sure, though, we primed every cut end before installation.

### Siding goes on conventionally

The first trim boards up were corner boards. Before nailing up the corners, we covered their furring strips with #15 tar paper.

Next came the water table, a 1x8 capped with a 1x2 that we ripped to pitch 15° to drain water outward (drawing p. 87). The water table is installed level with the bottom of the plywood sheathing. We avoided joints in the water table as far as was possible. Where they were unavoidable, we scarf-joined the boards and protected the furring strip behind the joint with a tar-paper spline.

The clapboards were installed conventionally (see *FHB* #47, pp. 48-52, and #112, pp. 62-67), but on top of the furring strips. They were face-nailed with small-head 6d stainless-steel ring-shank nails. Every joint was backed up by a 3-in. by 5-in. tar-paper spline that laps the clapboard below (drawing p. 87). All the joints were tight, a razor-knife blade thickness or less, but not so tight that they would bow the corner boards or window casings.

We lapped the lower tar-paper splines at interruptions such as windows or light-mounting blocks over the top of the clapboards (bottom photo, facing page). The final trim piece is a 1x4 installed in place of a final clapboard, tight to the soffit. This board's lower edge is rabbeted 1/4 in., creating a weatherproof, almost-invisible vent (photo, drawing above).

Even on a rain-screen wall, good paint is worth the cost. I ordered clapboards preprimed with Cabot's Problem Solver (800-877-8246; www.cabotstain.com). I spot-primed cut ends with Pratt and Lambert Suprime 8; then the entire house got three coats of Pratt and Lambert's best acrylic exterior paint, Accolade, in an eggshell finish. We'd made the joints tight enough that no caulk was needed. Caulk doesn't last, and it doesn't make up for poor carpentry.

I've been back recently to look over this house. After three years, the paint still looks new—on a house that previously wouldn't hold paint for half that time. □

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