Making Walls Watertight

Careful detailing of housewrap and flashing will keep out wind-driven rain and lengthen the life of wood-frame structures

PATRICIA HAMILTON

To protect this oceanfront home from wind-driven rain and surf spray, the builder has covered the housewrap around doors and windows with a self-adhering bituminous membrane.

I vividly remember the job where I learned that even properly installed siding isn't waterproof. It was a large, expensive gambrel on the peak of the highest hill in town. Start to finish, the job was a plum. The clients were overjoyed with my work and moved in ahead of schedule. But six months later, a wind-driven rain converted my plum into a prune. In a late-night phone call, the owner explained in detail how many drips-per-minute were falling from the head jamb of the east-facing double-mullion window.

I "fixed" the leak the next day, but it reoccurred once a year for three consecutive years. Each time there was a heavy east wind driving the rain directly against the window and the wall surrounding it. I caulked every joint and tightened every flashing connection on the east wall of the home in an effort to fix the leak, but with no luck.

When out of desperation I finally removed every course of bevel siding from the east wall, the problem was right in front of me. I had prewrapped the entire wall with 15-lb. felt and popped in the back-ordered window later. The problem was caused by the Z-flashing above the window head casing — I had attached the Z-flashing against the felt paper rather than tucking it under. Heavy winds forced rain water through the butt joints of the siding above the window, where it ran down the face of the felt paper, behind the window flashing and head casing, and dripped into the house.

Wind and rain can drive water through the smallest of cracks in any siding. All homes should have a second line of protection, especially those exposed to wind-driven rain. After investigating structural failures and repairing homes for many years, I have found that some failures are chronic. The details provided here will improve your chances of preventing leaks, even in severe conditions.

by Paul Fisette

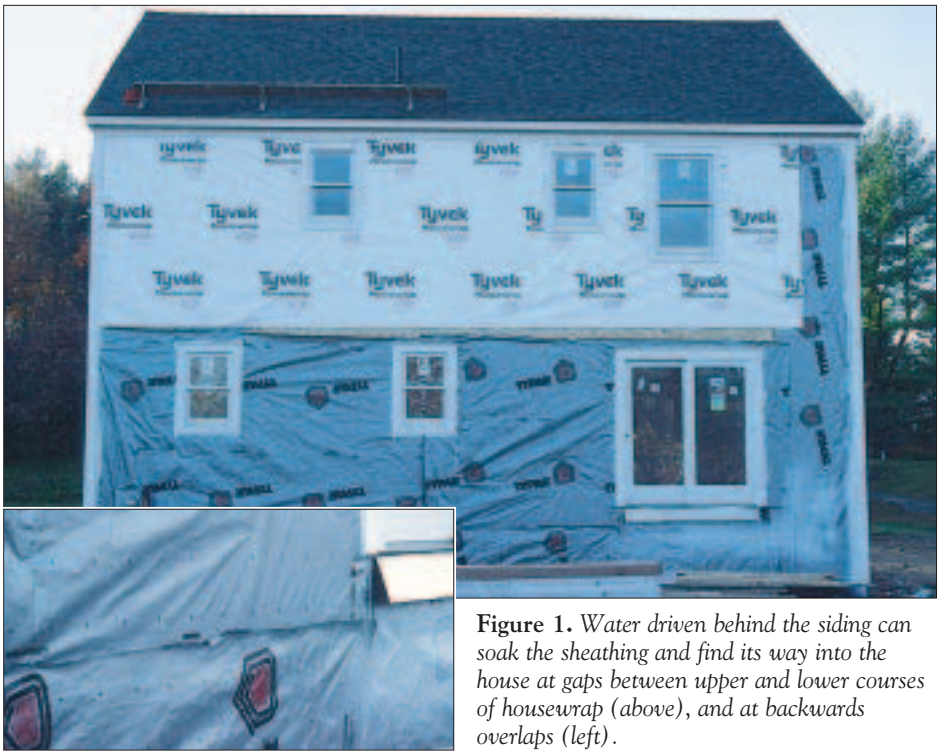

Figure 1. *Water driven behind the siding can soak the sheathing and find its way into the house at gaps between upper and lower courses of housewrap (above), and at backwards overlaps (left).*

HOUSEWRAPS

Too often, builders neglect to wrap houses with a water-resistant membrane before they apply siding. This is especially true when the house will be sided with vinyl — many builders are convinced that nothing gets past vinyl siding. But vinyl siding isn't waterproof, as I learned while inspecting a house in frigid temperatures after a heavy, wind-driven rain. The sidewall had icicles protruding from beneath one section of the vinyl siding where rain had penetrated the siding and was frozen in its tracks trying to escape.

Patchwork. Poorly installed housewrap is just as bad as no housewrap. Figure 1 shows a combination of Tyvek and Typar on the same house. This is not a problem in itself, but the lack of consistency caught my eye. What concerns me is how the builder has cobbled together little scraps of housewrap; there are gaps, and in some cases the lower pieces overlap the upper pieces. If rain penetrates the siding on this house, it could easily find a path behind the housewrap.

Wrapping windows. Most builders wrap the entire house before installing windows or doors. In fact, manufacturers recommend wrapping over rough openings, then cutting an X into the window opening and folding the wrap inward. The windows are then installed over the housewrap. When I see this, I am always reminded of my leakage problem with the gambrel. When rain penetrates the siding on homes wrapped this way, it will find its way behind the window flashing and into the house.

Step flashing. Another problem area is a sloping roof that intersects a taller sidewall, as when the gable end of a garage is attached to the gable end of a two-story house. The garage roof shingles are usually step-flashed against the housewrap on the sidewall sheathing of the main house. But in cold climates, water from melting snowdrifts collects at this joint and will find its way through butt joints, knots, cracks, and other irregularities in the siding. The solution is to place the garage roof flashing directly against the bare house sheathing, then make sure the housewrap overlaps the step flashing.

Housewrap Checklist

- Use housewrap or felt paper on all houses, no matter what kind of siding you're using.
- The wrap should be continuous; avoid a patchwork of small pieces.
- Provide an unrestricted path down and out of the space behind the siding. Wall membranes should overlap by 3 inches horizontally and 6 inches vertically. Tape all seams.
- Protect all pathways into the building envelope by lapping housewrap over flashings.

CORNERS

Not all leaks result in water dripping on carpets in plain view of nervous clients; some leaks slowly compromise the structural integrity of a building. Rip off the corner boards of enough old houses and you will see your share of rotting corner posts. In general, corners of buildings experience the greatest effects of wind pressure, so you should take special care to protect this area from exposure to rain water.

Last month I visited the construction site of a very expensive new home. Overall, the quality of construction was excellent, but one detail troubled me. The 1-by wood corner boards were applied directly over the plywood sheathing, with no housewrap underneath. Over time, the corner boards and the wood siding will shrink and expand, giving rain water a path to the sheathing and framing.

Many builders caulk between corner boards and siding, assuming this creates a watertight joint. In wood-frame construction, however, the bond between most sealants and wood deteriorates within a few years, faster in severe exposures. In my opinion, caulking only makes matters worse by retarding the drying process when water penetrates the corner joints.

A more forgiving corner detail is to extend whatever type of housewrap you're using around the corner before installing the corner board. And because corners of houses are often dinged and damaged during construction, I would also recommend that a second vertical spline of felt paper or housewrap be applied over wrapped corners just before the corner boards go on.

Corner Board Checklist

- Install felt paper or housewrap at all corners.
- Double-wrap corners by applying vertical felt or housewrap splines under the corner boards.
- Don't caulk the joint between the siding and corner board; caulk deteriorates over time, providing a pathway for water to get into the frame and preventing trapped water from escaping.

Figure 2. *When water gets behind window and doors casings, correctly installed felt-paper splines keep water from wetting the sheathing.*

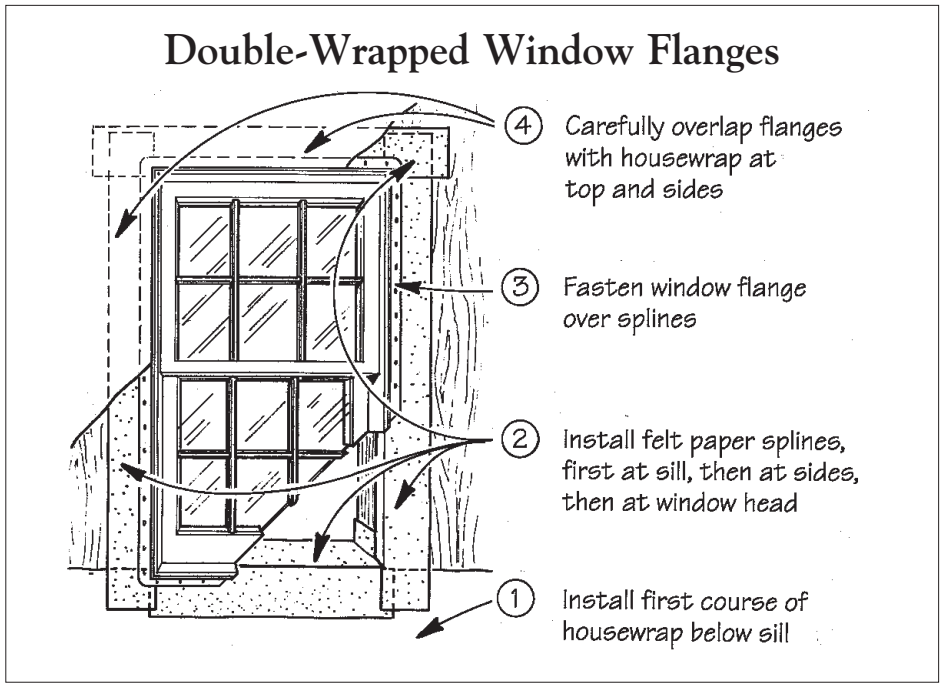

Figure 3. *Clad window flanges provide excellent protection against water penetration when double-wrapped with splines and housewrap. Make sure the upper course of housewrap overlaps the flanges at the top and sides of the window; at the sill, however, the spline and window flange should overlap the housewrap.*

WINDOWS & DOORS

One of my first assignments as an apprentice carpenter was wrapping window and door jambs. I would unroll a length of felt on the deck, cut 1-foot-wide strips (a little longer than the window and door openings), then fasten these "splines" along the sides of the window and door rough openings (Figure 2). I was taught that splines protect the sheathing from any weather that might penetrate the joint between the siding and window casings.

This makes sense, but there is a little more to this detail. Don't bury the bottom of the splines beneath a layer of housewrap. The bottom of the spline should be lifted and placed over the felt or housewrap that runs horizontally beneath the window. This will guide any water that penetrates the joint down the spline and over the felt or wrap that covers the wall.

Figure 4. *To prevent leaks at window heads, lap felt paper or housewrap over the cap flashing.*

Windows with nailing fins (vinyl, clad, and metal) have nearly replaced traditional wood-cased units on most job sites. When these units are properly installed, they offer more protection against water infiltration than wood-cased units, because the housewrap membrane can be double-overlapped in a weather-tight detail (Figure 3).

Head flashing is critical for window installations. The top edge of the window fin or Z-flashing should be protected by an overlapping membrane (Figure 4). When using a housewrap like Tyvek or Typar, it is not as easy to weave the flashing under the wrap as it is with felt. When using these wraps, you can prewrap the entire house, install the windows and flashing, and then tape the top of the flashing to the housewrap with 3M contractors tape (3M Corp., St. Paul, MN 55144; 612/733-1110). You can also wrap the walls before the windows are installed and slice the wrap above the window so you can slide the top of the window flashing beneath the housewrap.

Whatever method you use, be sure the splines don't lead rain water beneath the housewrap in any way (Figure 5). Be very careful at the window head: On windy days, water that collects on top of the window flashing will be blown sideways and may leak when it reaches the window's edge. Nailing flanges on clad

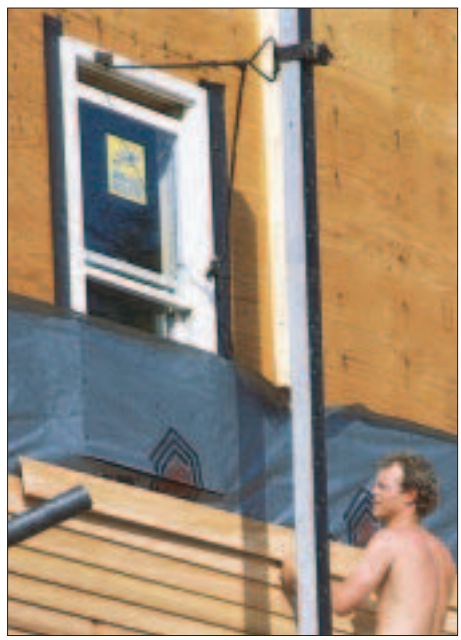

Figure 5. *Because this carpenter has stretched the housewrap over the splines at the bottom of the window, wind-driven rain will be able to run down behind the housewrap onto the sheathing.*

Window Flashing Checklist

- Protect the top of the window flashing with overlapping wrap.
- Double-overlap housewrap around nailing fins of vinyl and clad windows.
- At sills, splines must direct water over underlying housewrap.
- At head, leave a 1/4-inch gap between the window flashing and bottom edge of siding to prevent wicking of moisture.

windows provide good protection when double-wrapped, but make sure that Z-flashing leads water over the housewrap at the ends of the window. This may require carefully patching in with pieces of housewrap or felt at windows.

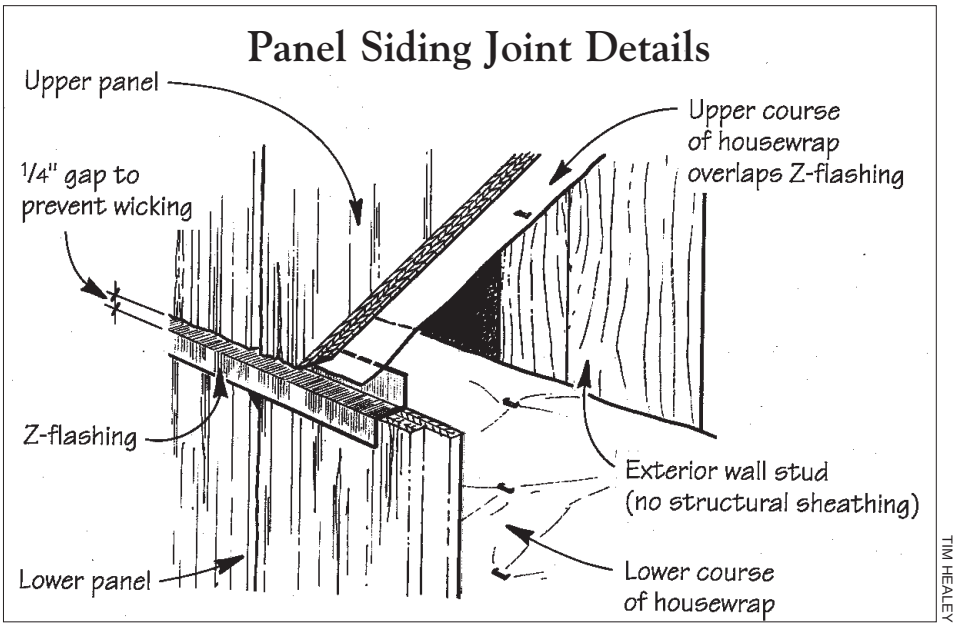

Figure 6. *Apply the lower course of panel siding over the housewrap, then overlap the Z-flashing with the upper course of housewrap before installing the upper panels. Leave at least a 1/4-inch gap between panels to prevent wicking.*

SIDING

Many books have been written about siding, so I won't explain again how to prevent siding failures. But I will provide a sampling of some failures I've investigated in recent months.

Diagonal board siding. I don't like board siding that is installed at a diagonal. On rainy days, windward walls are covered by a thin film of water that's looking for somewhere to go. Gravity may pull it down; wind may push it sideways, upward, or even inward through breaches in the siding. Eventually, most of the rain water finds its way into the seams between adjacent siding boards.

Siding Checklist

- Don't install board siding on a diagonal.
- For horizontal board siding, use top-grade boards with no knots, splits, or other defects. Install T&G and shiplap siding so that the joints between boards drain away from the sheathing.
- For panel siding, use housewrap over studs. Housewrap should overlap Z-flashing at the joint between panel courses.
- Protect wall sheathing close to grade with bituminous membrane.
- Siding should overlap sill-to-foundation joint by at least 2 inches.

These seams act like gutters, collecting and channeling the water downward at an angle. The water is forced against the sides of windows, doorways, corner boards, and any vertical element that stands in its path. Without very careful detailing, the runoff will leak into the building at these points.

Horizontal boards. I'm not crazy for horizontal board siding in windy or exposed locations either. If the design calls for horizontally applied, tongue-and-groove or shiplap siding, be sure to install it with the tongues up so the joint will drain. Even when installed correctly, knots, splits, and other defects in the milled edges may allow water to pass through the siding, so good house-wrapping details are critical.

Panel siding. Problems typically occur with plywood panel siding at the joints between upper and lower panels. Often, plywood panel siding like T1-11 is used to economize, so structural sheathing is not installed beneath the siding panels and neither is housewrap. Typically, either Z-flashing is installed at the top of the lower panel or the top and bottom edges of adjoining panels are beveled to "prevent" leakage. These connections, however, are not weather-tight. The safest practice is to apply housewrap before installing the lower course of panels. Then install Z-flashing at the top of the lower panels and overlap the Z-flashing with the upper course of housewrap (Figure 6). Be sure to leave at least a 1/4-inch gap between panels to prevent capillary suction.

Splashback. We've all noticed siding that is discolored just above grade. This heavy weathering is caused by splashback — water bouncing off the ground and splashing back onto the siding — and is unavoidable on most homes. Regardless of the type of siding, this part of the wall will experience heavy exposure to water, so the sheathing just above grade must be carefully protected with a continuous layer of housewrap. Installing a strip of bituminous membrane like Ice and Water Shield under the siding at the bottom of the wall may be a worthwhile investment.

The intersection of the sill to the foundation is critical. Be sure that water runs down the siding and is carried past this joint. Also make sure wind will not drive water under the sill — let the siding overlap the sill-foundation joint by at least 2 inches.

As is the case for all detailing, be conservative in your estimation of the forces influencing your design. Plan on water penetrating your primary line of defense, and develop a plan that offers solid backup protection. ■

Paul Fisette is a wood technologist and director of the Building Materials Technology and Management program at the University of Massachusetts in Amherst. Photos by author, except where noted.