Understanding Water Intrusion

The power of wind-driven rain may be more insidious than you think

Rain falls from the sky. That's no news flash, but it's curious how conditioned we have become to expect that … and only that. Coming from above, we expect rainwater to flow downhill, and we detail the exterior accordingly: we lap roofing, housewrap, flashings, and siding with the bottom layers under the top, so the surfaces that will be presented to the weather shed water down and away from the structure. Reverse lapping (installing the bottom course over the top course) is a sin; that catches water. Everybody knows that.

We are much less prepared to think about how water gets driven uphill and pushed with enormous pressure through the smallest cracks and crevices in the facade. In particular, we don't tend to think much about those exterior surfaces that face the ground, such as soffits and the underside of cantilevered floors. Yet wind pressure makes these surfaces as vulnerable as any others.

Research at the University of Florida using a "wind machine" — a monstrous propeller fan capable of moving air and water at hurricane-force speeds (for a description of this apparatus, see "Blown Apart," *Backdoor*, September/October 2006; www.coastalcontractor.net) — has demonstrated just how insidiously high winds can drive water into a building. Richard Reynolds, a builder based in Bradenton, Fla., who participated in the research, shared his observations of water intrusion through soffits during simulations blowing near-100-mph air and water. It's worth spending a moment to visualize the phenomenon Reynolds describes

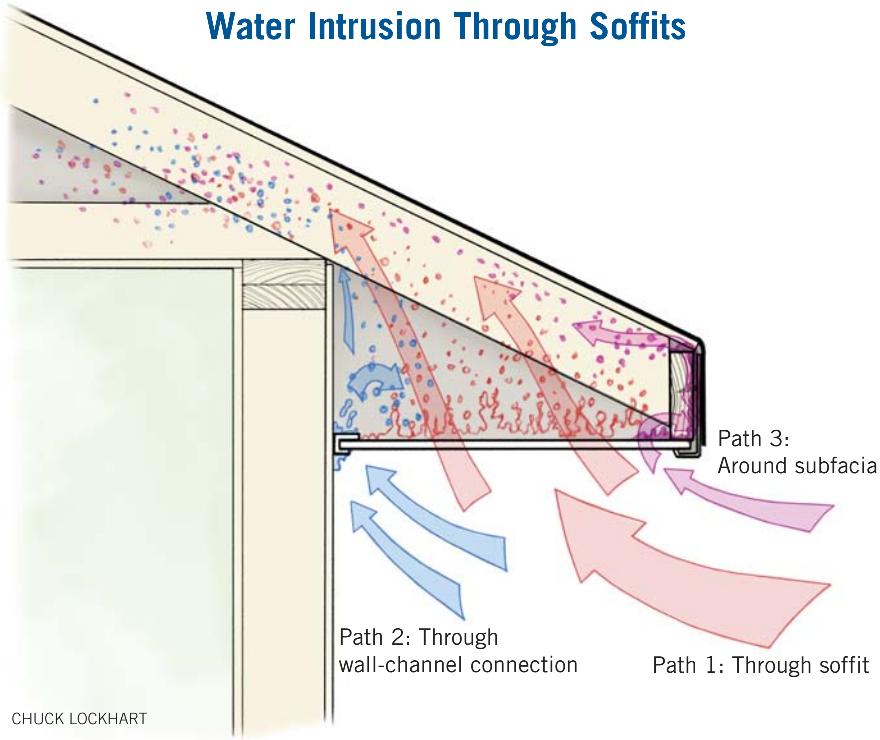

FIGURE 1. Observations of wind-driven water blown at speeds around 100 mph revealed three principal paths for water blowing into the attic. The observer said the air and water appeared like a "cauldron of boiling water," out of which the spray of water droplets saturated attic and ceiling surfaces in a matter of minutes. For the test, the roof and fascia were wrapped with a peel-and-stick roofing membrane to isolate the intrusion points to the soffit area.

and rethink any conventional ideas we might hold about water intrusion through soffits. It's far more powerful than you might imagine.

Richard Reynolds explains: Three principal paths of water flow were observed (**Figure 1**). The largest path was, as one might expect, water entering through the flat soffit panels. From one angle of view, the water immediately above the soffit had the appearance of a cauldron of boiling water, with a somewhat pervious pool of water immediately above the panels consisting of boiling spirals (dynamic stalagmites) of water extending upward an inch or so. Some of those spirals were breaking into drops that were either so large they fell back down or they became airborne, turning into a shower of droplets that blew into the attic.

Another path was made evident by high-speed digital photography (1,000 frames per second). This showed up as water that initially hit the wall just below the soffit panel, then got forced into the space above the soffit by getting blown between the J-channel against the wall and the ends of the soffit panels. These thick, stringlike formations of water, on the order of an inch long and perhaps a quarter-inch in diameter, appeared to float relatively slowly in the air just above the juncture of the J-channel and the soffit panel. There they wriggled, until the bulk of each falling strand broke apart onto the soffit panels, adding to the water in the cauldron and to the shower spraying into the attic.

The surprising path was a circuitous one: water that got blown from the front of the soffit space, along the bottom of the subfascia, and vertically up the 5 1/2-inch distance between the outer face of the subfascia and the fascia cover (**Figure 2**). The air blowing through this circuitous path was at a low enough wind speed to allow water to collect on the top edge of the subfascia. However, the air blowing along that path blew through the collected water, producing water droplets and giving the appearance of boiling water here as well. These droplets tended to disperse into the attic, because they were introduced into the air stream at a higher elevation.

All three paths produced water droplets that entered the air stream flowing into the attic. The total accumulation of water that got deposited in the attic was enough to saturate ceiling drywall in just a few minutes.

Path 3: Detail

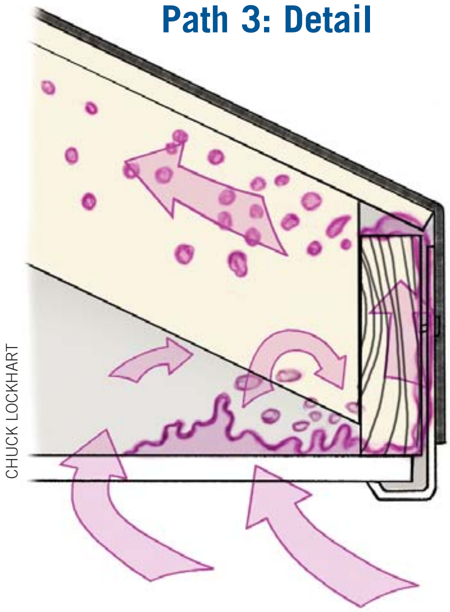

FIGURE 2. The air pressure in the soffit was great enough to force water up through the minute gap between the fascia cover and the subfascia, collecting and seeming to boil on the top of the subfascia before getting sprayed directly into the attic.