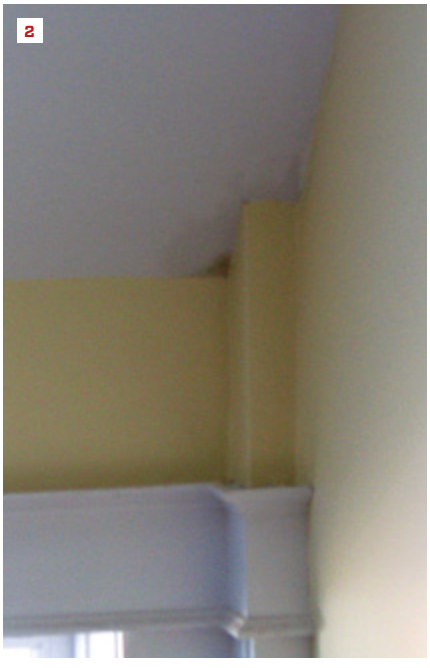
BY MIKE GUERTIN


# Finding the Source of a 'Roof Leak'

**The house was less than a year old** when the owner called me in late February to investigate persistent roof leaks that the builder had been unable to repair. The water seemed to be coming in around the skylights, leaving moisture stains above and below the openings. The builder had tried to fix the problem by removing the asphalt shingles around the skylights, installing waterproof membrane, and re-flashing the curbs. At first, the problem seemed straightforward, but when I asked some follow-up questions, the symptoms and timeline didn't add up.

The house was built in the fall and the owner moved in just before Christmas. Moisture stains appeared within a couple of weeks **(1, 2)**. Roof repairs were done in mid-January, but new stains showed up soon after.

We hadn't gotten much snow or rain that winter, so with no precipitation that might cause ice dams on the roof, how could water leak into it? Background information from the owner and a look around inside the house began to paint a different picture.

The first thing I noticed was that the indoor humidity was high, with water condensing on the inside of the windows and skylights. The relative humidity (RH) measured 65%. But there wasn't any obvious moisture source, like a wet basement or lots of house plants.

Then the owner mentioned that the foundation and first-floor walls of the house were built with insulating concrete forms (ICFs). The builder probably didn't realize how much water would dry out of the concrete during the first year. I calculated that more than 1,500 gallons of water was in the concrete that filled the ICFs. With the short construction period, a lot of that water was probably still drying to the interior of the house.

The upstairs of the Cape was divided into three sections: a loft with tongue-and-groove plank ceiling applied to the underside of the rafters, a vaulted open foyer with the skylights, and an unfinished storage room that held the air handler and ducts. Kraft-faced fiberglass batts were installed in the rafter bays of the storage room with poly sheeting covering part of them.

Photos: Mike Guertin




The Kraft facing on the insulation looked fine, but when I pulled the insulation out of a couple of rafter bays, I found saturated fiberglass **(3)** and saturated plywood roof sheathing **(4)**. In some bays, there was actually frost on the sheathing and insulation **(5)**.

Vent chutes were installed in the rafter bays, but solid blocking between the rafters along the top of the exterior wall prevented any ventilation air from circulating. There were no intake vents along the eaves and there was no ridge vent at the roof peak.

Moisture-meter readings of the plywood ranged from 26% to 76%. Staining on the sides of the rafters showed where water had dripped down to the ceiling level. I removed a recessed light from the tongue-and-groove ceiling area of the loft and pushed the insulation aside. The moisture in the sheathing measured between 24% and 35%.

I didn't cut into the drywall around the skylights to check, but I surmised that the same condensation problem was occurring in those rafter bays too. Either humid air was piggybacking on air leaks or moisture was diffusing through the drywall and condensing on the cold underside of the roof sheathing. What appeared to be roof leaks at the skylights were most likely condensed water saturating the drywall and dripping through the perimeter trim.

## RECOMMENDATIONS

I made several recommendations to fix the problem. First, the house needed to be dried out. There was no mechanical fresh-air ventilation system in the house, so one would need to be installed, preferably a heat recovery ventilator (HRV), which would exhaust moisture-laden air and bring in drier air from outside. In addition, dehumidifiers could be used to accelerate drying. When the weather warmed up, windows could be opened and fans used to circulate the air.

I also recommended removing the insulation from all the rafter bays. This would need to be done after the deepest winter cold had passed and would mean removing the tongue-and-groove wood ceiling in the loft as well as the drywall in the foyer.

During the summer, after the roof sheathing and rafters had dropped below a 15% moisture level, the roof could be re-insulated with high-density spray foam. Spraying foam would be a messy job inside a finished house, but it seemed like the best choice. High-density foam would help block moisture vapor to keep the underside of the sheathing dry. Then new drywall could be applied to the ceilings in all three areas to cover the foam. Finally, the tongue-and-groove ceiling could be reinstalled over the drywall, but without recessed speakers or recessed lights that could cause air leaks.

After those modifications were made, the owner would need to monitor the air-moisture levels during the winter and operate the ventilation system to keep RH in the house at around 40%.

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