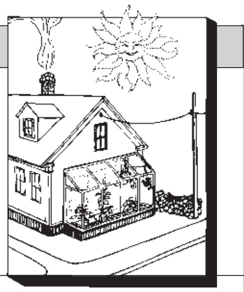

Why Not Slash the Vapor Barrier?

by Terry Brennan and Chuck Silver

"And then you take a knife and do this…," Jim said while casually slicing the foil facing of the 4-inch fiberglass ceiling insulation. Even at age 15, it seemed odd to me to put it in and then slash it. But I did. After all, Jim had the wisdom of 24 or so years behind him and it was kind of fun whaling away at the stuff with an old 12-iinch butcher knife.

"Hey! Watch out for that wire, it's hot…" from Jim slowed me down.

"So why do we put it up and then punch holes in it"? I asked.

"Lets the water out," said Jim.

"Oh."

Theory vs. Reality

As with many of you, that's how I learned about ceiling vapor barriers when I started building. It's not how I do them now, however, and it has been a long and difficult road from my 12-inch butcher knife to my current practice. There were two major obstacles to my understanding how to install vapor barriers. The first was the fact that when I went to building conferences and saw panel discussions by moisture-in-building experts, they all disagreed with each other in the first two minutes and within five minutes were shouting insults at each other. The second obstacle was that when I actually went into houses and looked, what I saw sometimes supported the accepted theories and sometimes didn't. Things in the field were a bit more complicated than simple theoretical models could account for.

Some examples:

We learned at conferences that if you don't put a vapor barrier in the ceiling, you could end up with frost in the attic. Well, you won't get frost in the attic if there is no moisture in the house. If indoor relative humidity is 4% then it doesn't matter about ceiling vapor barriers or wall vapor barriers, for that matter. If the attic isn't cold enough to raise the relative humidity of air from the house to dew point it doesn't matter either. However, if the attic is cold and the indoor relative humidity is in the 30% to 50% range that is recommended for human health, then a vapor barrier in New England ceilings is a pretty good bit of cheap insurance.

This brings me to the second example. "Heck," said another builder acquaintance (the only builder I know who actually says heck), "I put a vapor barrier in the ceiling once and the Sheetrock fell off the bathroom ceiling covered with slime mold. I'll never do that again." Well, he's right and he's wrong. The vapor barrier in the ceiling didn't create any moisture. One thing a good vapor barrier does do is make the house more airtight than it would have been without it. That probably made the indoor relative humidity higher, increasing the chances of condensation in the drywall. In the sense that tightening the house does this, you could, with slightly twisted logic, say that the vapor barrier caused the problem.

High Humidity, Cold Surfaces

But in every case where I've seen condensation inside buildings, there always has been either indoor relative humidity greater than 60% or something causing a cool surface where the condensation forms. If the relative humidity is 95%, all it takes is a degree or two of cooling and you have moisture condensing. Hence, water drips from the walls and ceiling of a bathroom when someone showers. If a piece of insulation is missing or if wind can blow through fibrous insulation so the drywall cools down to 50°F or so, then any indoor relative humidity above 50% will reach dewpoint on that surface. Hence, you might find dampness or mold on the ceiling near the soffit vents where the west wind blows in through the fiber insulation and cools the drywall. Or you'll find a mysterious puddle of water on the sill of the bow window only on days when the wind is from the east (and somehow the foam board that was supposed to cover the bottom of the sill got left out). Incidentally, windows with the new R-4 argon-filled low-e glazings are much less prone to condensation problems because of their warmer surface temperature.

Vapor barriers are a key part of the defense against moisture problems. Seal the joints and penetrations as well as you can within reason.

A third example of how job-site realities are more complicated than simple models is vapor barriers in the walls. For years I heard that you needed vapor barriers in the walls to keep moisture out. And on and off over the years I saw moisture problems in walls. But I saw nowhere near as many as I should have seen given the high indoor relative humidities and the feeble attempts at wall vapor barriers. Other people who spend their professional lives ripping walls open report the same.

In most pre-1980 houses I've studied, air enters through all the walls. As it enters, it is warmed up and the relative humidity drops, reducing the risk of condensation in the walls and in the house. So why not leave holes in the ceiling and walls and have houses work the way they used to?

Infiltration Helps

Most of the wall problems I've seen are on the lee (downwind) side of the house where wintertime prevailing winds push and pull house air through the wall, or on the north sides of houses sheltered by spruce trees with branches touching the siding. And the problem houses are often built in a swamp to boot. No, I think the reason I don't see so many wall problems in houses is that all those cracks and holes in the walls through which moisture should be entering the wall are plugged already. They are plugged with cold outside air coming into the house. The air is being sucked into the house because there are so many holes in the ceiling. In most of the houses I've studied that were built before 1980 or so, when there is no wind and it is cold outside, air is entering the building through all the walls upstairs and down. As the air enters, it is warmed up and the relative humidity drops, reducing the risk of condensation in the walls and in the house.

So why not leave holes in the ceiling and have houses work the way they used to? Because you have no control of the process that way. If a homeowner uses lots of water or the basement is damp or the wind blows from the wrong direction or a piece of insulation was left out or it's a cold winter, you could have condensation problems or the house might be too dry for the occupants. You also have no way of telling if you left enough holes in the ceiling and walls or if they're in the right places.

Finally, uncontrolled infiltration as a ventilation strategy uses more energy than a planned ventilation system. Yes, the house has to breathe just like you and I, but you and I breathe through specially planned openings, not through gashes made with a knife.

It's not that we built houses wrong all those years; it's more that we've been changing the way we build buildings in a piecemeal fashion. None of us can imagine every consequence of a change in the way we detail things. This is especially true when dealing with something like moisture in building where it takes a special set of conditions to result in condensation. These conditions involve the weather (temperature, wind speed and direction, previous precipitation, relative humidity, even barometric pressure changes), occupant behavior, the specific detailing of the building and how carefully those details were built. In other words, there are a lot of ways you can get water vapor in the air to contact a cool surface and thereby form condensation. Vapor barriers are part of the defense against condensation in buildings.

Rules of Thumb

So, what do I do for vapor barriers now? I don't think in terms of just a vapor barrier. I think in terms of how the vapor barrier, climate, amount of moisture, and ventilation system fit together. Here are the rules for cold, fairly humid climates found in most of the Northeast.

- Try and make the insulation layer as continuous as possible so that there are no cold spots because of low R-values. Prevent cold air from blowing through insulation by using baffles or foam board in susceptible spots. These include areas such as cantilevered overhangs, bottom sills of bow windows, roof overhangs, and skylight wells.
- Make a vapor barrier on the warm side of the insulation as airtight as possible without driving yourself crazy. Building tight can be relatively easy if the detailing is planned for it. This includes the ceiling.
- Plan the foundation dampproofing and drainage systems so that it is difficult for moisture laden air from the soil to enter the house.
- Plan the mechanical system so that moisture is exhausted near the sources (baths, kitchens, and laundries) and so that air pressure differences seal the cracks and holes through the vapor barrier that were missed. That means running the house under a slight negative pressure. Warning: Be sure that running the house negative does not downdraft combustion devices, such as fireplaces, hot water heaters, furnaces, and boilers. This means planning the heating/cooling, hot water, and ventilation devices as a system, not a hodgepodge. But that's another story.

By following the above rules you can maintain wintertime indoor relative humidity at between 30% and 50%, protect the building shell from condensation damage, control the unavoidable small sources of indoor air contaminants produced by human bodies and normal household activities, and lower the energy cost of conditioning the house. The result is a more comfortable, cheaper-to-own house that has less chance of causing problems. ■

Chuck Silver designs custom homes, and Terry Brennan consults on energy design. They currently run training seminars on energy-efficient construction for the New York State Energy Office.