Vapor Barriers and Condensation: Part II

Building researchers are helping out with the tricky questions.

Last month, in Part I of this column, we looked at the fundamentals of condensation in buildings—what causes it, how to control it, and whether we should worry about it. We concluded that small amounts of condensation can and do occur in wall cavities, but that structural damage rarely results because the walls dry out before temperatures are warm enough to support wood-eating fungi. Still, risks of paint-peeling, corrosion of metals, and degrading of insulation R-values do exist. A dry wall is certainly preferable to a wet one. And the most reliable way to achieve a dry wall is by installing a continuous vapor-retarding membrane such as 6-mil poly, paying attention to joints and penetrations. In fact, the penetrations may be more important than the main surfaces, since air leaks generally transport a lot more moisture than does diffusion.

This month, we'll look at questions frequently raised about how various materials and applications affect condensation. Even if you have a good handle on the theory, applying it can be tricky. Some materials both insulate and block vapor flow, confusing the issue. And in some applications, vapor flows reverse seasonally or spaces need both venting and sealing. It's enough to make a vapor-conscious contractor move to Phoenix (where presumably it's warm and dry enough that mold dare not grow).

Q: *How about insulating sheathings? Do they cause problems?*

A: Recent tests at the Forest Products Laboratory in Madison, Wis., confirm earlier reports that in a 2x4 wall in a moderately cold climate (7863 degree days), insulating sheathings create no greater condensation hazard than ordinary sheathings. In fact, in the FPL tests, insulating sheathings seemed to protect the siding from condensation, probably by slowing the flow of moisture to the siding. For thicker insulated walls, which will have colder sheathing, or for more humid interiors (greater than 40 percent relative humidity) these findings should be applied with caution. See Tables 1 and 2, which present some of the FPL findings.

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Q: *But don't insulating sheathings put a vapor barrier on the wrong side of the wall?*

A: A widely accepted rule of thumb holds that the exterior surface should be 5 to 10 times as permeable as the interior vapor retarder. ("Retarder" not "barrier" is ASHRAE's new preferred term.) However, since insulating sheathings keep the wall cavity warmer and present a warmer face to the wall cavity, higher levels of vapor in the wall can be tolerated before condensation occurs. Hence, the ratio of inside to outside permeability may be lower.

Q: *How much lower?*

A: You can play with the numbers if you're so inclined (see "Practical Engineering," *Solar Age*, 1/84) or hedge your bets by using a lapped and caulked poly barrier with all penetrations sealed. This approach also controls air infiltration. Hence the awkward but useful phrase *air/vapor barrier*.

Q: *Is polystyrene better than foil-faced insulating sheathings in preventing condensation?*

A: Theoretically, yes, because it is more permeable to water vapor; but no, because it has a lower R-value per inch. In the FPL tests, the foil-faced sheathing did slightly better, probably because the wall cavities were slightly warmer. Placing the rigid insulation on the interior sidesteps the whole problem.

Q: *How about using vent strips for the foil-faced sheathings?*

A: These are probably not a good idea. They were tried on one wall in the FPL tests, and actually increased the amount of condensation. One possible reason is that the air drawn out of the wall through the vents was replaced with moist interior air. Vents were used only at the top of the walls. If they're put top and bottom to solve this problem, they might degrade the R-value

Q: *How about stress-skin panels?*

A: Many of these have no vapor retarder on the inside—just drywall—and low-permeance sheathing such as waferboard on the exterior. Theoretically water could condense within the panel, most likely at the foam/sheathing interface. However, since on a 0°F winter day, less than a quarter of an ounce of water will diffuse through an entire 4x8 panel of foam (3½-inch thick) over 24 hours, I wouldn't lose sleep over this. I have asked around