Wet Insulation

More Moisture Myths Unmasked

by Henri de Marne

Only when water is constantly supplied to the warm side of fibrous insulation does its R-value suffer— and that never occurs in actual field conditions.

Much has been said about the R-value degradation of fiberglass insulation when it is subjected to moisture. I myself addressed the subject in the October 1985 issue of *NEB,* after reading that fiberglass loses 50 percent of its R-value when it gets wet. That comment got my dander up because it was made totally out of context and was completely misleading. I challenged the author about his assertions, and he replied that he made the statement only to make people aware of the problems of moisture in insulation (a totally irresponsible approach, as far as I am concerned).

Now, prompted by an *NEB* reader who asked me to follow up my October article with a more in-depth look at the issue, I am back again to look at wet insulation.

How Wet is Too Wet?

Wet fiberglass loses a great deal of its R-value, of course, but the question is: How wet does (or must) it get before this great loss occurs?

The 50 percent loss in R-value to which the misguided writer referred was attained by injecting water into one-inch-thick, high-density fiberglass insulation placed in a sealed, flat plate. This laboratory experiment used transient heat-flow measurements of a short duration to measure the effect of moisture in fibrous insulation. Real buildings, however, operate under a very different set of dynamics. These dynamics may not be fully understood, but they are widely recognized.

So what *does* happen to insulation in residential buildings when it is subjected to moisture in the course of weather and temperature changes? Much research, both in the field and in the laboratory, has been conducted on the subject, and the results often have been surprising.

Let's first review a study conducted by the late Professor Frank Joy of Pennsylvania State University College of Engineering more than 20 years ago. You might think that his research is too dated to be of use, but many authorities consider Joy the dean of heat-and-moisture research, and he still is cited in the *ASHRAE Handbook of Fundamentals.*

Joy tested a number of panels finished with various exterior sidings. Some were filled with blown glass fiber, and others with cellulose. After taking a number of readings over more than a year and spanning the peak and valley of the annual moisture cycle, he found that condensation occurs on the inside of the siding and of the sheathing—but only in the *interface* of the sheathing and fiberglass, with very little penetration.

This finding was corroborated in a more recent study by French scientists. Their findings were presented at an international conference in 1981 sponsored by the American Society for Testing and Materials, the Department of Energy and the Oak Ridge National Laboratory.

The French scientists found that in actual conditions experienced in real buildings, water vapor migrating through buildings by diffusion or by convection through various openings may condense on the cold side of the insulation (i.e., the back of the sheathing or siding). However, under these conditions, the most water that can be adsorbed (that is, deposited on the surface as opposed to being absorbed; it is impossible for fiberglass to absorb anything because it is nonporous) is 2 percent of the insulation's mass. And at such a low moisture content, the effect on thermal conductivity is negligible.

What this tells us is that there is a great deal of difference between a sample of dense, fibrous material placed in a flat plate and saturated with water and fiberglass batts—which are less dense to start with—installed vertically in stud cavities.

However, if water penetrates insulated cavities via roof leaks, ice dams at the eaves, etc., a considerable amount of thermal conductivity takes place. But these are not typical conditions, so the loss of R-value cannot be blamed on the fiberglass insulation—the leaks or ice dams should be fixed.

There also are "normal" conditions under which water can penetrate insulated cavities without the aid of roof leaks and ice-dam blockages—brick walls subjected to prolonged or heavy rains, for example. Here again, however, field research has proved that water penetrating from the cold side of the insulation generally will stay there and evaporate in summer without moving toward the warm side. Again, then, there is no measurable loss of R-value.

Only when water is constantly supplied on the hot side does fibrous insulation reach a level of increased thermal conductivity that affects its R-value—and that situation is never encountered in actual field conditions. Even in roofs, where the temperature gradient may vary significantly during the day, no field measurements have reported significantly increased thermal conductivity under normal conditions (i.e., insulation not saturated by roof leaks).

Wet Attics

In the attic, there are other variables, of course. In well-ventilated or large attics, vapor that might condense on the cold, or top, side of the fiberglass insulation generally evaporates rather swiftly.

But in poorly ventilated attics under shallow roofs, evaporation may not be possible, and water can migrate downward toward the ceiling finish. When plywood roof sheathing is used, this condition can occur much sooner than when plank sheathing is used, because the glue between the bottom two veneers of the plywood may stop or slow absorption by the wood fibers. (In older plyscord, the glue is not waterproof, however, so the plywood can delaminate.)

Board sheathing, on the other hand, has great storage capacity, as do the rafters. This storage capacity helps to bridge the temperature differences that result over time in condensation or evaporation.

If a plastic vapor retarder is installed properly, there is very little chance of moisture migrating into the insulation, except at perforations that have not been well sealed. Thus, there should be no problems. But when an ineffective vapor barrier (or none at all) has been installed, severe moisture conditions can cause staining of the ceiling. (In some very severe conditions over a long period of time, the ceiling-finish fasteners can rust and the ceiling can fall down—but again, this is not your everyday occurrence.)

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Crawl Spaces

Crawl spaces are especially susceptible to human error and negligence and thus are a different story. The most experienced among us—those who have risked life and limb crawling in dank, spiderweb-infested, muddy crawl spaces and sparred with an occasional skunk, sharp rock or rusty nail—are all too familiar with fiberglass insulation batts caught with their vapor retarders down.

Years ago, the thinking was that the vapor barrier should be toward the soil because the crawl space was so damp. But that was years ago—about 40 of them. We now know (as we have for years) that the vapor retarder (the recent evolution of the name) must face the *warm* side of the insulation. In any language, this means on the side of the floor when we're talking about a crawl space. Dampness coming from the ground must be *dealt with* on the ground—not underneath the floor joists.

Yet, time and again I come across recent installations in which the vapor retarder is facing down—toward the cold side—and fastened by its flanges to the bottom of the joists. This leads me to several conclusions: (1) Some people in the trade must not read what the manufacturer prints on the vapor retarder itself; (2) they can't read at all; (3) they purposely disregard instructions because they don't intend to get back down there, and they've never seen any trouble with the way they do it in the first place; or (4) flanges are for stapling, and you can't staple from the floor side when you are on your back in a crawl space, no matter what the misguided manufacturer says on the package (the maker obviously never worked under these conditions!).

What, then, is the result of this malpractice? If ground moisture is not controlled by a sheet of plastic thoroughly covering the earth, it permeates the entire space and bypasses the poorly installed vapor retarder. Meanwhile, interior moisture pressure, aggravated by the crawl-space dampness, drives vapor through the floor system, creating very high relative humidity within the insulation.

Crawl-space vents, however few there are, cool the crawl space during the cold months, and condensation takes place on both sides of the vapor retarder. I have been in crawl spaces where it was actually "raining" condensation and where the vapor retarder was sagging from the weight of water (which can be a blessing in disguise if you consider that the barrier *could* already have broken and dumped the water on the ground). Under these conditions, the vapor retarder generally is so rotten that it disintegrates when touched. In some cases, the insulation also drops to the ground.

Over a period of time, structural rot can take place—as it did in a house I inspected a couple of years ago. It was built on sand that felt very dry inside the crawl space, mind you, but don't let appearances fool you. Moisture can come up from great depths by capillary action, and, in this case, it certainly had. (After plastic was laid on the sand at my recommendation, water beads became visible within hours.)

I found all the problems associated with poorly installed insulation and vapor retarders throughout the entire floor area of this very large rambler. Upon removing batts from a number of areas, I saw that the floor joists were discolored (or even black), wet, or already rotting. The band joists were the worst because they, of course, were the coldest and therefore received more condensation.

Under these circumstances, there is no doubt that the R-value of the fiberglass had been reduced somewhat. But I don't believe this reduction was too drastic, since only the bottom quarter inch or so of the insulation actually was wet. The lack of band-joist insulation in that house undoubtedly created more heat loss by short-circuiting the insulation, which had been installed on the bottom of the joists. ■