MOISTURE PROBLEMS: FIVE CASE STUDIES

Understand the mysteries of moisture, or your buildings may suffer the consequences

by William Lotz

The basics of avoiding moisture problems in buildings are simple and few. But when they are ignored or misunderstood, the damage can be substantial and the repair costs high. In many cases, the builder lands in court. I know because I've consulted on and testified in a number of cases. Here are a few recent examples of moisture blunders, and a summary of what a builder needs to understand to steer clear of moisture damage.

Confused Over Vapor Barriers

This New Hampshire house was a year old when I saw it. The main level was log cabin construction but the second-story wall was framed. From the inside out, the upper-story wall consisted of v-groove 1x6 pine boards, unfaced 6-inch fiberglass, 4-mil poly, and vertical T&G plank siding. There was water damage everywhere. Ice ran down the exterior of the logs (see photo, top right). The contractor was obviously confused about the vapor barrier, which he installed on the cold side of the wall, rather than the warm side where it belonged. He also made the error of installing a recirculating kitchen fan over the gas stove and no exhaust fan in the main-floor bath. The second-floor bath fan vented into the attic (against the law in many states). Added to this was a basement water problem. The house is now being torn apart and rebuilt. I hope the contractor has good insurance coverage.

Rain From the Ceiling

This factory-built house was on the Massachusetts-New Hampshire border. The photo at right (middle) shows the black mold and mildew that resulted from one year of venting a kitchen exhaust fan into the eaves above the soffit. The prevailing winds blew the moisture back up into the attic space. The water dripped down into the fiberglass and damaged the drywall ceiling. The fan should have been ducted to a point outside the house, not into the eaves.

Cape Cover-up

A family bought this house in June; it had a nice new yellow paint job on the clapboards. By fall, the paint was peeling and it was evident that the new paint covered up severe wall rot (photo, bottom right). For years, the previous owner had stored many cords of green firewood in the basement. Not only was there no exhaust fan, but the dryer was vented into the basement. The wall had a poly vapor barrier, but it was full of holes as the result of a sloppy installation.

Due to moisture damage in the walls, the house required a major rebuild. The new owner filed suit against the former owner for trying to cover up the moisture problem. Someone had installed small, round aluminum vents in the stud spaces in an attempt to solve the problem. The vents didn't help with the moisture, but only lowered the thermal value of the fiberglass insulation.

High School Failures

The school was two years old and plagued by ice dams, which caused leaks into the lobby. The school board spent almost $20,000 in "corrective" ventilation which only made things worse. The problem was finally solved by applying a few rolls of vapor barrier tape (4-inch-wide TuTuf Acrylic), and modifying the existing insulation.

The ceiling insulation consisted of two layers of fiberglass batts in the ceiling/roof joists with a 2-inch air gap under the roof sheathing. The roof had eave and ridge vents, but a poorly sealed vapor barrier. Warm, moist air was leaking up into the cathedral ceiling due to the "stack effect." This reduced the thermal value of the insulation and melted the snow on the roof.

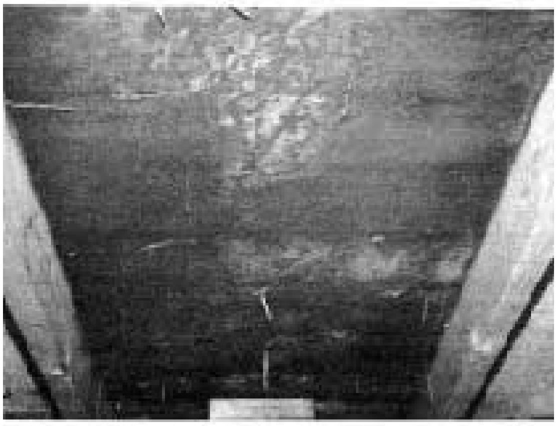
Heat loss through the roof was also increased by poor insulation placement. The contractor had installed the 4-foot-long batts directly on top of one another without staggering the joints. Multiple layers of insulation are much more effective when the joints are staggered.

We were able to solve this problem at minimal cost by sealing the vapor barrier and breaking up the

Vapor Barriers

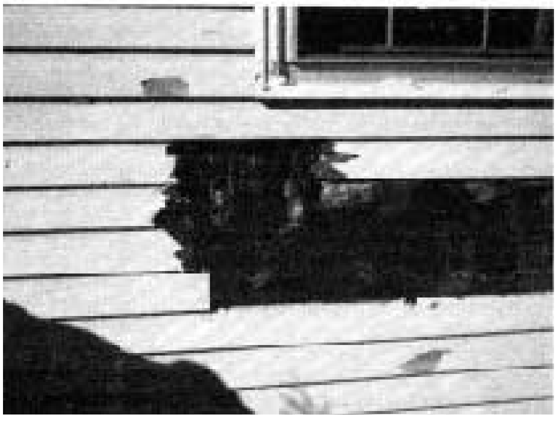
High moisture levels and a wrong-side vapor barrier ruined this year-old home. Note the ice running down the logs.

Rain from the Ceiling



The plywood roof sheathing turned black from moisture. The source: a kitchen fan exhausted in the eaves.

Cape Cover-up



Firewood stored in the basement contributed to rotted sheathing and studs.

batt joints. This stopped the ice dams and the related leakage.

Crawlspace Swimming Pool

I don't like crawlspace foundations. Here's a classic example of how they can fail. These buildings were built to U.S. Government specs for low-income housing. The architect's design included crawlspaces under each building. The builder put poly on the ground, but it had no value because the water table was *above* the poly!

After seven years, many of the floor joists had to be replaced because they had turned to black mush (see photo, right). Fortunately the house was built with a poly vapor barrier in the walls and ceiling, so damage to the rest of the building was limited.

To repair the crawlspace area, we needed sump pumps and a carefully installed concrete floor. The slab had to be reinforced and structurally connected to the foundation walls and columns. We also upgraded all of the bathroom exhaust fans and wired them through the light switch (rather than a separate switch).

I know of other similar buildings that collapsed into the crawlspace after less than 20 years because of wet crawlspaces and no vapor barrier.

Crawlspace Swimming Pool

Plastic sheeting on a crawlspace floor doesn't help when it's under water. The results: rotted 2x12s, a rusty window frame, and moss growing in the window sill.

Contractor, Educate Thyself

As a consultant, I commonly see moisture problems resulting from inadequate design or construction. In many cases, the problem stems from a lack of contractor training on the subject. Here are some basics that will help you steer clear of costly mistakes:

Insulation. The insulation must be continuous: that is, free of gaps and holes. This helps avoid cold spots that lead to condensation and heat leaks that cause ice dams. I see many problems caused by 1-inch to 3-inch gaps between batts, or by batts removed by tradesmen (often the electrician) and not replaced.

A good solution is to use multiple layers of insulation. In walls, I like to see foil-faced foam on the warm side of the fiberglass. In attics, a combination of batts and blown-in fiberglass works well.

Vapor barrier. Install 4-mil TuTuf (cross-laminated high-performance poly) on the walls and ceiling. Tape all of the holes and joints, and make sure the wall poly seals to the ceiling poly. And watch that tradesmen don't damage the installed vapor barrier.

The poly must be installed on the warm side of the insulation. In New England and similar cold climates, the vapor barrier should go on the inside. In Florida and similar climates, the vapor barrier goes on the outside of the insulation. In many parts of the South, placing the vapor barrier on the inside of the insulation results in problems with mold.

In the intermediate climates that require both heating and cooling, consider using a 1-inch-thick foil-faced foam board with taped joints. It can go on either the inside or the outside of the fiberglass insulation. The foam will then act as the air/vapor barrier. Also, because the inside surface of the foam stays warm, it is not prone to condensation.

It's important to understand that to keep moisture out of wall and ceiling cavities, the vapor barrier system *must* block both vapor diffusion and air leakage (since much of the moisture is carried by leaking air). That's why the factory-applied facer on batts is essentially worthless — it doesn't block air flow.

Ventilation. Once in a while I still hear, "I don't want to live in a ziplock bag." Some people just don't understand. The approach that is most energy efficient is also the one that best protects your building from rot. This is to install as good a vapor barrier as possible and then use *controlled ventilation*. Install good quality, quiet exhaust fans in the kitchen and bath and duct them outdoors — *not into the soffit or attic*. There are few more worthless items than a "recirculating" kitchen exhaust fan.

Hot tubs and indoor pools require special ventilation design. Always vent clothes dryers outdoors. In cold climates such as New England, a clothes dryer vented into the building can cause substantial damage in one season.

Common sense. Don't store cords of green firewood indoors. Don't leave bare ground in a basement or crawlspace. Avoid humidifiers in energy-efficient buildings. Don't put skylights over hot tubs.

Exterior sources. All buildings need flashing and caulking. You'd be surprised at the buildings I see with neither. And caulk does not last forever. It wears out and needs to be inspected and repaired regularly.

In cold climates, roofs need ice dam membrane under the shingles. The membrane should cover 3 feet at the eaves in a typical roof, but may need to cover up to 100% of the roof under some conditions.

Finally, the backfill should slope away from the building and foundations should have a drainage system if the site requires it. A wet basement leads to moisture problems throughout the house.

Notify the owners. Leave written instructions with the owner that explain moisture problems. Most homeowners have no idea why there is frost on their windows. I was called by an attorney this morning. He told me a lawsuit against a contractor was settled finally. The homeowner abused a house with too much humidity and then sued the contractor when the window frames turned black. The suit cost the contractor several thousand dollars in fees from lawyers and experts for some minor window frame damage. A few instructions on occupant behavior could have saved a lot of trouble. ■

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