Moisture problems in buildings in hot humid climates

Moisture problems can be minimized by employing the four basics of moisture control

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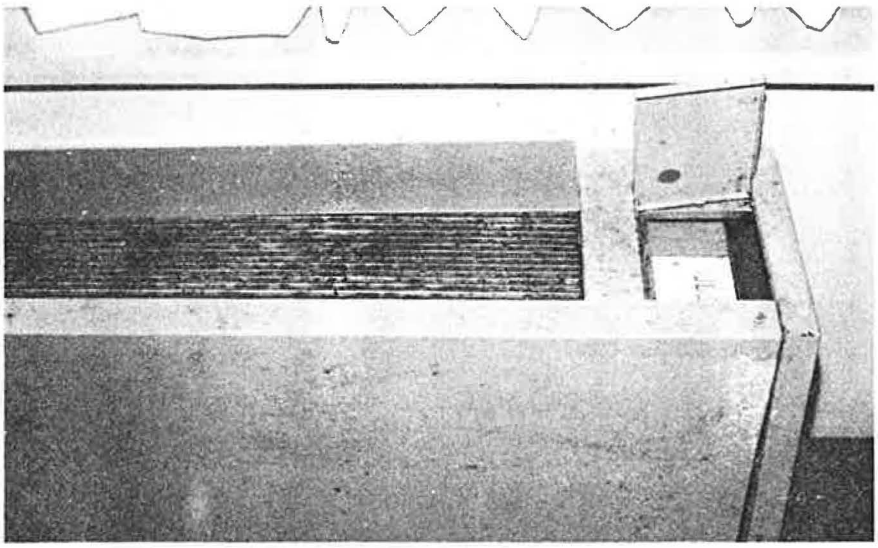
For this paper's purposes the definitions of hot and humid are, by ASHRAE, one percent standard design criteria with hot humid defined as over 90° F Dry Bulb with coincident 76° F or higher Wet Bulb temperature. In the USA this includes the Gulf Coast, Florida, coastal Georgia, North Carolina, South Carolina and Virginia.

The basics of building moisture control, regardless of the climate are the same:

- Control (reduce) indoor relative humidity.
- Insulate to control surfaces above the dew point.
- Vapor retarders to control vapor and air flow between indoors and outdoors.
- Control of external water penetration into the building including rain and ground water.



Extreme moisture problems in a building in south Florida, caused a heavy growth of mold on this thru-wall air conditioning cabinet in less than one year's time. The vents were almost entirely covered with growth.

Indoor Relative Humidity

Most buildings in this geographic area are air-conditioned. The air-conditioning system should be designed to keep the relative humidity below 50 percent, which means a dew point in the upper 50°F. The make-up air to replace exhausted air needs to be conditioned and hence, included in the sizing calculations for the A/C equipment. The ducts for the air conditioning need to be properly insulated for condensation control including a good quality FSK (Foil-Scrim-Kraft) vapor retarder on the duct insulation. Fiberglas duct is more cost effective than insulated sheet metal ducts.

All bathrooms, kitchens and other moisture sources must have a good quality, quiet exhaust fan ducted to the outside. Clothes dryers *must* be vented outdoors. Of special importance is the use of the kitchen hood exhaust fan if gas is used for cooking since its combustion creates water vapor.

It is also particularly important to provide air flow via ducts in closets, otherwise, mold will grow on leather products such as shoes. Less effective means of control for closets are via louvered doors and/or a light bulb left on.

Insulation

Masonry buildings are very popular in this geographic area. Durability, cost, termite problems and thermal mass are among the reasons that wood buildings are not as popular in this climate. Masonry buildings are frequently insulated with foam boards, whereas Fiberglas batts are the most popular insulation for wood frame buildings. Insulation does more than just slow down the rate of heat transfer, it has an effect on moisture flow and condensation. In my opinon, the best way to insulate a masonry building is with polystyrene board insulation on the outside of the masonry and then cover the insulation with a stucco finish. Several manufacturers make complete systems consisting of insulation, fastening systems, reinforcement and an acrylic stucco material. The polystyrene foam has the ability to block moisture flow and it has been successfully used for over 30 years in cold storage warehouse construction. The system is frequently referred to as exterior finish insulation system (E.I.F.S.). This system is limited to 4-in. thick (R 16) foam by fire codes in most states.

Foil-faced foam boards provide excellent insulation, and if the seams are sealed, a good vapor retarder. However, the foil is thin and if it is used against portland cement products or the foil surface is damp frequently, the foil will corrode and lose its vapor resistance. This is true due to the higher temperature (chemical corrosion goes faster at higher temperatures) and humidity (higher likelihood of condensation) found in this climate.

Fiberglas batts are an excellent, very low cost, ubiquitous insulation. If used properly, Fiberglas can provide a good return on investment. Fiberglas must be used in conjunction with an effective air/vapor barrier/retarder. If air can flow through the batts, the air flow can reduce the R value of the batts to zero. This can happen in buildings with a negative pressure and also in buildings where the builder attempted to ventilate (for moisture control) the stud space.

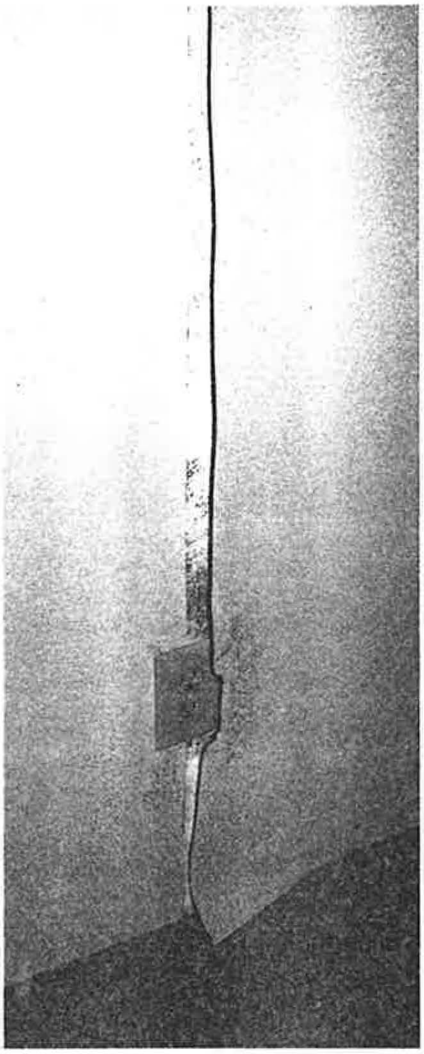
Vapor retarders/air barriers

Vapor retarders are a necessary aspect of any insulation system. Many years ago, a vapor retarder (then vapor barrier) was defined as any material with less than one perm (grains/hour/square foot/inch of mercury difference) moisture flow rate. In my opinion this is no longer a valid definition for an energy-efficient building. A more realistic definition is 1/10 perm. We have seen in scores of buildings, examples of residential fiberglas batt foil facers (.5 perm) not being an adequate vapor retarder.

The vapor retarder must also be an air barrier. Moisture flows by two mechanisms —diffusion and air movement—*both mechanisms must be addressed.* The vapor retarder must be installed on the warm side of the insulation. This is most critical with fibrous insulations.

Common building materials such as concrete block, wood, sheetrock and 15 lb roofing felt are not vapor retarders. Foil backed gypsum sheetrock is a good vapor retarder, *in the laboratory,* however in job site conditions, there is no effective means to seal the joints against vapor/air flow.

A serious problem in hot humid climates is a wall with little vapor resistance on the exterior and a vinyl wall covering on the inside. There are many of these buildings in hot humid climates that are in severe distress as a result of this type of construction.



This vinyl wall covering has pulled away from the wall as a result of high mosture conditions. The vinyl acted as a vapor dam on the "cold" inside wall as result of no vapor resistance on the the exterior wall.

The most frequently used vapor retarder for general building construction is polyethylene film—usually referred to as poly. Instead of the familiar transparent poly, a cross-laminated high performance poly has better properties. This type of product is more durable, puncture resistant and has a better perm rate than "ordinary" or transparent poly. As with any material, the joints must be sealed. A common construction problem is caused when an electrician or plumber cuts a hole in the poly for installation of conduit or pipes. To solve this problem one should seal all holes in the poly with vapor retarder tape. This should be clearly shown on electrical, plumbing and HVAC drawings where the installer can read it.

Aluminum foil is an excellent (low perm) vapor retarder—if the joints are sealed with a compatible foil tape. In hot humid climates, foil is more likely to corrode and lose its vapor retarder properties. See page 84, June 1969 *ASHRAE Journal,* "Facts about thermal insulation" for test data on holes in foil vapor barriers.

Some insulations are also effective at controlling vapor flow and need no separate material to retard vapor flow under normal building use conditions as long as joints are sealed.

Protection from condensation is necessary on cold ware or refrigerant piping, internal rain leaders, or other cold system components inside the building.

External moisture

As a moisture consultant, the first challenge in examining a "wet" building is to determine if the moisture source is external or internal condensation. Sometimes both are found.

In the Gulf coast and southeastern area of the United States, heavy rain is not unusual. Even under a normal, hard driving rain most buildings will leak somewhere. Masonry buildings can leak and/or wick water. Treatments are available to reduce this problem.

Generally, any slab-on-grade should have 8 or 10 mil poly under the slab to reduce water wicking through the slab. Flashing and caulking, or the lack thereof, are frequently to blame for moisture problems.

Another result of excessive moisture is mold on building surfaces. Mold inhibitors are available in exterior paints. These paints can be used in any climate to reduce mold formation.

Building foundations need to be professionally waterproofed. There are a variety of commercial products on the market, such as bentonite, tar, asphalt, plastic materials, etc., that can provide adequate waterproofing on the exterior of a poured concrete foundation.

In summary, if you pay attention to details during the design and construction of a building and take into consideration "the four basics" of moisture control, the likelihood of moisture problems will be minimal. ■

About the author

William A. Lotz, P.E., Member ASHRAE, is a consulting engineer. He is a graduate of the University of Miami with a bachelor of science degree in mechanical engineering.