Condensation in Walls

Q: All of the literature I have read on the subject of condensation within wall cavities warns of the problem but does not provide any clues as to how to predict it. Is there a formula which will determine the dew point when both inside and outside relative humidities and temperatures are known?—J.L. Bokus, Greenfield Center, N.Y.

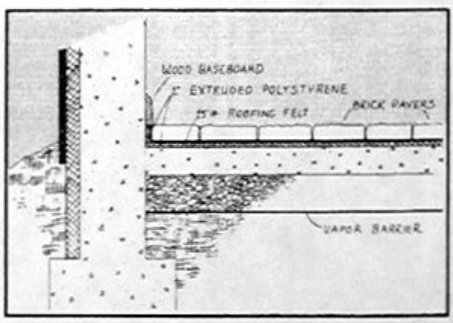
A: Mathematical models exist for computing the place and accumulation of condensation in walls. Their usefulness, however, is limited for a number of reasons. First, the models are based exclusively on diffusion theory. In reality, air leakage rather than diffusion accounts for the largest portion of moisture transmission in homes. The relative contributions of each in walls and ceilings is unpredictable. Second, the models assume the wall is continuous and the environmental conditions unchanging. Actually, conditions constantly change and cold spots occur at air leaks to the outdoors, lapses in insulation, at building corners, around openings for doors and windows, and at thermal short circuits caused by highly conductive materials such as metal, glass, and concrete. These are the places where problematic condensation is likely to occur. Also, the prediction of condensation does not necessarily indicate a problem. The length and severity of winter, and the ability of building materials to safely store and expel moisture are important factors. With this in mind, the best defense is a good offense: proper air and vapor barriers, caulking, and thermally broken door and window components.

To do the calculations, you need to know the temperature and vapor pressure gradients through the wall. These are directly proportional to the resistances of the wall's components to heat flow and vapor flow, respectively. At any point where the calculated vapor pressure exceeds the saturation vapor pressure (derived from the temperature at each point), condensation may occur. For greater accuracy, the vapor pressure curve is recalculated for each plane of condensation in an iterative procedure. For further information, see the National Bureau of Standards Report #BSM63, *Moisture Condensation in Building Walls* or check the *ASHRAE Fundamentals Handbook*, which is available in many libraries.

Insulating a Greenhouse

Q: We have a greenhouse with a 30- by 20-foot vertical south-facing wall and have searched in vain for a thermally efficient and aesthetically acceptable nighttime insulation. Also, we plan to add a brick floor on top of our slab which is insulated only on the perimeter and always feels cold. Should we put an inch of blue Styrofoam under the brick to isolate it completely from the slab? We have no significant overheating problem.—Paul Pease.

A: A number of options for nighttime insulation are described in the *Solar Age* article (6/83) "Warm Wraps for Cold Windows." Slab floors, even if they are insulated, tend to be chilled by downdrafts from cold window surfaces. So you should look for a window insulation with good edge seals to reduce the cold airflow at night.



If you find that window insulation does not solve the cold floor problem, then adding insulation to the slab would be in order. Your approach should work well as long as the brick will provide adequate thermal storage for your design. To increase the new floor thickness, you can set the brick on edge. Since you are setting the brick over compressible material, a flexible (mortarless) paving system would be easiest. In this type of system, the bricks are tightly packed to one another without wet mortar. A mix of sand and dry mortar may be swept between the joints and dampened for a more solid and less permeable floor. You may set the bricks on the foam insulation or add a layer of plywood underlayment first. In either case, a double layer of 15# felt paper is recommended directly under the brick as a cushion and to protect the underlayment. Since heat loss is greatest from slab edges, you might want to thermally isolate the new floor from the foundation walls by adding a foam strip at the floor's edge, which you can conceal with a baseboard.

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