Converting Our Infrastructure Into Self-Composting Buildings

By Dr. Richard E. Norris, RRC, PE

We are converting many existing buildings that used to work into self-composting buildings by changing to reflective roofs and/or adding ventilation.

Efforts to improve energy efficiency and to reduce the heat island effect have prompted legislatures to make rules requiring green or reflective roofs. This effort is well intentioned, but it can have unintended consequences.

Let us send a message to legislators: "You cannot change the laws of physics! White roofs are not always a good thing." This reminds me of the joke about the admiral and the seaman first class. The radar shows that there are two blips converging that will soon collide. The admiral, on the bridge of his flagship, tells the radio operator to order the other blip to change course to avoid an imminent collision. The radio operator does so, but the radio operator from the other radar blip replies, telling the admiral's fleet to change course. There is some back and forth, and finally the admiral gets on the radio himself and says, "This is Admiral Smith on the Aircraft Carrier Enterprise. I command you to change course." The seaman responds, "This is Seaman First Class Jones in the Cape Hatteras Lighthouse. I am very sorry, sir, but I am unable to comply."

I have a similar message for the International Code Council: "Ventilation of the attic is not always a good thing!" Most of the time, it is a great idea; but in humid climates, it lets moisture into the attic. It also lets warm (or cold) outside air into the attic under the roof deck, marginalizing the insulation on top of the roof deck, "where it belongs."

Building envelope assemblies must work with the buildings on which they are installed. An architect once said, "It's not my job to design the roof. That's the material manufacturer's job." I couldn't disagree more. The manufacturer's system designs and details are not "one size fits all." They make the materials, and it is their responsibility to give the designer sufficient information about their materials and systems to allow the designer to design the building system. Different climates, different uses, different exposures/orientations, different adjacent materials and systems—different anything—can allow condensation to accumulate in one building, while another "identical" building has no such issues.

Common-sense building envelope design is essential; however, it is not sufficient. Computer hygrothermal-analysis tools (WUFI is the only such tool generally available in North America—THERM does not include moisture movement in its model) are necessary, but WUFI is very difficult to use properly and is easily misused. Consultants, architects, and engineers are the majority of the designers of building envelope systems, if one does not count contractors (or owners), who make up the majority of the designers of the roof replacements on existing buildings.

The science necessary to understand hygrothermal analysis is generally taught to mechanical engineers (or in some countries such as Canada, building scientists). Architects and others who learned ASHRAE Standard 160 prior to 2009 need a refresher course. We will soon become subconsultants to the HVAC industry if we do not learn the science. It isn't easy. I struggled with some of it at first. It involves higher math (integral calculus) and thermodynamics (movement of heat through building materials and systems). Moisture movement is included, also involving higher math.

Example: Changing from a dark gray, built-up roof to a cool (white) single-ply membrane has resulted in the accumulation of condensed moisture in the roof assemblies on many buildings. Roofing material manufacturers are beginning to warn designers and contractors that there may be a problem with this practice in cold climates. I have seen it in coastal areas of Northern California, too.

Unfortunately, the industry has forged ahead for the last ten years or so. We now have a large inventory of buildings with deteriorating roof decks and supporting framing. Building owners will have to dig into their pockets to reroof again long before the anticipated useful life of the "new" roof has expired.

There is plenty of finger-pointing. To my knowledge, the courts have not yet settled the question of responsibility.

Let us stop this unfortunate practice now and insist on designing building reroofs properly. We need to educate building owners so that they are willing to pay the "extra" cost for a proper design, including a hygrothermal analysis. This is far cheaper for them than reroofing again (possibly also replacing portions of the roof deck and supporting framing) in two to five years.

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