Ventilation is Key to Roof Cooling

By Gary Urbanski, Chairman, Roof Assembly Ventilation Coalition

Heat is energy or the flow of energy. On a cloudless day, it arrives from the sun at a rate of more than a kilowatt per square meter. Some of this energy is reflected but even accounting for reflectivity (or albedo) a substantial fraction is absorbed by the roof as heat.

In hot climates, heat arriving on a residential roof accelerates the aging of roofing materials and raises attic and household temperatures. The best thing to do with this excess heat is to remove it.

Heat transfer occurs by three mechanisms: radiation, conduction and convection. Radiative heat transfer depends on the roof temperature relative to its surroundings and the emissivity of the roof material. (Emissivity is simply a measure of a material's ability to radiate absorbed energy.) Conduction is undesirable because the whole purpose of insulation in hot climates is to block conduction from the roof into the household. That leaves convection as the most controllable mechanism for removing heat from the roof and this is where ventilation plays a key role.

Convective heat transfer is very efficient. A fluid (air) flowing over a surface will cool that surface provided the fluid is at a lower temperature than the surface. Some convection occurs naturally on the upper surface of the roof but convection can also be enhanced by flowing air underneath the roof deck as well. In this manner, heat is not allowed to accumulate between the roof surface and the insulation. In short, ventilation is a highly effective method for reducing roof temperatures in hot climates.

In contrast, reflectivity only reduces the energy load on a roof. It does not actually remove heat that has accumulated. In hot climates, ventilation is the best assurance that the temperature of the air *against* the insulation is closer to the outdoor ambient air temperature.

Adequate insulation combined with proper ventilation is a key principle of building design, which is becoming increasingly important in the drive for energy-efficient homes.

It is not surprising therefore that the chapter in the *Asphalt Roofing Residential Manual on Design Considerations* [1] opens with three sections on ventilation, including sections that address:

- Ventilation and Moisture Control
- Ventilation Effects on Heating and Cooling Costs
- Ventilation Hints and Practices

Moreover, the ARMA Technical Bulletin titled *Ventilation and Moisture Control for Residential Roofing* provides a concise overview of ventilation requirements [2]. It explains how calculations depend on three primary factors: the size of the attic, the placement of the vents and the *rating* of the vents.

The most efficient ventilation works on a principles similar to the *cross ventilation* that occurs when windows are opened on opposite sides of a room and the *chimney effect* that occurs when heat rises and is replaced by cooler air through a chimney. There are two types of vents, intake vents (at the eave or soffit) and exhaust vents (at the upper portion of the roof). It is a combination of these types that provides free-flow ventilation, which is the most efficient way to handle problems of unwanted heat and moisture in enclosed areas.

Instead of looking at new and potentially expensive ways to achieve green, let us look to tried-and-true methodologies such as ventilation as ways to save some green in the greening process.

The ARMA technical bulletin states:

In most cases, a minimum free-flow ventilation area equal to one square foot per 150 square feet of attic floor area must be designed and properly installed to provide proper ventilation. Where a

'properly' designed and installed eave and ridge ventilation system is employed, a free-flow ventilation area equal to at least one square foot per 300 square feet of attic floor area is often sufficient. Combination eave and ridge venting is generally recognized as a superior venting technique.

The best ventilation solution will depend on the climate conditions as well as the specifics of the home design, i.e., the roof slope, roofing materials, decks, insulation, vapor barriers, attic space and so forth. Best results will be obtained through knowledge of building science and proper application of ventilation technology, both of which continue to advance. The calculations can be somewhat complex so the services of an experienced professional roofer or expert building designer may be needed for optimal results.

Responding to the need for a better understanding of roof ventilation and material performance as it relates to the code and regulatory bodies and other forums, ARMA recently formed the Roof Assembly Ventilation Coalition (RAVC) along with six key industry roofing ventilation companies. Based in Washington, D.C. under the umbrella of ARMA, the purpose of RAVC is to help identify sound science regarding steep-slope roof ventilation.

In the years ahead, there will be many improvements in how homes are designed to accommodate hot and humid climates. These changes are difficult to predict but one thing is certain about the development of energy-efficient homes in Florida: Ventilation will play a key role.

Energy efficiency is a key aspect of green policy for the new administration. Instead of looking at new and potentially expensive ways to achieve green, let us look to tried-and-true methodologies such as ventilation as ways to save some green in the greening process.

For more information about roof ventilation please visit www.ravcoalition.org.

References

1. Asphalt Roofing Residential Manual, Chapter 3, ARMA, 2006. Available from ARMA.
2. ARMA Technical Bulletin, “Ventilation and Moisture Control for Residential Roofing,” ARMA Form No. 209-RR-86, Revised May 2007. Download PDF free-of-charge at www.asphaltroofing.org/pdf/tb_209.pdf.