Unvented Attic and Cathedral ceiling construction

History of roof venting

Before the introduction of insulation, moisture was not a problem in roof spaces. Roofs were exposed to warm, humid interior air. This warm air raised the interior temperature of the roof space and decking materials. The roof itself, made of vapor-permeable, natural materials, allowed water vapor to pass through it to the outside without condensing on the interior surface.

With the introduction of insulated roof spaces (attic and cathedral ceilings), the temperature in attics was reduced and water vapor passing through the ceiling to the attic encountered decking materials that were now colder than before. Condensation resulted, causing moisture problems and in winter, a build-up of ice.

The solution was to install a vapor diffusion retarder (VDR) on the warm side of the insulation, and to ventilate attics to remove any water vapor that succeeded in passing through the VDR and the insulation.

Similarly with cathedral ceilings, designers and builders faced similar moisture problems. Their solution was to leave an air space between the roof deck and the insulation material. Vents at the soffits and ridges allowed outside air through the space. The function of the air space in a cathedral ceiling is exactly the same as the function performed by attic vents.

Modern attic and cathedral ceiling technology

The Icynene Insulation System® provides architects and builders with a new tool. While this modern material may be used with ventilation in the same configuration as glass fiber, it also allows us to roll back the clock and build as our forefathers did. There is no longer a need for ventilation or air spaces. This is accomplished with spray-in-place, air sealing foam insulation called polyicynene – the basic element of The Icynene Insulation System®.

Purpose of present conventional roof space ventilation practices

Conventional purposes for ventilation and the air spaces in roof spaces are:-

(1) remove moisture;

(2) lower the temperature of the roof to impede the buckling of roof shingles; and

(3) prevent temperature rise in the roof deck, which could result in ice damming.

Moisture problems and ice damming in roof spaces are caused by air leakage from within the conditioned building and vapor diffusion, which allow moisture to pass through fibrous insulation materials and to condense on the nearest cold surface. It is well documented that, in most situations, diffusion accounts for only 1% of moisture transfer, while movement of air accounts for 99% of the total moisture load on roof spaces and materials. Thus, controlling air leakage virtually eliminates moisture problems.

Scientific research (University of Illinois Small Homes Council, and Florida Solar Energy Center) has determined that the maximum exterior roof temperature for roofs without ventilation or air spaces is virtually the same as those with ventilation and air spaces. The tests, conducted over six months, found that, in the critical high-temperature range above 140° F (60° C), there was only a 3° to 5° F (1.6° to 2.8° C) difference in the non-vented roof. They concluded that any effect of the ventilation was far out-weighed by the solar gain – so that no difference could be expected to occur to shingles, with or without ventilation.

In Montana, a mountain state with heavy snowfall, insulating cathedral ceilings with spray foam without ventilation or air space has been standard practice for many years. There is no evidence of an ice-dam problem in those homes. Similarly foam-core, stress-skin panels

(SIP panels), without ventilation, have been used as roofing for decades, with no evidence of problems.

Unvented roofs are now widely accepted in humid climates like Florida.

Why Icynene® does not require ventilation: Air leakage control

Icynene® has a low air permeance – low enough to be classed as an air barrier. Therefore moisture movement through polyicynene foam by air transfer is virtually nil.

Why Icynene® does not require ventilation: Vapor diffusion permeance

The 1% of moisture that is conveyed by diffusion is usually not a problem, because the amount is so small that it is measured in nanograms (one-billionth of a gram). Its effect is easily overcome by normal drying cycles inherent in wood materials.

Five inches (125 mm) of polyicynene foam has a vapor permeance of 10 perms (565 ng/m^2/s). This property allows low rates of moisture diffusion to occur, just enough to allow breathing of adjacent framing and decking materials to prevent moisture entrapment. The minimal diffusion that does occur through polyicynene foam will pass through the material without condensing, provided that the substrate to which it is attached is equally (or more) vapor permeable.

Final Word

The Icynene Insulation System® has been applied in unvented roof spaces in all climatic extremes for many years. There has not been a single reported complaint about any lack of performance or failure with the material. However, the building code in your community may dictate that ventilation and air spaces are still required. The final authority may not be the building code, but a professional consultant. Many jurisdictions allow for alternative installation techniques provided they have been reviewed and approved by professional architects or engineers. Finally, many building codes have been amended in recent years to allow for unvented roof installations. This is a promising sign that this approach to insulating attics and cathedral ceilings may be universally adopted in the future.