Ventilation White Paper
Roof Assembly Ventilation Coalition
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Debate over Sealed Attics vs. Ventilation Intensifies Amid Calls for More Scrutiny

Residential attics have become a focus of debate between the academic and construction communities over roofing design and, ultimately, the appropriate use of roof ventilation in new construction.

Promoting the introduction of new attic designs is a small group of building researchers who think that unvented roofs may perform as well as ventilated roofs in preventing excess attic heat and moisture.

Calling for caution before substituting theoretical designs for proven practices are roofing and insulation manufacturers, constructors and home builders who say the research to date is too fragmented and incomplete to alter traditional ventilation methods and that potential downside risks of unvented roofs have not been investigated.

Although this type of debate typically is confined to research papers, the subject has taken on a sense of urgency following efforts to introduce unvented attic designs directly into accepted HVAC practices and code considerations.

Understanding the Debate

The current impetus for alternative attic designs goes back to the energy crisis of the 70's and the search for energy savings through the reduction of residential heating and cooling loads. By the early 90's, research was focused on the use of unvented attics to eliminate heat and cooling load losses from air leakage in attic-installed ductwork and to improve moisture control in response to reports of excess attic and interior moisture in newer homes using "tight" construction methods.

In simple terms, unvented attic constructions - also referred to as "sealed" or "cathedralized" attics - call for excluding all venting to the exterior. Typically, for traditional flat-ceiling attic spaces with a sloped roof plane, unvented construction calls for creating an airtight ceiling plane to eliminate indoor moisture infiltration, followed by a thermal barrier [insulation].

Because of the impracticality and costs of constructing a completely airtight ceiling plane, unvented "cathedralized" construction is increasingly being viewed as the more realistic alternative. Unvented cathedral configurations place both the insulation and vapor barrier along the underside of the roof sheathing, with the finished space directly below the attic insulation. Alternately, the attic insulation and vapor barrier may be placed along the underside of the roof sheathing, making the attic cavity a conditioned space.

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Shortcomings Cited

Although the possibilities for unvented attic designs seem promising for limited climate areas, building product groups and home builders are adamant about the need for further study before considering the introduction of unvented attic spaces as a routine design option.

Of particular concern is the lack of research on unvented attic performance in varying climates, differing structure sizes and varying roof slopes; researcher reliance on simulations rather than field demonstrations; the absence of energy consumption analysis and costs, and the lack of any investigation into possible downside health risks. Major unresolved issues appear to focus on the following areas:

Moisture Control: Because sealed attic constructions eliminate the moisture-reducing effects of ventilation, moisture control must be accomplished by halting the infiltration and leakage of interior air into the attic cavity or roof assembly. Critics charge this highly complex and difficult-to-achieve design requirement - although crucial to determining the viability of unvented attics - has not been significantly addressed in full-scale modeling, analysis, or field demonstrations for varying climates and structure types. In addition, suggestions for ensuring moisture control by adding mechanical ventilation or other system alternatives have not been fully subjected to comparative economic analysis with traditional ventilation. For example, studies in the 70's found that adding mechanical ventilation to control moisture resulted in net energy cost penalties.

Ice Dam concerns: Several studies have indicated the need for additional design elements or safeguards to ensure the effectiveness of unvented roof cavities in preventing winter icing and ice damming in cold climates. Because traditional ventilation has been shown repeatedly to be effective as well as a cost-efficient means of preventing ice damming, roofing professional argue that consideration of unvented attics in ice dam prone areas is must address the need for ice dam prevention.

Limited Climate Data: Most of the research conducted on unvented attics has been limited to very broad climate categories, such as cold-dry, cold-wet, warm-humid, and warm-dry.

This overlooks scores of in-between and temperate climate zones throughout the United States. Because the performance of attic cavity designs varies significantly with climate, building product groups and home builders argue that much larger demonstration projects need to be done in highly defined climate areas to better reflect real life situations.

Heat Build-Ups: Most research on unvented construction has shown both higher peak temperature readings for the sheathing and shingle undersides, as well as higher heat levels for longer periods of time than with vented constructions. Lack of data and analysis on the impact of this sustained heat build-up on shingle life span and overall degradation of roofing materials remains a significant shortcoming in determining the suitability of unvented attics in hot climates. In addition, roofing manufacturers point to long-term research data and field readings that show substantially higher shingle and roof deck temperature readings than reported in the limited research on unvented configurations.

Indoor Air Quality: Because indoor moisture, microbes and airborne pollutants cannot be vented to the exterior with a sealed attic construction, the potential for inadvertently trapping fungal-growing moisture and microbial contaminants in the attic cavity and home interior, presents a potential occupant health concern which requires in-depth health analysis and investigation to ensure homeowner safety and well being.

Ventilation Ratios: The research trend away from ventilation was spurred in part from the absence of supporting documentation for the long-standing code requirement of a 1:150 ventilation rate [1:300 with balanced eave soffit and ridge vents]. Although the 1:150 and 1:300 ratios remain sound guidelines for the majority of U.S. homes today, a growing number of building professionals are now suggesting that researchers should consider developing scientifically verified ventilation rates for different climate areas to established optimum ventilation ratios for attic performance.

Impracticality of Airtight Barriers: Researchers studying unvented attics using an airtight ceiling plane have reported exceptional difficulties in constructing a true airtight barrier. Building professionals agree, noting the virtual impossibility and extremely high costs of constructing a perfectly airtight ceiling. In addition, they point to the pitfalls of ensuring a ceiling plane's integrity over time due to lumber shrinkage, normal settling, poor workmanship, and homeowner alterations.

Practical Implications

Until recently, few professionals in the construction community were aware of the research being done on unvented attics, let alone the possibility that such preliminary research findings could find their way into accepted building practices.

But in late 1996 - with little fanfare of input from roofing professionals and building contractors - a heavily academic-oriented committee of the American Society of Heating, Refrigerating and Air-conditioning Engineers [ASHRAE] decided to eliminate attic ventilation requirements from its "***1997 ASHRAE Handbook of Fundamentals".*** The 2001 revision of the ***Handbook*** now calls for attic venting as a recommended-but-not-required practice in cold and mixed climates, and as a design option in warm climates.

Even then, little notice was taken of the unvented attic movement until early 1999, when the issue suddenly surfaced in the form of a quiet proposal to eliminate ventilation requirements from the International Building Code. Although the proposal was subsequently defeated for lack of supporting data, the action sounded a wake-up call among building industry trade and professional groups.

Code Considerations

As previously discussed earlier residential codes required ventilation beneath the roof deck and contractors wishing to use unvented attic or roof assemblies were required to submit alternate demonstration of compliance with the intent of the code. Recent code changes have introduced provisions for unvented attic assemblies. ..

In March 2005, Danny S. Parker, Florida Solar Energy Center, noted in his *Literature Review of Attic Ventilation Impacts of Homes for the Florida Department of Community Affairs* that:

> Codes vary somewhat in interpretation from one geographic region to the next. Some jurisdictions allow new sealed attic construction, while others do not. Although the 50% distribution rule within the code requires both soffit and ridge vents, it seems very unlikely that 1:150 is ever enforced based on calculation alone. Often, the code approval is based on the least common denominator: "building has perforated soffit vents and ridge vents = pass."

Questions linger, however, about the code definitions of attic, plenum, and cathedral ceilings, and the potential effect of unventilated roof decks on the durability and performance of the roof coverings.

Conclusions:

Consequently, several building product manufacturers, contractors and residential construction groups are now calling on the building research community to conduct additional research, environmental analysis and field demonstrations to learn if unvented attic configurations are a suitable and safe design option to traditional ventilation.

This article has been developed by the Roof Assembly Ventilation Coalition, representing those whose interests may be served and benefit from the goal to study, monitor, and promote the interests of steep slope assembly ventilation through sound theory backed by scientific data.

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The Roof Assembly Ventilation Coalition mission is to study, monitor, and promote the interests of steep slope roof assembly ventilation through sound theory backed by scientific data. For more information please contact James Baker at 202-207-1114 or email jbaker@kellencompany.com.