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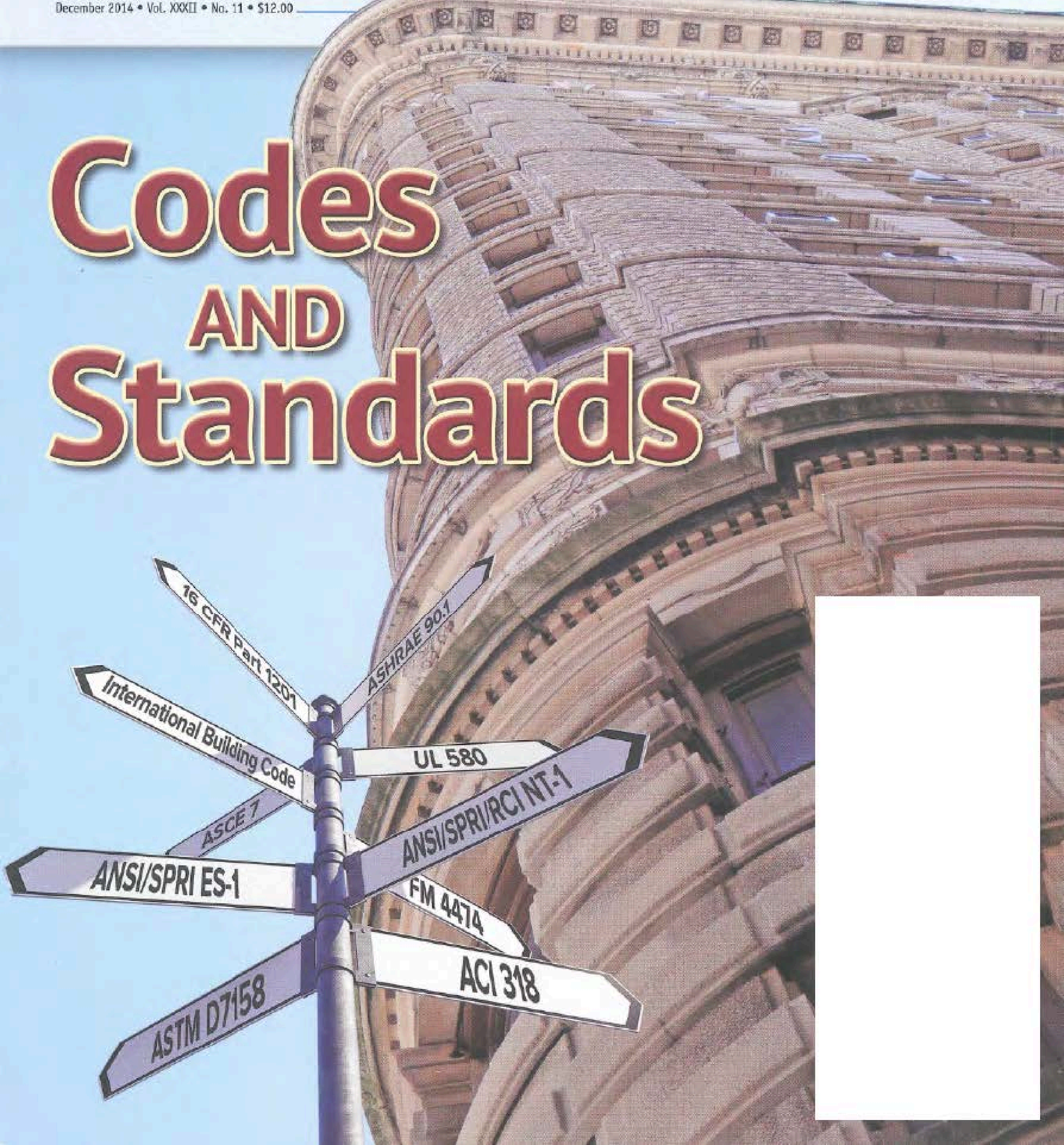
Codes AND Standards



Venting and Residential Roof Design

By Eileen Dutton

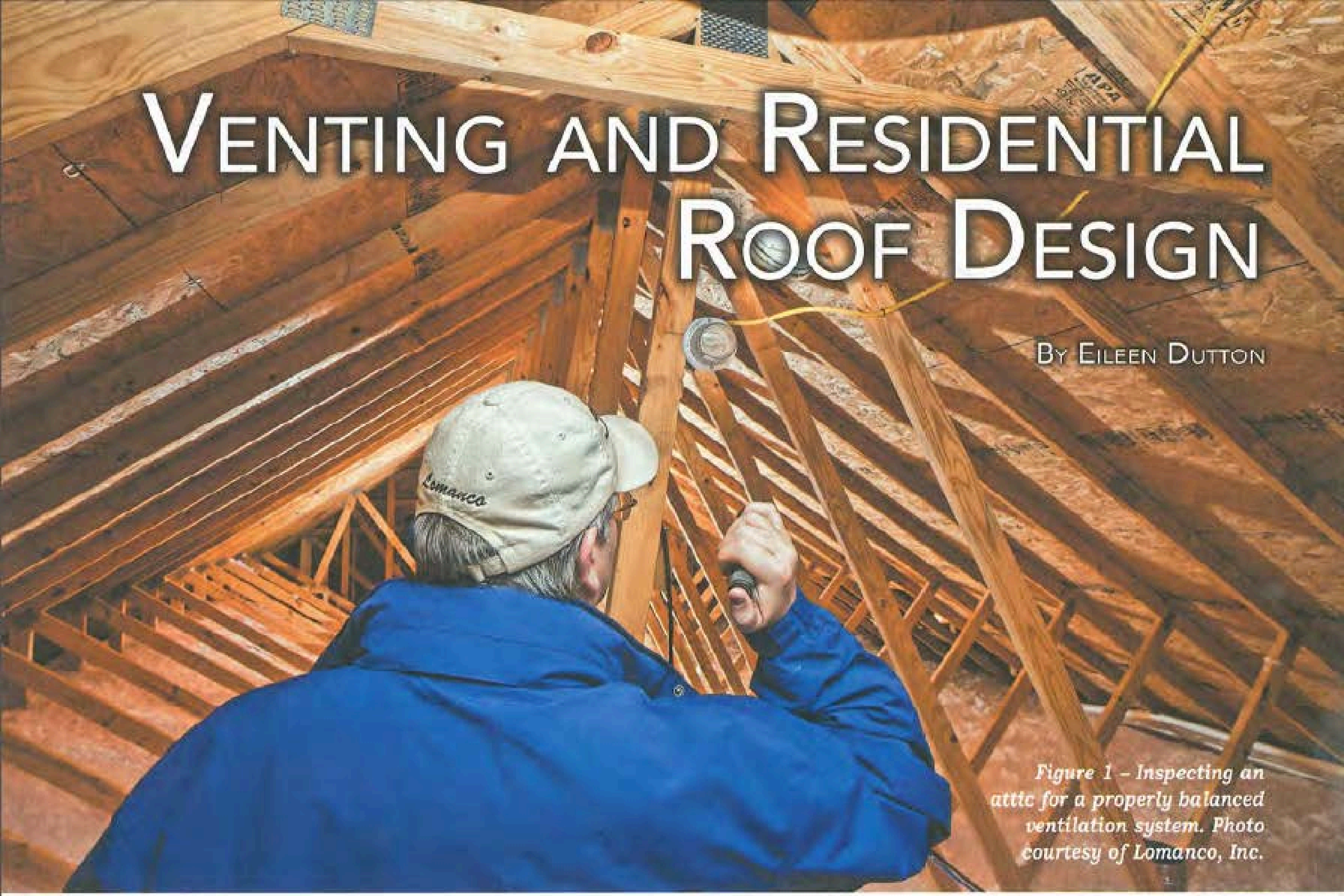


Figure 1 – Inspecting an attic for a properly balanced ventilation system. Photo courtesy of Lomanco, Inc.

Ventilation is a simple concept, right? If so, why are there so many questions on whether to ventilate, how to ventilate, and if it is working? But before we discuss that—why do we have ventilation requirements in the building codes?

Moisture control is one of the main reasons for attic ventilation. Houses are more tightly sealed and more highly insulated than they used to be. In addition, we have simultaneously increased the sources of moisture, resulting in increased potential for trapping moisture in attics, which can, in turn, lead to mold and poor air quality. Since the 1960s, homeowners have added dishwashers, clothes dryers, and heating and cooling ducts in attics, and have changed certain habits, such as taking longer showers—all of which are adding moisture in our homes. The increase in attic insulation has also reduced the drying potential of the attics during cooler months (increased insulation results in less warming of the air in the attic, which, in turn, reduces the ability of the air within the attic to absorb moisture).

Moisture gain in building materials such as rafters, sheathing, and drywall may lead to premature deterioration or decay, as well as mold and mildew. Reducing moisture and heat buildup in the attic space can help keep the roof deck and shingles from prematurely deteriorating. Additionally, proper ventilation can assist in preventing ice-damming by keeping the attic and roof deck cool in the winter in colder climates and in providing energy savings by reducing heat buildup in warmer weather. (See *Figure 1*.)

Ventilation is a simple concept: Air movement from the intake vents up through the exhaust vents, drawing moisture and heat from the attic space (*Figure 2*). But with so many different roof designs—simple gable roofs, hipped roofs, mansards, flat, saltbox, gambrel, complex combinations (and then add in dormers and knee walls)—a simple concept can become a complicated issue. (See *Figure 3*.)

The simple gable roof can be easily vented from the eaves to the ridges. Balanced ventilation, with an equivalent intake and exhaust combining to equal 1 sq. ft. of ventilation for every 300 sq. ft. of attic space (1/300), is the typical minimum code requirement; however, 1/150 is recommended by the Roof Assembly Ventilation Coalition (RAVC) as a more optimal design. Almost everyone agrees that having more intake airflow than exhaust is helpful in fighting moisture and heat buildup.

Building code requirements in the International Building Code (IBC) and International Residential Code (IRC) have evolved over the past several code cycles. When the International Codes (I-Codes) were published in 2000, attic ventilation provisions required that the vent area be equivalent to 1/150th of the attic area, but contained no requirement that the vents be "balanced" so that intake and exhaust vents perform as intended. The code allowed a reduction of the vent area to 1/300th of the attic area if the ventilators were balanced or if a vapor barrier were installed on the "warm-in-winter" side of the ceiling. The requirements for balanced ventilation were flawed, however, because the reduction in vent area was allowed if up to 80% of the vents were at the ridge. This provision, with

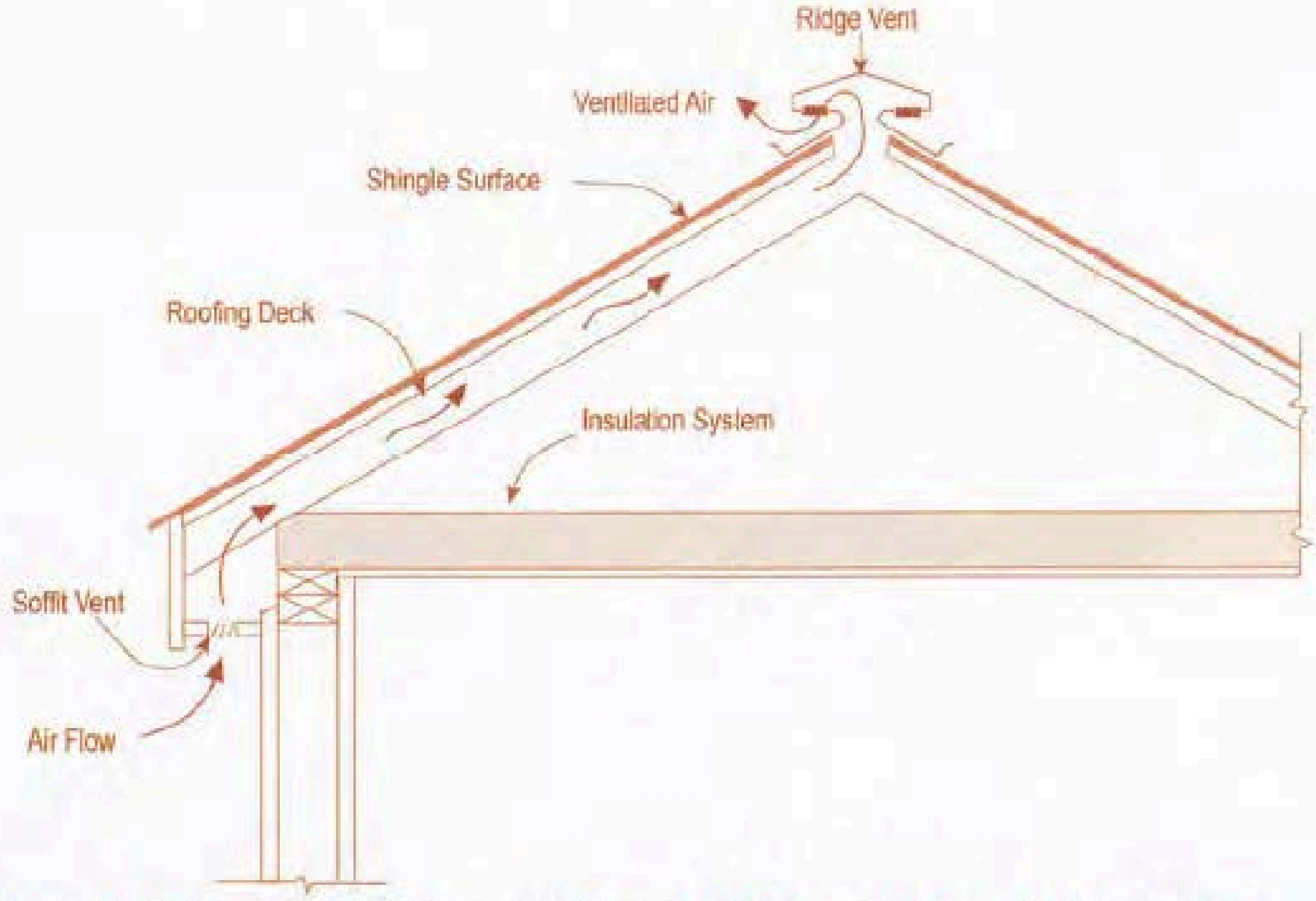


Figure 2 – With proper ventilation, air will circulate freely under the roof deck and carry away water vapor before it can condense. One of the best methods is a combination of continuous eaves and ridge vents that together provide uniform natural draft ventilation from the bottom to the top of the attic space. Louver and vent openings should not be covered during the winter. Eaves or soffit vents should not be blocked by insulation. Image taken from the 2014 edition of ARMA's Residential Asphalt Roofing Manual.

a 4:1 ratio of exhaust to intake, could lead to a negative pressure in the attic, which can lead to increased air leakage from the occupied space into the attic.

In the 2012 I-Codes, the exceptions that allowed the reduction in area were changed to require more balance with increased intake area and limited the vapor barrier exception to cold-weather climates. The base requirement for vent area at 1/150th of the area, without being balanced, remains in the 2012 code. As this article is published, the RAVC is working with code officials and building science experts on a code change that will require balanced ventilation regardless of the area.

Based on research, recent IRC code changes require that at least 40% of the venting, but no more than 50%, be in the upper portion of the roof, according to the ICC, Section 806 Ventilation, 2012.[1] This is a change (proposed by the RAVC) from the previous codes that allowed up to 80% of the ventilation in the upper portion of the roof. Ridge vents, passive vents, and active roof vents are typically used to ventilate the upper portion of the roof, while continuous soffit, individual soffit, drip edge, or eave vents are used in the lower portion of the roof. Gable end vents may also be used; however, as roofs become more complex, gable vents are ineffective.

A common mistake, particularly when updating older homes, is to combine two types of exhaust vents on the same roof above a common attic. This can cause disruptions in the flow of air and lead to the collection of warm, moist air in the attic, which can lead to ice damming, wood rot, and poor air quality. To help designers achieve proper ventilation, the RAVC has worked to update the model building codes and to offer communications in construction trade publications to educate builders and designers on appropriate ventilation methods.

As roof designs become more complex, the method of ventilation becomes more critical and more commonly disputed by researchers. A cathedral or vaulted roof is one such structure in debate. Failure to vent a cathedral or vaulted ceiling may result in ice damming when warm air escapes through the insulation and warms the roof deck from the underside.

Venting a cathedral roof can be achieved by creating an air space above the insulation and below the roof deck. Soffit or eave vents should then be used in conjunction with ridge vents to keep the cathedral roof deck vented under the nailing surface to which the roof covering is installed. However, there must be a continuous air barrier between the occupied space and the attic if ventilation is to be used as a strategy to remove incidental moisture from the attic.

Bear in mind that in areas where there is a snow load, ice damming is still a possibility with a sealed attic unless the roof deck is vented. The unvented attic is a relatively new concept, and while there have been some positive results with unvented attic spaces, it is still being researched. Building movement such as settling or owner modifications (for instance, cutting into a sealed area to install new lighting) can make the fully sealed attic difficult to maintain.

When employing a nonvented roof, be sure to check with the shingle manufacturer to see if it will warrant its shingles over nonvented roofs, as nonvented roofs are typically warmer than vented roofs. The RAVC is

Figure 3 – Example of improper ventilation system using mixed type of exhaust vents on the same attic area. Photo courtesy of Lomanco, Inc.

still reviewing data and supporting research on vented versus nonvented attics. Studies have not been performed in all climates to date, and most have been on a small-scale test area rather than on full-sized homes. Moisture, mold, and mildew are concerns in buildings, and lack of ventilation could increase the presence of mold if there are leaks to the sealed attic area.

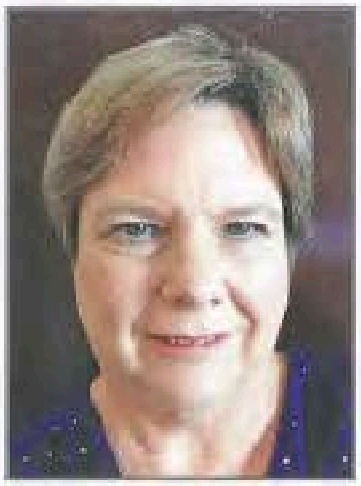
The Roof Assembly Ventilation Coalition was formed in 2008 and represents vent manufacturers, the design community, and property owners regarding best practices for roof ventilation in the regulatory arena. RAVC educates specifiers, builders, architects, engineers, building code officials, municipalities, the public, and other parties as to the benefits of proper roof ventilation. For more information on attic ventilation, please visit RAVC at www.ravcoalition.org or contact one of its member companies.

Bill Rose, a professor of architecture and a leading researcher at the Building Research Council (BRC), the research arm of the School of Architecture at the University of Illinois at Urbana-Champaign, has conducted many research programs related to building materials, including insulation, moisture control, indoor air pollution, and ventilation. In "Roof Ventilation Update," published by Rose in the 2007 issue of the *Journal of Light Construction*, he stated there are many factors that affect attic ventilation, and that his team would be looking at the shingles on the BRC Attic Research Center's roofs (which were about 18 years old at the time). While white shingles were in the best condition, they found that "A few of the most aged-looking shingles [were] found on the hottest bay—the one with foam directly on the underside of the sheathing."

Dr. Joseph Lstiburek of Building Science Corporation agrees that there may be a penalty on the service life of the shingle roof system on a nonvented roof. "Shingles that are installed on unvented roof assemblies operate at slightly higher temperatures, roughly 2°F to 3°F warmer than shingles on vented assemblies. This can reduce their service life by roughly 10%," Lstiburek says in the article, titled "A Crash Course in Roof Venting" in the August/September 2011 issue of *Fine Homebuilding*. The research on vented versus nonvented roofs will surely continue.

REFERENCES

1. http://publicecodes.cyberregs.com/icod/irc/2012/icod_irc_2012_8_sec006.htm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Eileen Dutton is the vice president of technical services for Malarkey Roofing Products. She has over 34 years of experience in the roofing industry and has been active in many industry groups. Dutton is currently serving as the chair of the steep-slope technical committee of ARMA.