Considerations in Attic Ventilation System Selection

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The 2021 International Residential Code defines an attic as "the unfinished space between the ceiling assembly and the *roof assembly*." Attics generally fall into one of three configurations. The most common places insulation on top of the ceiling of the underlying rooms, resulting in an unconditioned space not regulated for temperature and relative humidity. In some cases, HVAC equipment for the conditioned portion of the building is located in this unconditioned space. Ventilation for this attic space may or may not be present.

A second attic configuration incorporates insulation at the underside of the roof deck using an adhered, batt, or loose form of insulation. Although this may also include insulation on top of the ceiling of the underlying rooms, the attic space is not conditioned for temperature or humidity control. HVAC equipment serving the conditioned areas of the building may be placed in this unconditioned space. Ventilation for this attic space may or may not be present.

A third attic configuration places insulation at the underside of the roof deck level and conditions the space beneath by using HVAC equipment to control temperature directly and relative humidity either passively or actively. This conditioned space may or may not be habitable. Ventilation between the roof deck and the insulation may or may not be present.

Each attic configuration interacts with and affects the asphalt roofing systems installed over the attic space. Thoughtful consideration of these interactions can lead to improved roofing system service life.

Consider the Functions of Attic Ventilation

Moisture conditions and temperature in attics are important considerations tied closely to the geographic location of the building. Attic configurations that work well in one climate may not function well in others. Failure to properly manage moisture and temperature has consequences for the building and the roofing system above the attic.

It is critical to handle moisture entering the attic from the building below. Water vapor generated by occupants of the building is the key source of this moisture. If excess moisture enters an unconditioned attic space and is not handled effectively, it may condense on surfaces during colder times of the year. This may cause wood framing, decking, walls, and ceilings to deteriorate. In some cases, mold may begin to grow on surfaces. Without proper ventilation, excessive moisture fluctuations within an attic may cause the deck components to expand and

contract and buckle the overlying shingles. In a conditioned attic, an effective HVAC system manages moisture that enters the space and reduces or eliminates moisture-related issues. In an unconditioned attic, effective ventilation balanced with intake and exhaust airflow removes excess moisture.

Attic temperature is another important variable to address. Unconditioned attics may experience wide fluctuations in interior temperature as roof surface temperatures increase during sunny days and decline during cloudy times and after the sun sets. Heat buildup in an attic may accelerate the aging of asphalt roofing products, and heat transfer from the attic into the occupied areas of a building reduces energy efficiency. Ventilation helps take the heat out of the attic space. Insulation above the ceiling of the underlying rooms helps prevent heat transfer between occupied areas and attic spaces. Consult local building codes for the minimum R-value of insulation required above the ceiling.

Ice damming is another issue related to attic temperature management. Ice dams form during cold weather when heat from the conditioned space of a building rises into an attic and causes cyclical snow thawing over the warmer portions of a roof and re-freezing at the colder eave area. Ventilation can reduce the heat in the attic space to mitigate or eliminate the snow thawing over that space. More information can be found in ARMA's technical bulletin, "Protecting Against Damage from Ice Dams."

Ventilation: A Key Element of Attics and Roof System Assemblies

Ventilation, which is the free flow of outside air through the space immediately beneath the deck of an asphalt roofing system, maximizes the service life of asphalt roofing materials, improves the energy efficiency of the building, removes excessive moisture in the attic space, reduces the likelihood of mold and mildew growth, and mitigates ice dam formation in cold climates. ARMA strongly recommends incorporating ventilation into all three attic configurations discussed previously. Natural attic ventilation is effective because warm air rises. Outside air flows through an attic space when intake vents allow warm air to rise and escape through exhaust vents at or near the upper portion of the roof while cooler air draws in at the lower portion.

Recommended Practices for Ventilating Attics

Installing an appropriate minimum amount of attic ventilation is important, and three factors should be considered:

- Size of the attic; measured length x width (area) of the attic floor
- Placement of the two types of vents (intake and exhaust)
- Airflow rating of the vents (expressed as net free ventilation area)

Building codes generally recommend a minimum net free ventilation area equal to one square foot per 150 square feet of attic floor area. Reduction to as low as one square foot of ventilation area per 300 square feet of attic floor area is permitted by building codes in some cases, provided an acceptable ratio of properly located intake and exhaust vents is present and, in Climate Zones 6, 7, and 8, a vapor barrier is appropriately installed.

Proper location and quantity of intake and exhaust vents are necessary to create a functioning system. Place intake vents at the eaves or in the lower portion of the roof. These are often located on the underside of enclosed eaves. Install exhaust vents at the ridge or upper portion of the roof to provide efficient exhaust of heat and moisture from the attic space.

The location of intake and exhaust vents must ensure airflow in all areas of the attic space. Continuous vents along eaves and ridges are an excellent and popular option. If using a series of individual vents for either intake or exhaust, space them equally and close enough to each other to ventilate the entire attic. Be sure to avoid blockage or restriction of airflow, such as due to improperly installed insulation over the soffit or intake vents.

The net free ventilation area of intake and exhaust vents should be close to equal, with slightly more intake than exhaust. As a recommended practice, intake vents should comprise 50-60% and exhaust vents should comprise 40-50% of the net free ventilation area of the total system. However, always follow the shingle/vent manufacturer's instructions. To create a properly functioning system, the intake amount should never be less than the exhaust amount.

A combination of different types of intake and exhaust vents may be necessary for proper ventilation in each attic space. However, combining different types of exhaust vents on the same roof above a common attic space may cause short-circuiting of the attic ventilation system and adversely affect performance. Using different vent types together often is inconsistent with the vent manufacturer's installation instructions.

Additional Considerations: Attics with Insulation at the Underside of Deck

It is possible to implement this attic configuration with an unconditioned or a conditioned attic. The same principles related to the amount of ventilation, placement of intake and exhaust vents, and balance between intake and exhaust apply when venting this kind of attic. However, this approach may require additional steps to ensure there is open airflow from eave to ridge between each rafter space.

There are various approaches to accomplish open airflow between the insulation and the underside of the roof deck. Placing baffles between rafters prior to insulation installation is one

option. Using Structural Insulated Panels (SIP) that include a built-in ventilation space is an option for new construction. An approach called above-deck ventilation installs a second deck on spacers to create a surface for installing asphalt shingles with a space between the decks for ventilation. This option may be suitable in both new construction and roof replacement situations. These designs require continuous eave and ridge ventilation unless cross ventilation is present in the above-deck ventilation design.

Additional Considerations: Conditioned Attic Spaces

It is possible to employ the previously discussed approaches for the construction of conditioned attics, which of necessity have insulation placed at the deck level. Taking the extra steps to create a space between the underside of the roof deck and the insulation to permit ventilation will have the long-term benefit of maximizing the service life of the overlying asphalt roofing products by facilitating the dissipation of heat caused by incoming solar radiation. Failure to do so may accelerate the aging of asphalt roofing materials.