Attic Space Ventilation in Steep Slope Asphalt Roof Systems

Asphalt Roofing Manufacturers Association

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ARMA strongly recommends incorporating proper attic space ventilation.

Attic space ventilation is the free flow of outside air through the space immediately beneath the deck of an asphalt roofing system. This space is commonly separated from the building's conditioned space by a vapor retarder, insulation, or both. This may be the space of a traditional attic configuration or the space in a vaulted ceiling provided above the ceiling and below the roof deck.

Passive attic ventilation is effective because warm air rises. This rising air escapes the attic space through exhaust vents at or near the highest point of that space. As this air leaves the attic space, cooler air is drawn in to replace it through the intake vents in the lower portion of the space. The benefits of venting this space include:

- Promoting healthy indoor air quality
- Removing excess moisture
- Reducing heat buildup
- Mitigating ice dam formation

The magnitude of the benefit from each of these will vary with the materials used in the roof system and the climate and geographic location of the building. Attic ventilation systems that work well in one climate, including configurations where the HVAC system is in the attic space, may not function as well in others.

Promoting healthy indoor air quality

Airflow through the attic space promotes healthier air quality in the occupied space below.

- Proper attic space ventilation may reduce mold and mildew growth and their intrusion into the living space.
- Proper attic space ventilation may help reduce the concentration of contaminants and pathogens in the living space.

Removing excess moisture

Airflow through the attic space enables the removal of excess moisture. Water vapor generated by building occupants is the principal source of this moisture.

- Moisture accumulation in insulation typically reduces the effectiveness of the insulation.
- The removal of excess moisture in the attic space helps promote a healthy living space by reducing the likelihood of mold and mildew growth.
- Removing excess moisture will also improve the durability of the wood framing, decking, walls, and ceilings in the attic space.
- Additionally, without proper ventilation, excessive moisture fluctuations within an attic may cause the deck components to expand and contract and buckle the overlying shingles.

Reducing heat buildup

Heat buildup in the attic space is typically the result of the roof surface material absorbing energy (heat) from the sun. Some of this absorbed heat is radiated back into the air. Part of it is transmitted down into the attic space and potentially into the living space. Airflow through the attic space allows outside air to displace the air heated in this manner.

- This heat buildup typically impacts occupant comfort and increases the amount of energy used to cool the occupied spaces in a building.
- This heat buildup also results in higher temperatures for the roofing products. This temperature increase may accelerate the rate of aging of these products and shorten their effective service life.

Mitigating ice dam formation

Ice dams form in cold, snowy weather when the attic space is warmer than outside air. Snow melts on the roof surface over a warmer attic space. That water runs down the roof and forms ice dams as it freezes on the colder roof surface beyond the area covering the attic and at the gutters.

- Water can pool and back up on a roof behind an ice dam. This may result in water passing through the roof and into the attic space.
- Attic ventilation moves warmer air out of the attic space and replaces it with cooler outside air. This reduces ice dam formation.

Standard practice (vented steep-slope asphalt roof system):

The standard practice for providing passive attic ventilation with a steep-slope asphalt roof system is to use intake vents and exhaust vents. Intake vents are installed in the soffit or

overhang of the house or low on the roof's edge. Exhaust vents are installed at the peak of the roof (ridge vents) or near the roof's peak (such as box vents, can vents, mushroom vents, wind turbines, and off-ridge vents). Another category of exhaust vents that could be considered is gable vents. For buildings with hip style roofs, exhaust vents designed for installation at the hip are also available.

All these vents have net free ventilation area airflow ratings assigned by the manufacturer. These are used to calculate the number of vents needed to meet the attic's intake and exhaust airflow volume. These vents are positioned to provide airflow under the roof deck in all areas of the attic or for each enclosed rafter space.

The recommended ventilating airflow volume is achieved by providing 1 square foot of net free ventilation area for each 150 square feet of attic floor area. With extra water vapor management features, a reduction in net free ventilation area may be tolerable. For special-use buildings with higher-than-typical humidity environments, an increased net free ventilation area may be needed.

Installation of intake vents and exhaust vents in a balanced ratio (50 to 60% as intake and 40 to 50% as exhaust) further promotes effective airflow. Specific, special construction practices are employed to assure airflow to areas that might otherwise be blocked by building features such as skylights or cathedral ceilings. It can be challenging to provide airflow in all areas when using gable vents.

Attic and enclosed rafter spaces using this venting practice provide all the benefits listed earlier:

- Promoting healthy indoor air quality
- Removing excess moisture
- Reducing heat buildup
- Mitigating ice dam formation

This standard ventilation practice has a well-established history as an effective, low-cost, low-maintenance method for ventilating the attic space.

Model code requirements (vented steep-slope asphalt roof system):

The 2024 IRC (sections R806.1 through R806.2) and the 2024 IBC (section 1202.2) have the same requirements for an enclosed ventilated attic or rafter space in a building with a steep-slope roof.

- The minimum net free ventilating area shall be 1/150 of the area of the vented space.
- An exception is allowed for the minimum net free ventilating area to be 1/300 of the area of vented space if both:
    - Vapor retarders are used (as detailed in the code).
    - Not less than 40% and not more than 50% of the required ventilating area is provided by ventilators located in the upper portion of the attic or rafter space. The balance of the required ventilation shall be located in the bottom 1/3 of the attic space (IRC) or by eave or cornice vents (IBC).
- A 1" minimum air space shall be provided for the free flow of air between the roof deck and insulation.
- Ventilation openings shall be a minimum of 1/16" and a maximum of 1/4".
- Installation shall be in accordance with the manufacturer's instructions.

Older versions of these codes may still be in use in some jurisdictions.

Model Code Alternative (Sealed Attics or enclosed rafter spaces with no ventilation): The 2024 IRC (section R806.5) and the 2024 IBC (section 1202.3) detail the requirements for constructing an attic or enclosed rafter space with no ventilation. Sealed attics and rafter spaces are permitted where all the corresponding conditions listed in the codes are met. These conditions include:

- The unvented attic space is completely within the building thermal envelope.
- Interior Class I vapor retarders are not installed on the ceiling side (attic floor) of the unvented attic assembly or on the ceiling side of the unvented enclosed roof framing assembly.
- In Climate Zones 5, 6, 7, and 8, any air-impermeable insulation shall be a Class II vapor retarder or shall have a Class II vapor retarder coating or covering in direct contact with the underside of the insulation.
- A set of requirements for various insulation configurations and amounts as required for condensation control.
- In Climate Zones 1, 2, and 3, if air-permeable insulation is installed in an enclosed attic, a vapor diffusion port must also be installed.

The IBC also notes that permission to use unvented attic and unvented enclosed rafter assemblies does not apply to special-use structures or enclosures, such as swimming pool enclosures, data processing centers, hospitals, or art galleries. They are also not permitted in enclosures in Climate Zones 5 through 8 that are humidified beyond 35% during the three coldest months.

Alternate Practice (Sealed Attics or enclosed rafter spaces with no ventilation):
Sealed attics are commonly constructed by having insulation (typically spray foam) directly in contact with the underside of the roof deck, with no insulation at the ceiling level for the occupied space immediately below the attic.

The principal advantage of a sealed attic is the expectation that a building so constructed will consume less energy heating the building. For structures with the HVAC system in the attic, air conditioning efficiency may also be improved. Leaks in the air conditioning ductwork would leak into a space that is already air-conditioned.

The principal disadvantages of a sealed attic include:

- Moisture management in this space is much more complicated, with a corresponding increase in the possibility of errors. The consequences of ineffective or incorrect moisture management are the potential for mold and mildew growth, as well as enabling rot and deterioration of wooden structural components in this area. These may develop in areas that cannot be readily inspected and become extensive or more advanced before they are discovered. Sealing an existing attic space as a retrofit changes the moisture management balance from the initial building design. This modification needs careful consideration and may require input from a consulting engineer to avoid future serious moisture problems and damage.
- By placing insulation at the roof deck, the rooftop temperatures are inherently hotter, which will accelerate the rate of aging of the roofing products, including shingles, underlayment, self-adhering substrates, etc….
- They may be less effective in mitigating ice dam formation or damage.
- It is difficult to maintain the full function of the vapor retarder while making modifications to this space or to the adjacent components, such as repairing or replacing the roof. The vapor retarder must be perfect or near perfect to avoid condensation, which could trigger the corresponding potential for water damage and mold and mildew growth.

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Changes to the existing building structures, use, or equipment

Attic space ventilation systems are designed and configured for the building into which they are built. As noted earlier, design considerations include:

- Sufficient airflow volume
- Balanced intake and exhaust
- Airflow into all areas of the attic or enclosed rafter spaces

Changes to the building structure, such as the addition of skylights or rooms, or the conversion of an attached garage into living space, may negatively impact attic ventilation or exacerbate existing deficiencies. Adding a ceiling fan or recessed lighting may result in an opening that reduces the effectiveness of a vapor retarder. If not done properly, adding more insulation on top of the existing attic insulation can result in partial or full blockage of airflow. Something as simple as house paint partially blocking the soffit intake vent openings is likely to result in diminished ventilation effectiveness.

The effects of changing a building's equipment also need to be considered. Adding air conditioning or moving the HVAC system into the attic may substantially alter the attic space ventilation, airflow, or needs. The same issues may follow the installation of that nice, big, Jacuzzi® type soaking bathtub.

Wildland Urban Interface (WUI) Considerations

The best practices for ventilation in an urban wildland interface are still evolving. Fire and ember-resistant vents are readily available and would be a good starting point.

Additional Information:

There are several types of ventilation products. Consult the manufacturer of the venting devices and the manufacturer of the roofing shingles for information regarding the most suitable devices for any given building construction, building use, and environmental considerations.

ARMA has multiple Technical Bulletins and other publications providing information on the subject of ventilation, including:

- Considerations in Attic Ventilation System Selection
- Why Ventilation is Important
- Residential Asphalt Roofing Manual, Design and Application Methods

These bulletins and additional information can be found on the ARMA website www.asphaltroofing.org.

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