Attic Space Ventilation in Steep Slope Asphalt Roof Systems

Asphalt Roofing Manufacturers Association

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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 it may be the space in a vaulted ceiling provided above the ceiling and below the roof deck.

ARMA strongly recommends incorporating proper ventilation in this attic space.
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:

- 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 configurations, including the placement of the HVAC system, that work well in one climate may not function as well in others.

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

> The removal of excess moisture in the attic space helps promote a healthy living space by reducing the likelihood of mold and mildew growth. Avoiding mold growth by removing excess moisture will also improve the durability of the wood framing, decking, walls, and ceilings in the attic space.
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> 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 down into the living space. Airflow through the attic space allows outside air to displace the air heated in this manner.

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This heat buildup typically impacts occupant comfort and increases the amount of energy used to cool the 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.

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.

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 that could be considered is gable vents. For buildings with hips, exhaust vents designed for installation at the hip are also available.

All these vents have net free open 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 and 50:50 balance needs. These vents are positioned to provide airflow under the roof deck in all areas of the attic or for each enclosed rafter space. Installation of intake vents and exhaust vents in a balance 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:

- Removing excess moisture
- Reducing heat buildup
- Mitigating ice dam formation

This standard ventilation practice has a well-established track record 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 (section R806.1 through R806.2) and the 2024 IBC (section 1202.2) have the equal 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 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.

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- 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, there would also be some improved efficiency for air conditioning. 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. Mold and rot 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 roof top temperatures are inherently hotter which will accelerate the rate of aging of the roofing products to include: 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,

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which could trigger the corresponding potential for water damage and mold and mildew growth.

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

See the ARMA website (www.asphaltroofing.org) for additional information.