Unvented Roofs for Conditioned Attics: Solutions That Work

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Unvented Roofs for Conditioned Attics

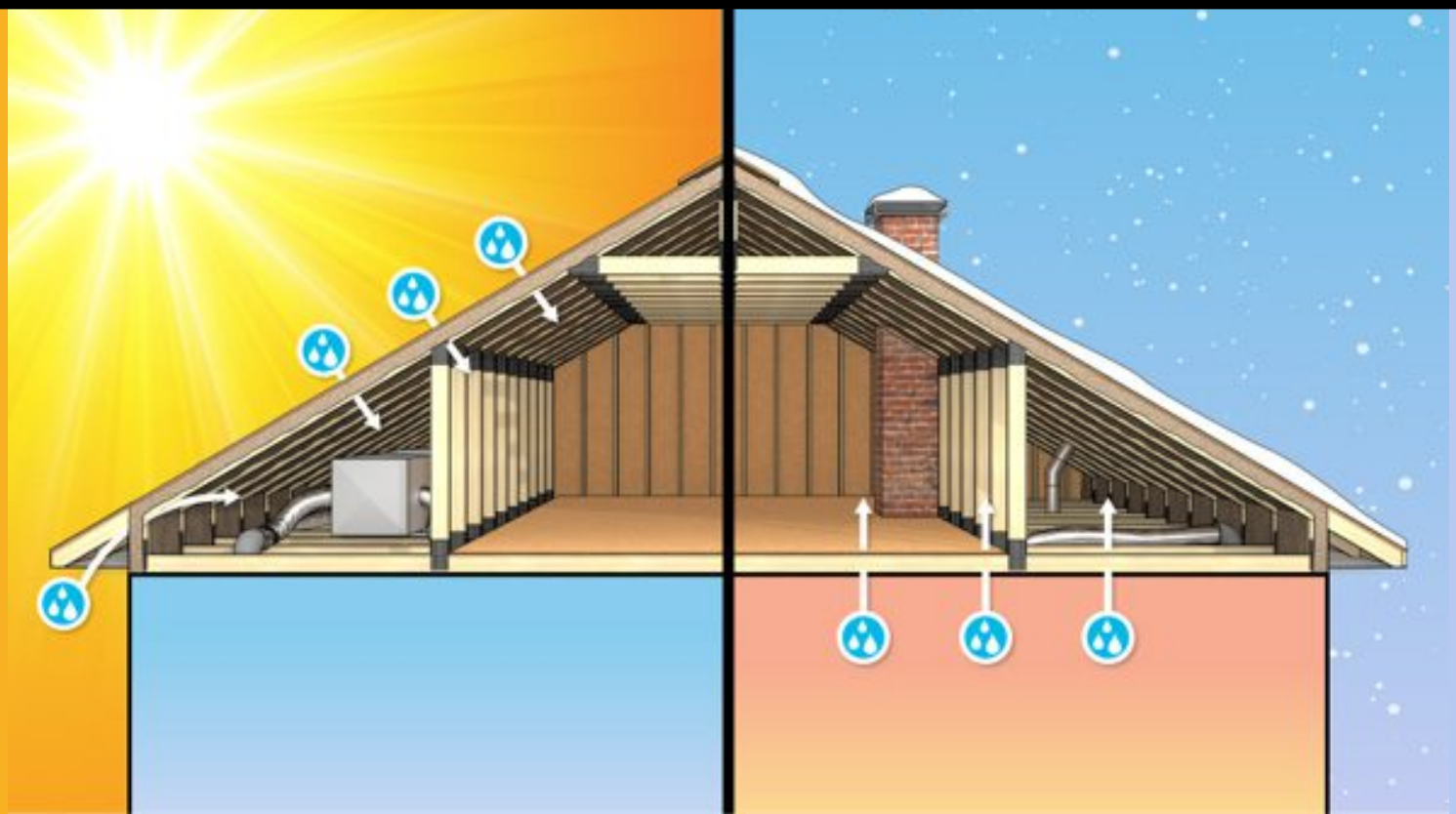
An unvented conditioned attic is a sealed, insulated space where the thermal and air barriers are aligned with the roof deck instead of the ceiling, bringing the attic within the home's conditioned envelope.

This design can reduce moisture risks, provide additional space utilization for occupants, and protect mechanical systems from temperature extremes. This conditioned space also supports safety, especially in wildfire-prone areas where ember intrusion through vents is a concern.

This guide will help provide information and details on designing and installing an unvented conditioned attic.

Critical Steps for Designing and Installing an Unvented Conditioned Attic

Critical to a successful design is mitigating water intrusion and condensation. Conditioned attics are specifically vulnerable to condensation as warm moist air (from either inside or outside the home) meets a relatively cooler surface in the space, such as the interior roof deck or HVAC equipment.



Critical Steps for Designing and Installing an Unvented Conditioned Attic: Climate Zones and Building Codes

Designing and building unvented conditioned attics in accordance with 2021 IRC Section 806.5 is critical for controlling heat, air, and moisture. Climate zone considerations are essential since the code prescribes different insulation strategies, vapor retarder requirements, and ratios of air impermeable insulation based on cold, mixed, or hot humid conditions.

TABLE R806.5

INSULATION FOR CONDENSATION CONTROL

CLIMATE ZONE	MINIMUM RIGID BOARD ON AIR-IMPERMEABLE INSULATION R-VALUE[a,b]
2B and 3B tile roof only	0 (none required)
1, 2A, 2B, 3A, 3B, 3C	R-5
4C	R-10
4A, 4B	R-15
5	R-20
6	R-25
7	R-30
8	R-35

a. Contributes to but does not supersede the insulation requirements in Section N1102 from the International Residential Code (IRC).

b. Alternatively, sufficient continuous insulation shall be installed directly above the structural roof sheathing to maintain the monthly average temperature of the underside of the structural roof sheathing above 45°F (7°C). For calculation purposes, an interior air temperature of 68°F (20°C) is assumed and the exterior air temperature is assumed to be the monthly average outside air temperature of the three coldest months.

Critical Steps for Designing and Installing Unvented Conditioned Attics

Airtight Design: Continuity of the air barrier/air control layer is critical in preventing moist air from condensing on or within the insulated attic assembly.

1. Air barrier layer
2. Vapor diffusion ports
3. Insulation
4. HVAC equipment and space conditioning vents

Vapor Control Measures:

Climate and material-specific vapor control strategies are needed to manage vapor drive through the enclosure assembly. This may require the use of vapor diffusion "ports" and/or vapor diffusion retarders on the warmer side of the assembly.

Space Conditioning Control:

Some mechanical conditioning of the non-vented attic space is sometimes required and is the best practice to reduce the risk of surface condensation on materials and equipment in the attic assembly.

Proper Insulation Levels:

The amount of insulation or R-value is important in preventing condensation and can also mitigate ice dams while increasing energy efficiency.

Material Selection for Unvented Conditioned Attics

There are several cost-effective and readily constructable ways to design an unvented conditioned attic. Depending on the design, insulation types can vary.

Insulating an unvented attic can be accomplished with a selection of traditional insulation materials, including:

- Fiberglass
- Mineral wool
- Cellulose
- Spray foam insulation (SPF) - either open or closed cell
- Rigid foam insulation (XPS, EPS, Polyiso)
- Hybrid Insulation systems: Combination of loose fill insulation materials and SPF or rigid board-type insulation

Fiberglass

Mineral Wool

Cellulose

Spray foam insulation (Open or Closed Cell)

Rigid foam insulation (XPS, EPS, Polyiso)

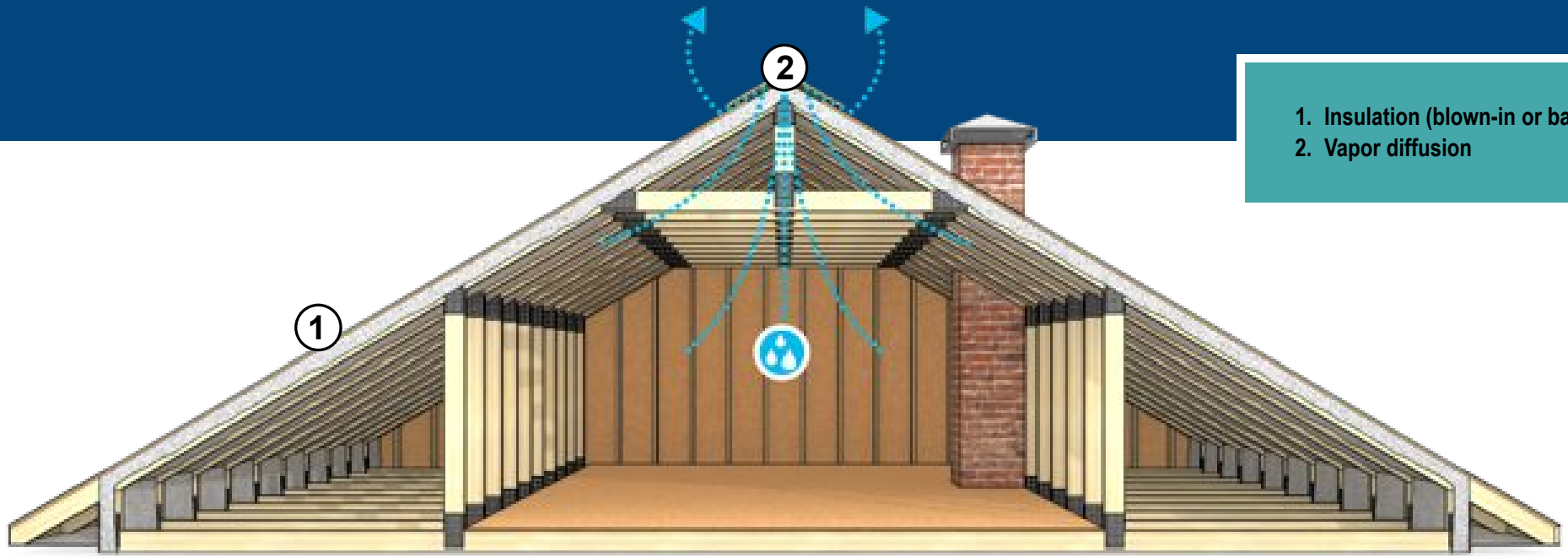
Hybrid Insulation Systems

Examples of Unvented Conditioned Attic Designs

Fibrous or batt insulation can be used in an unvented conditioned attic when combined with vapor diffusion ports to allow limited drying potential while maintaining air tightness. It is suitable for specific warm and mixed climate zones where interior-to-exterior vapor drive is minimal.

Key benefits:

- Cost-effective and familiar materials
- Maintains continuity of the air barrier
- Provides limited drying potential through vapor diffusion ports



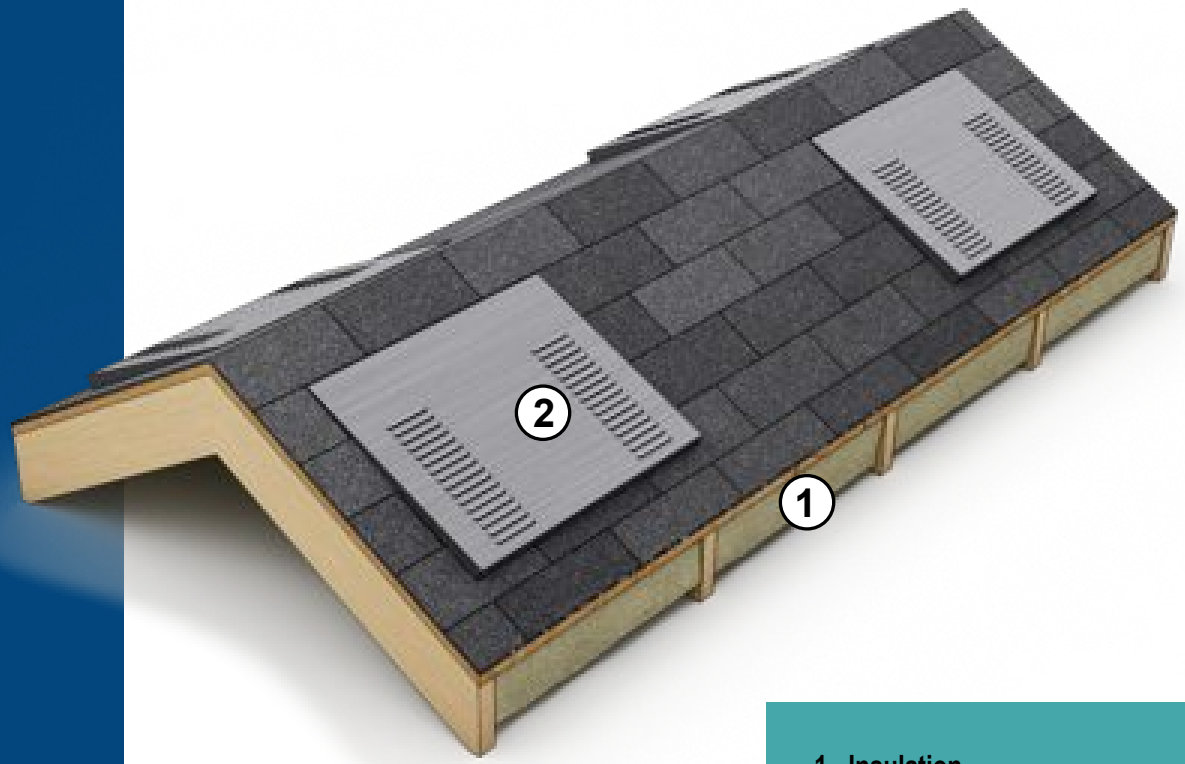
1. Insulation (blown-in or batt)
2. Vapor diffusion

What is a Vapor Diffusion Port?

A vapor diffusion port is a sealed opening at the roof's high point that is covered with a vapor-permeable, water-shedding, air-impermeable membrane. It allows water vapor to diffuse out of an unvented, insulated roof assembly without permitting bulk air flow or rain intrusion. Vapor diffusion ports are constructed on site and can be either full ridge port openings or off-ridge port openings.

How to:

1. Saw the ridge slot in the sheathing and ensure solid nailing surfaces remain.
2. Wrap a vapor-permeable, air-tight underlayment over the ridge lapping onto the roof deck on both sides.
3. Tape/adhere all laps and edges to the deck to create an air-tight seal.
4. Install the ridge vent/cap assembly over the membrane to shed water and provide UV/mechanical protection.



1. Insulation
2. Off-ridge vapor diffusion port

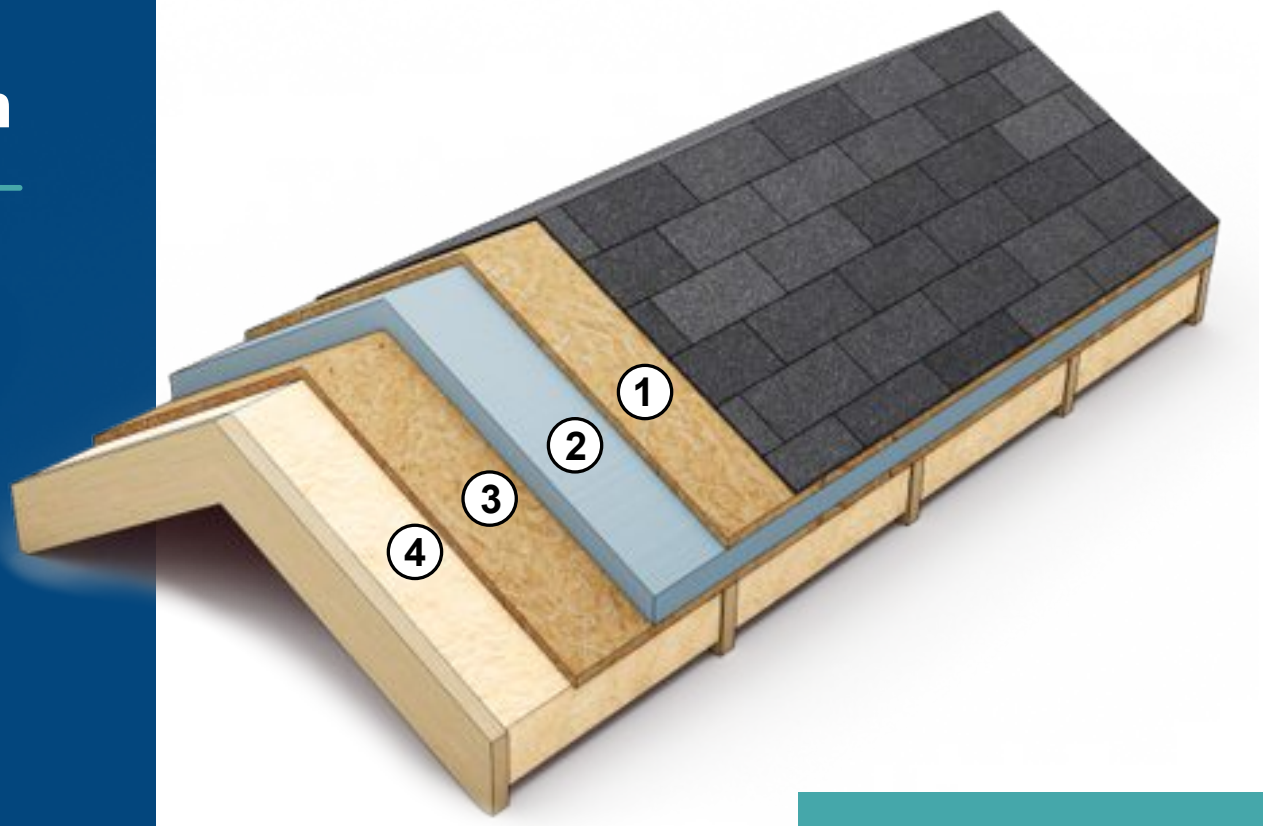
Split-Insulated Above-and-Below Approach with Exterior Foam Board and Batt Interior Insulation

This unvented attic design is a hybrid approach and uses rigid insulation above the roof deck and batt insulation below. It can be applied in both new and retrofit construction, with climate zone-specific R-values determined per IRC Table 806.5.

Benefits of this approach:

1. Enhanced condensation control in cold climates.
2. Reduced thermal bridging and improved roof-deck protection.
3. Compatible with standard framing and retrofit projects.
4. Some mechanical conditioning of the non-vented attic space is best practice and reduces the risk of surface condensation on materials and equipment in the attic assembly.

Code: Air-Impermeable Insulation for Condensation Control in Unvented Attics, per IRC Table 806.



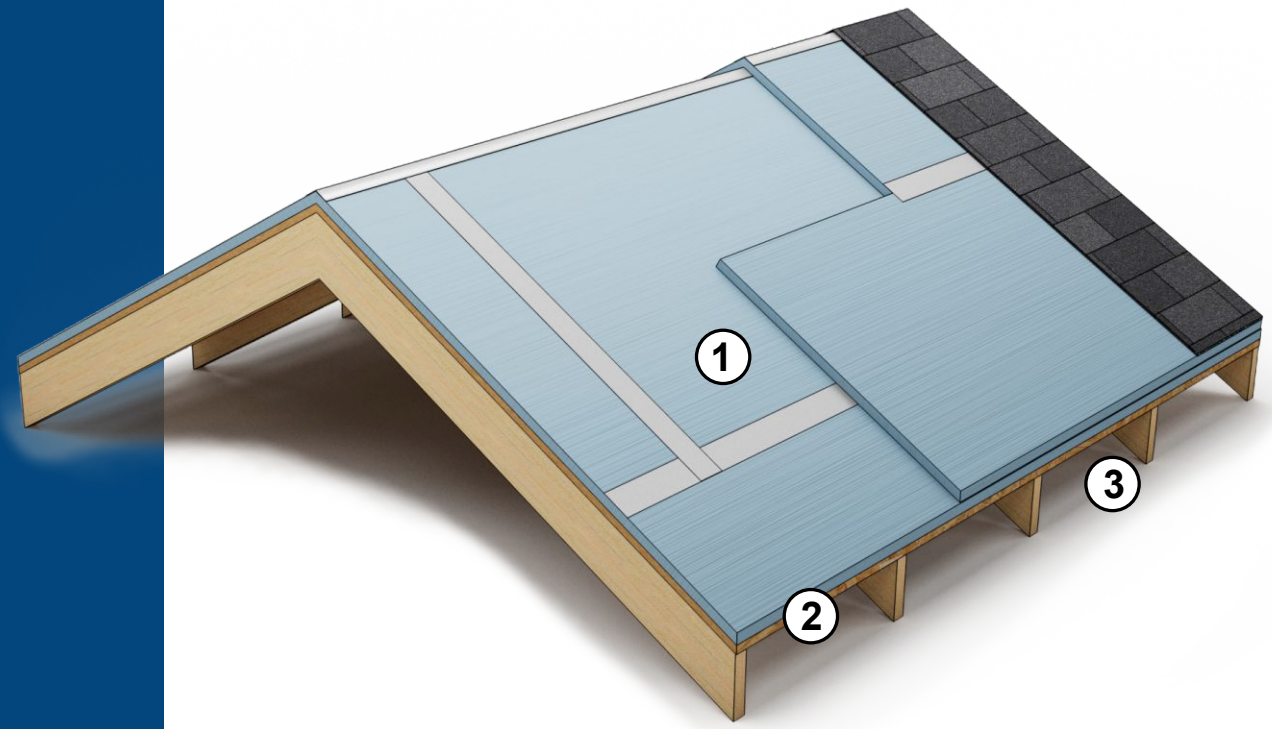
1. Sheathing
2. Rigid insulation
3. Sheathing
4. Batt insulation

Above-Deck Application (Exterior Layer)

Install continuous rigid insulation over the roof deck to maintain the deck temperature above the dew point of interior air.

Steps to success:

1. Offset insulation board joints to reduce air leakage.
2. Seal seams using approved tapes, caulks, or membranes for air barrier continuity.
3. The rigid insulation layer also serves as the primary vapor control surface, preventing condensation and moisture cycling.



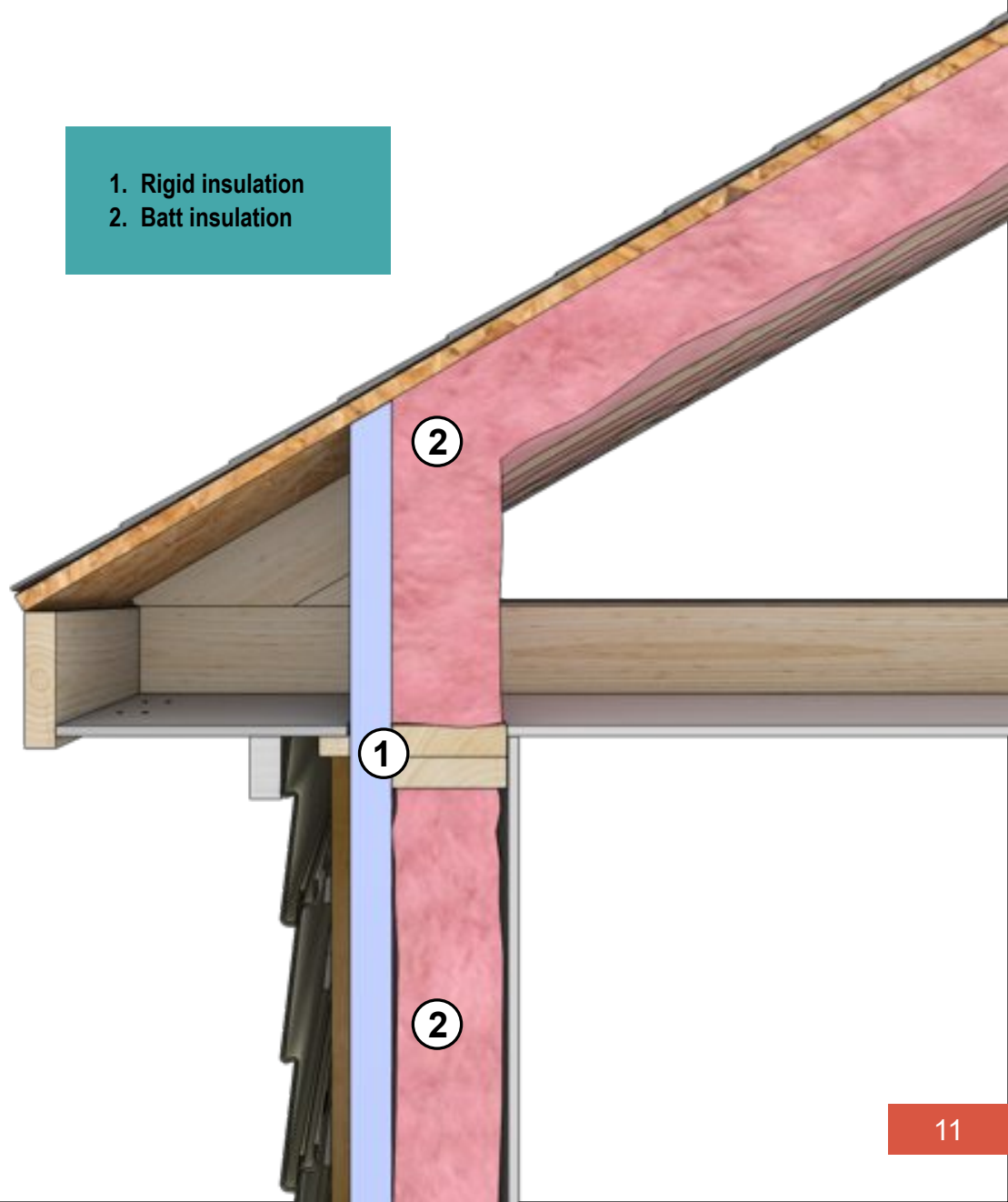
1. Rigid linsulation
2. Seam tape
3. Joints offset

Below-Deck Application (Interior Layer)

Use fibrous or batt insulation between rafters below the deck to achieve required total R-values and improve thermal performance.

Steps to success:

- Ensure air barrier continuity from wall-to-attic connections.
- Select vapor-permeable materials to allow limited drying potential.
- Maintain a balanced ratio of exterior-to-interior R-value to prevent condensation, per the IRC for your climate zone.



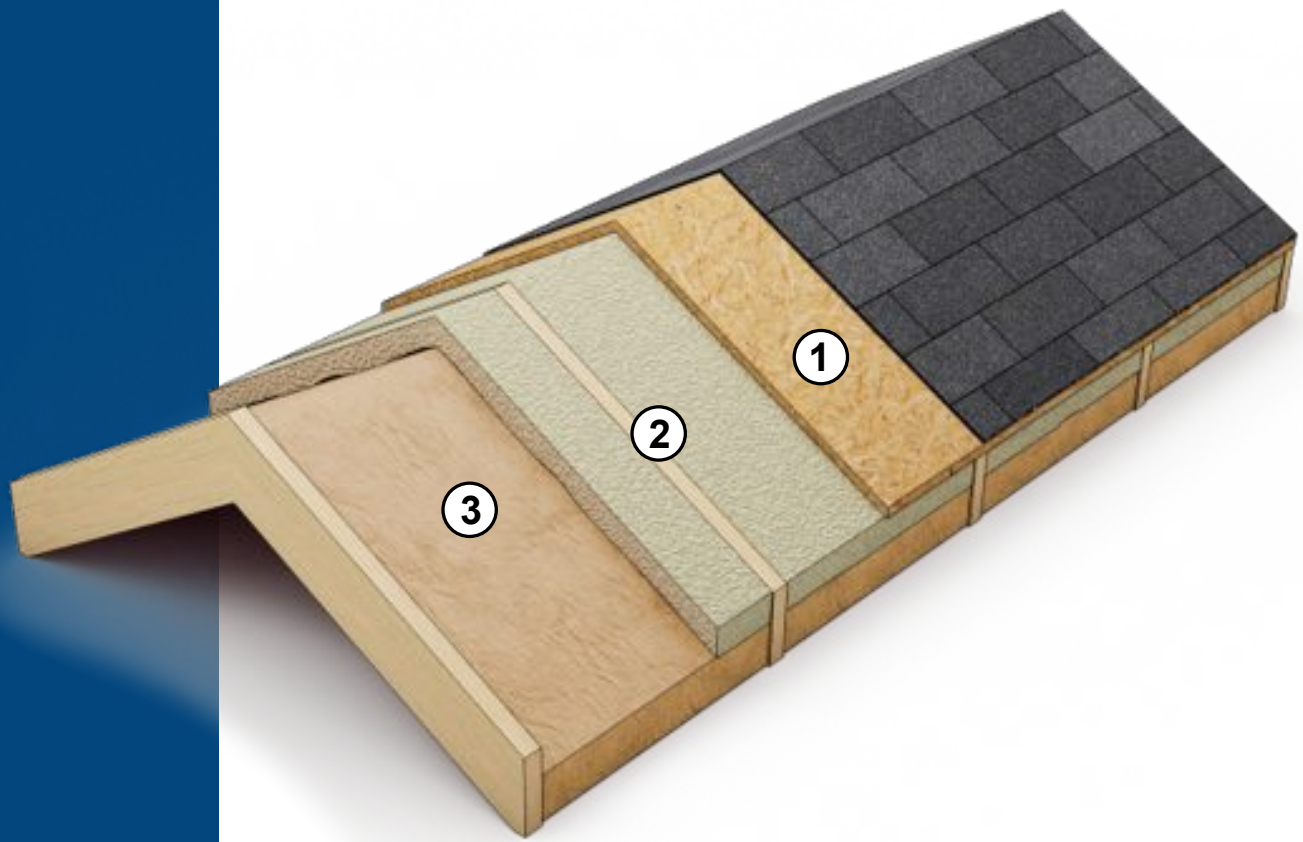
Flash and Batt Approach with Spray Foam and Batt Insulation

This unvented attic enclosure enables excellent air barrier/air leakage control through application of a single “lift” or layer of an appropriate closed cell SPF. The design consideration must be given to the flame spread or combustibility of the exposed SPF in the enclosed attic area.

Key benefits:

- SPF can provide an airtight control layer across the entirety of the roof deck.
- The continuous layer of closed cell SPF protects the roof sheathing from condensation wetting.
- This assembly can be generally used in all climate zones.

1. Sheathing
2. Spray foam insulation
3. Batt insulation

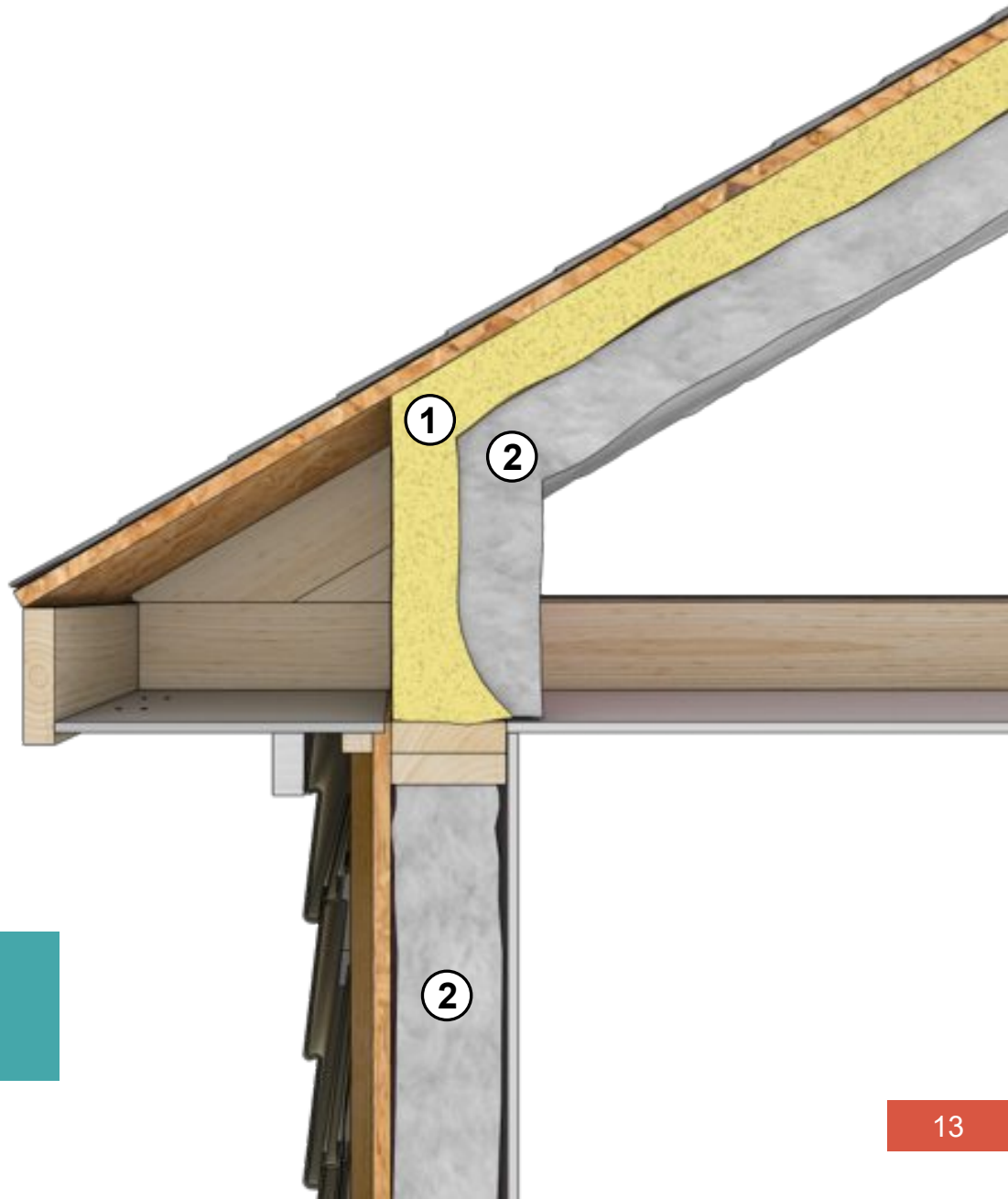


Flash and Batt Approach - Steps To Success

Steps to success:

- It is critical to connect the SPF air barrier to the air barrier layer of the walls and assembly adjacent to the attic.
- SPF must be installed correctly to ensure that no shrinkage or ‘cracks’ form in the air barrier layer.
- In conjunction with the modest space conditioning, the flash and batt approach reduces the risk of surface condensation on materials and equipment in the attic assembly.

Code: Air-Impermeable Insulation for Condensation Control in Unvented Attics, per IRC Table 806.5.

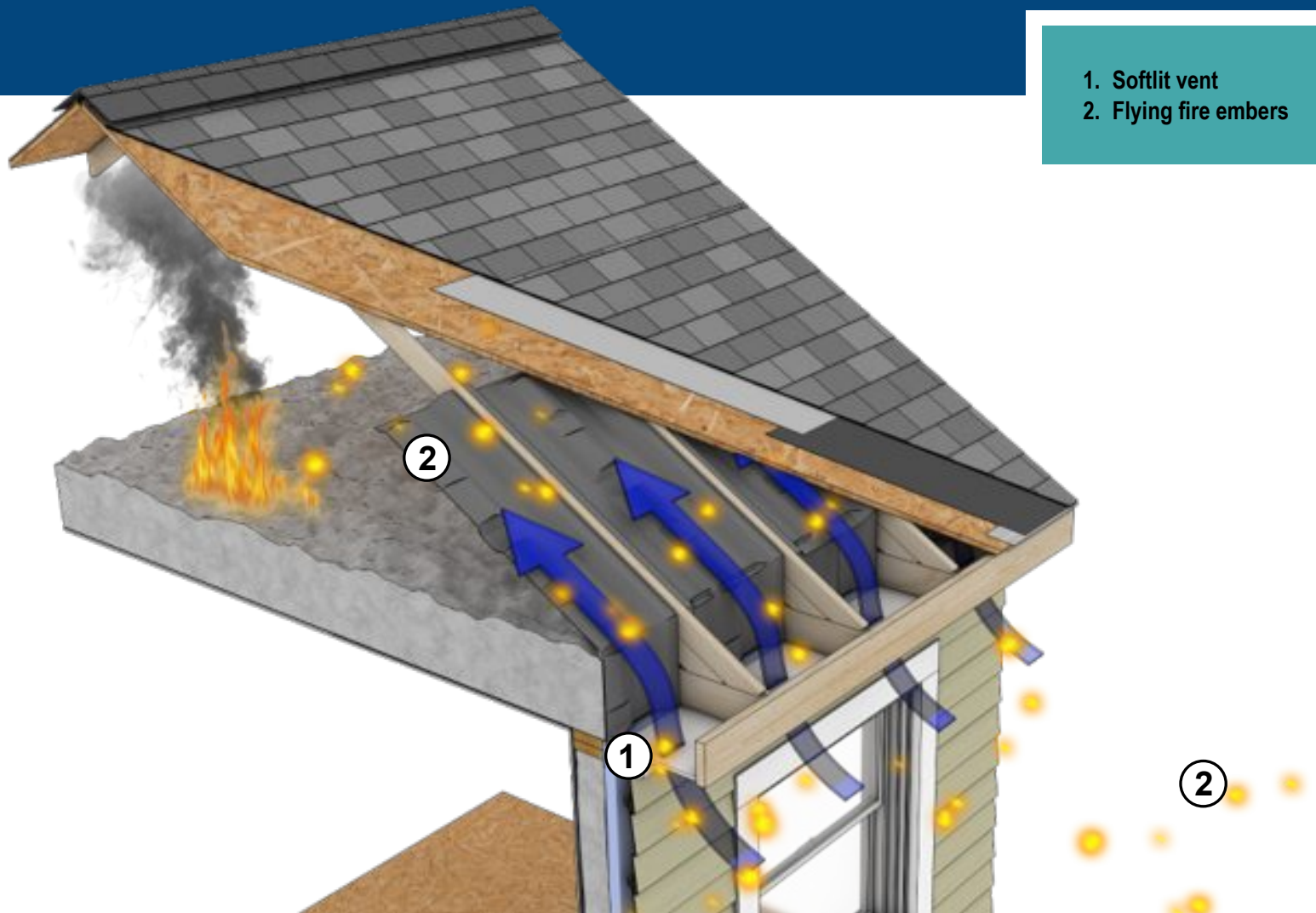


1. SPF insulation
2. Batt insulation

Wildfires and Unvented Attics

Flying embers are the cause of up to 90% of homes destroyed by wildfire. Wind-borne embers, also called firebrands or flaming sparks, can be carried miles ahead of the main flame, putting homes at risk even outside the wildland-urban interface. These embers can enter the home through attic vents and soffits, smoldering and igniting wood.

Unvented attics can offer a solution and provide protection for the occupant from this threat while also improving moisture control, comfort, and energy use.



1. Softlit vent
2. Flying fire embers

Conclusion

While there are several different approaches to a successful design and installation of an unvented conditioned attic, key steps must be completed in every project to ensure the space will perform as anticipated.

Overall performance of the space depends on a well-detailed continuous air barrier, climate-zone appropriate vapor control, and properly installed, code-compliant insulation.

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NAIMA is the association for North American manufacturers of fiber glass, rock wool, and slag wool insulation products. Its role is to promote energy efficiency and environmental preservation through the use of fiber glass, rock wool, and slag wool insulation, and to encourage the safe production and use of these materials.

Through the Insulation Institute, we leverage the collective insulation expertise of our organization and our members to empower homeowners and professionals to make informed insulation choices. Our mission is to enable a more comfortable, energy efficient and sustainable future through insulation – and we are constantly working with building professionals, homeowners, government agencies, and public interest, energy and environmental groups to realize that vision.

This guide was prepared for NAIMA by Construction Instruction (Ci), a nationally recognized building science company dedicated to helping the construction industry build better, more durable, and more energy-efficient homes. With over 100 years of building science experience, Ci Partners have worked alongside leading builders, manufacturers, and trade professionals across North America to improve building performance through education, consulting, field support, applied research, and visual education.

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