John Straube, Ph.D., P.Eng

CUFCA Foam Days 2008

Cathedrals and Conditioned Attics

University of Waterloo

See also www.buildingscience.com

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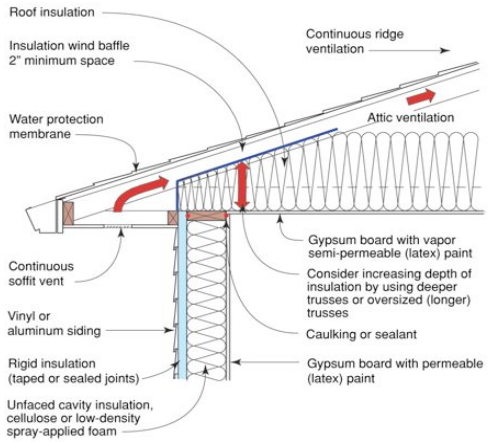
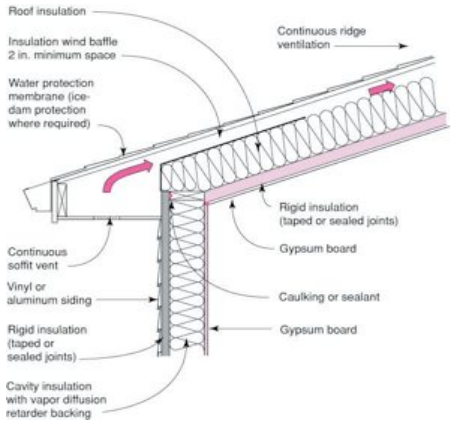
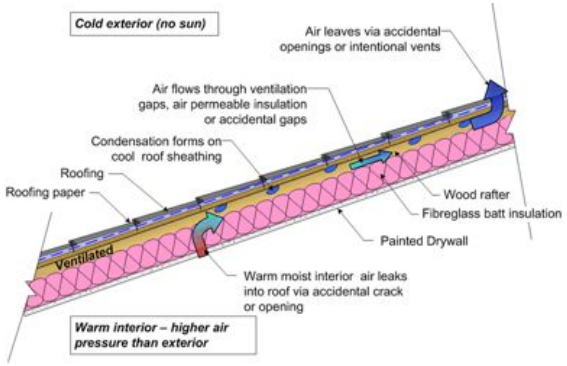
- See Building Science Digest
  - BSD-134 Ice Dams
  - BSD-115 Wood Roofs
  - BSD-102 Understanding Attic Ventilation
  - BSD-104 Understanding Air Barriers
  - BSD-106 Understanding Basements





Complexity

Air Leaks – cathedral ceilings



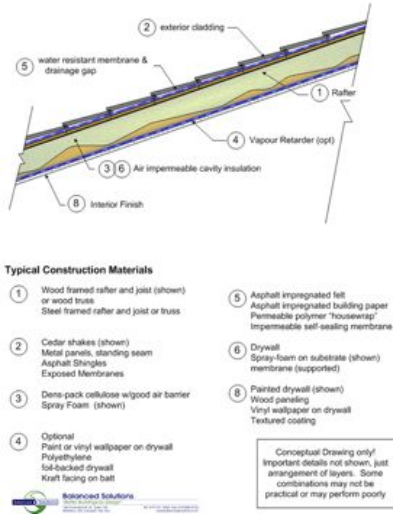
Unvented Cathedral Ceilings

- Not absolutely necessary to vent if airtight and vapour tight material,
  - e.g. spray foam.
  - Or insulated sheathing
- May be practical in retrofit
- If no wetting, little drying required
  - Demands very high performance
  - >R40, no penetrations
  - spray foam is a practical solution
  - beware thermal bridges

Unvented Solutions

Spray foam

- Airtight!



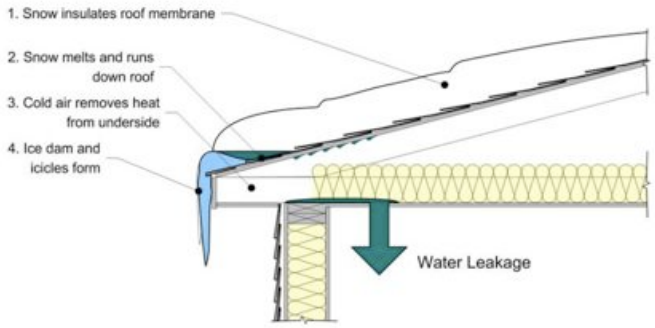


Figure 1: Ice Dam at a Typical Roof

Ice Dams

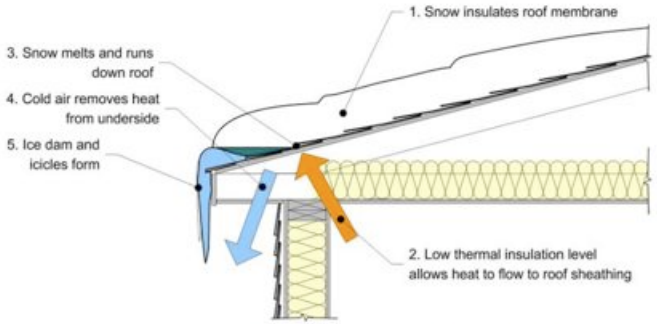
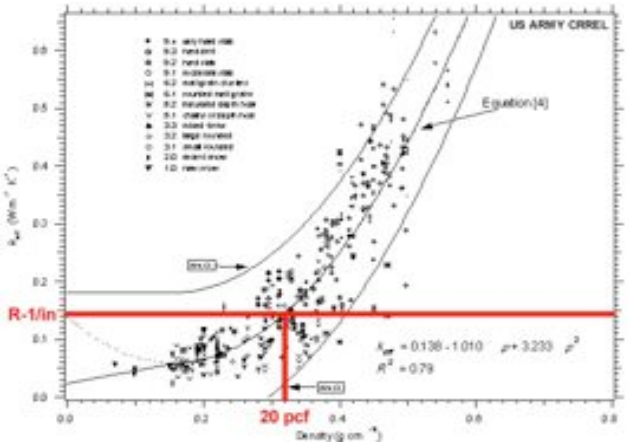


Figure 2: The Process of Ice Dam Formation Caused by Poor Insulation



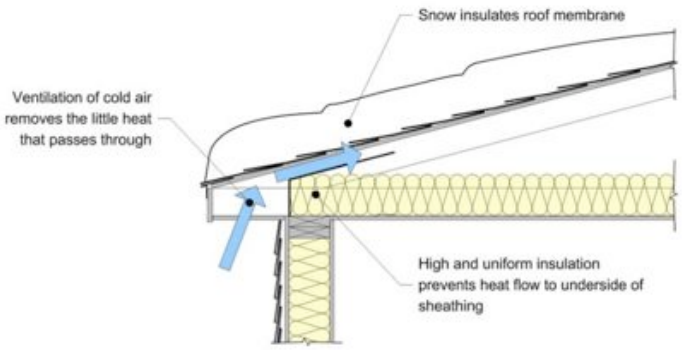


Figure 3: Solutions to Poor Insulation

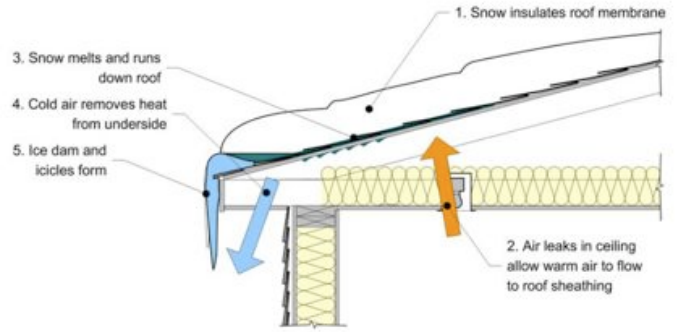


Figure 4: Ice Dam Formation Process Caused By Air Leakage

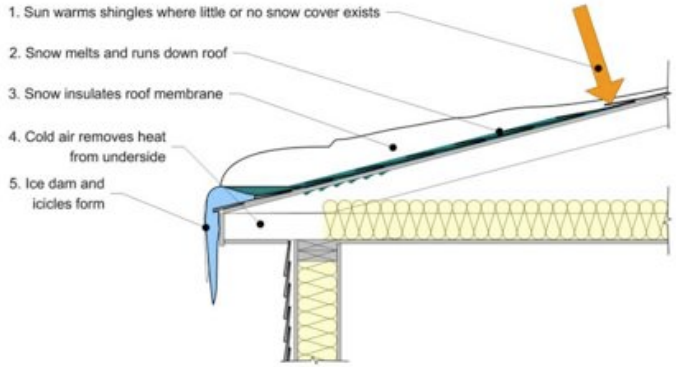


Figure 5: Ice Dam Formation Process Due to Uneven Snow Thickness

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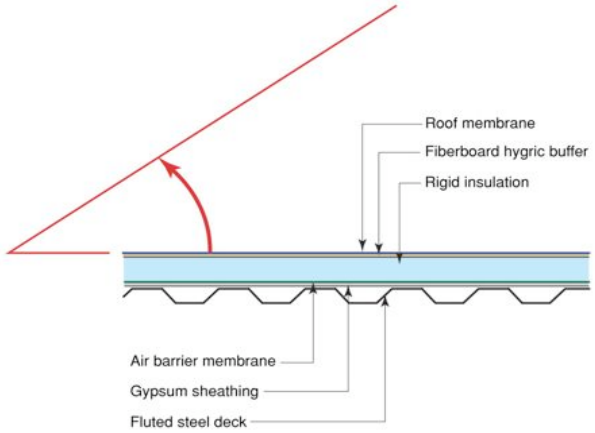

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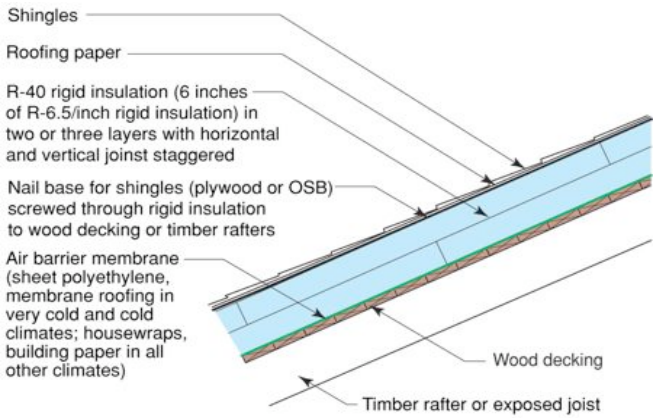

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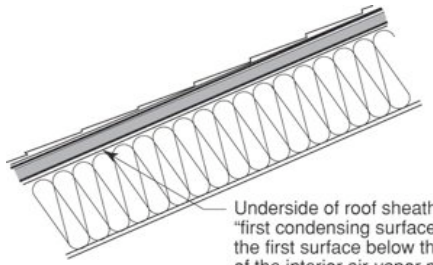
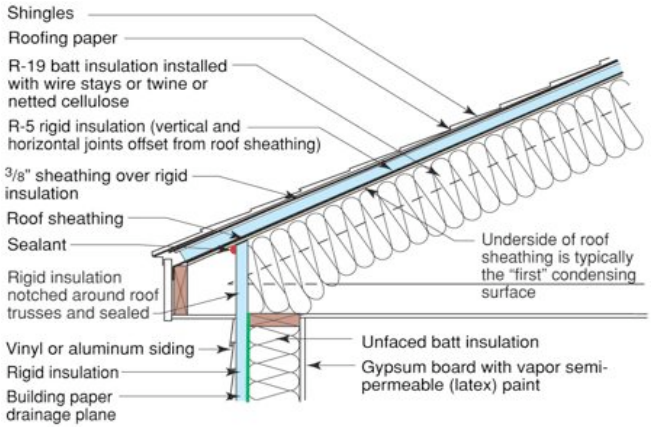


Underside of roof sheathing is typically the "first condensing surface" as it tends to be the first surface below the dewpoint temperature of the interior air-vapor mixture with sufficient thermal mass to support condensation during cold weather. Additionally, it also tends to be the first surface below the dewpoint temperature of the interior air-vapor mixture that is also relatively impermeable compared to the insulation layer beneath it.



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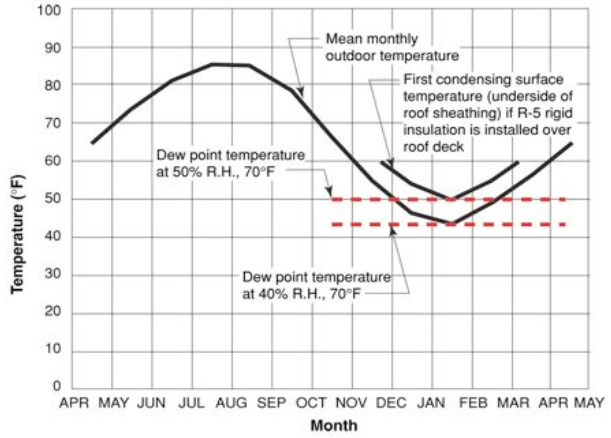

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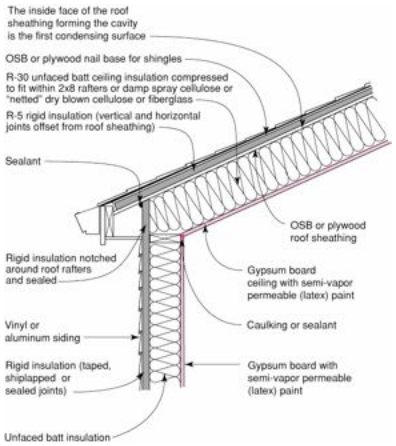

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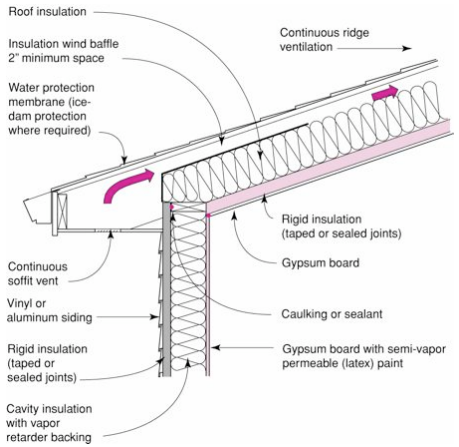

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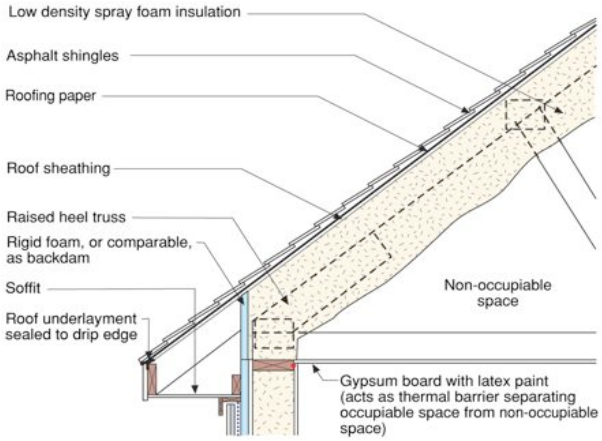
Low density spray foam insulation
Asphalt shingles
Roofing paper
Roof sheathing
Raised heel truss
Rigid foam, or comparable, as backdam
Soffit
Roof underlayment sealed to drip edge
Non-occupiable space
Gypsum board with latex paint (acts as thermal barrier separating occupiable space from non-occupiable space)

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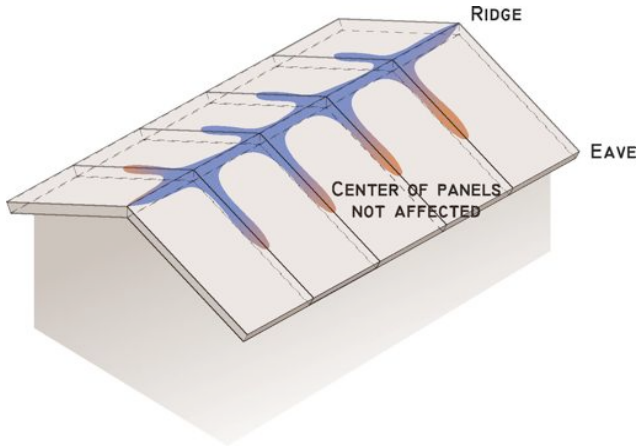

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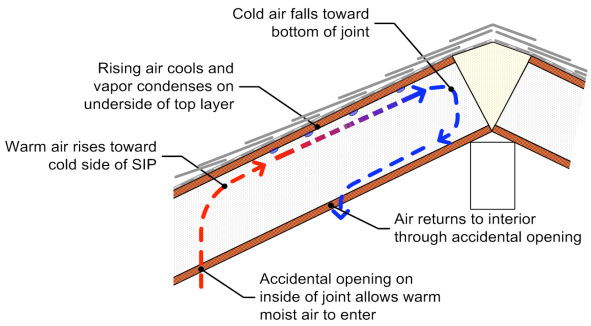

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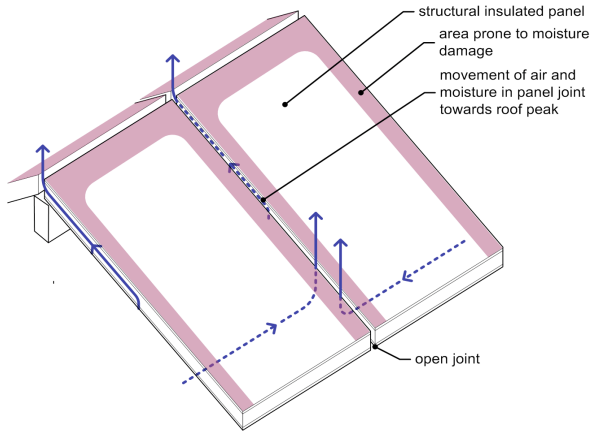

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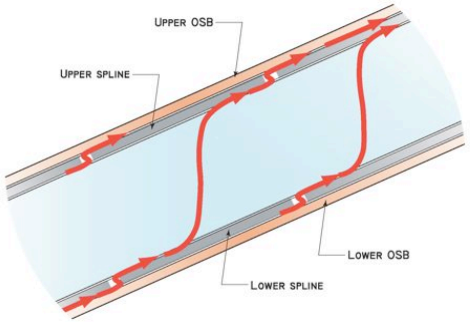

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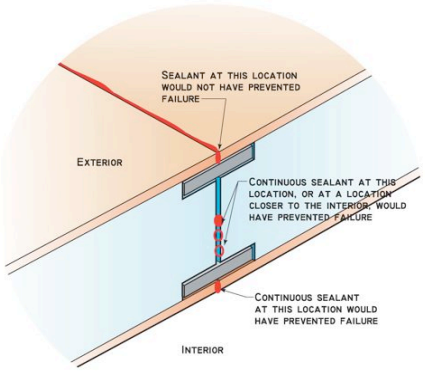

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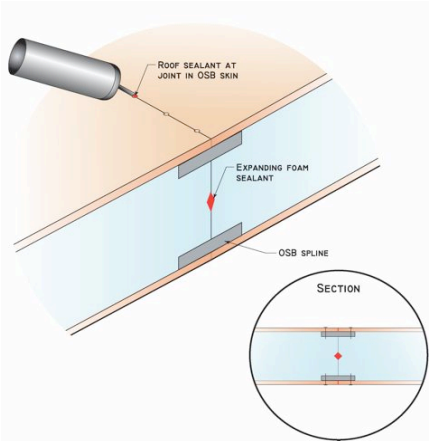

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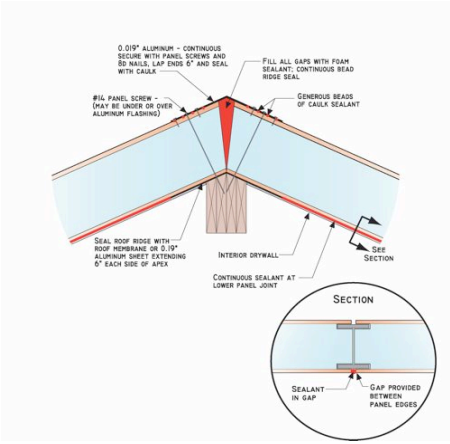

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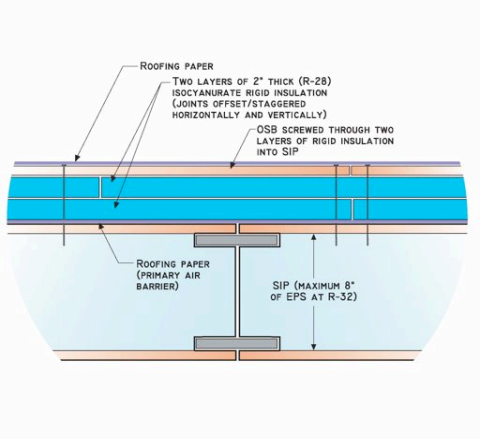

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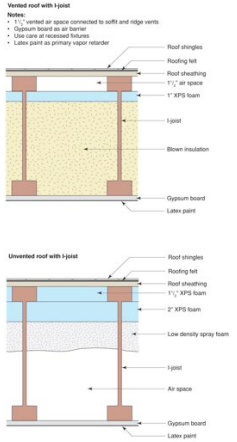

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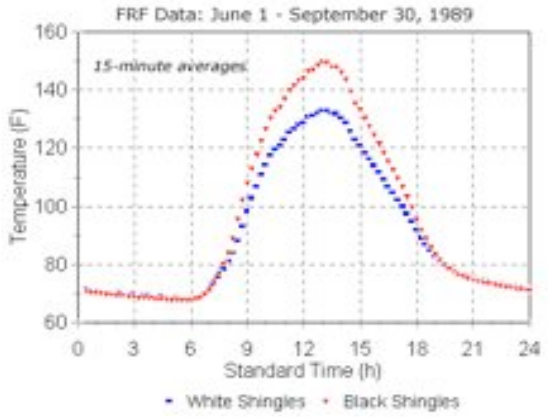
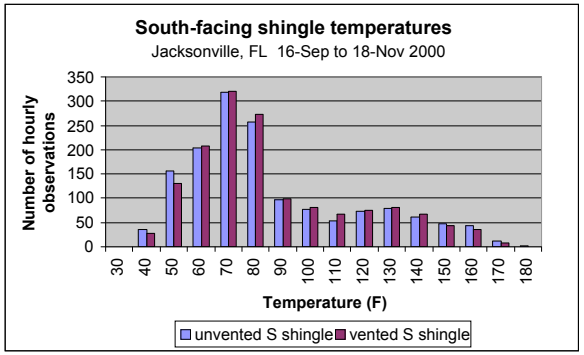


Vented vs. unvented shingle temperatures



Cathedral Ceilings

- What vapor control is needed to be safe for unvented SPUF roofs?
  - Similar to wall study
- Will roof be hotter than ventilated cathedral
  - We know this answer already
- Is ice damming a bigger concern?
- the need for venting to remove moisture and the impact of venting on roofing temperature
- the risk of roof leaks caused by the different drying strategies applied.

Proposed field testing

- Five different roofs: Each type faced one direction at a 3:12 pitch.
- R30 of 2 pcf SPUF between the rafters.
- R30 of 0.5 or 2 pcf SPUF between the rafters below a 2” ventilation space formed with an EPS baffle.
- R30 of 0.5 pcf open cell SPUF.
- R30 of 0.5 pcf open cell SPUF with a vapor retarding paint finish as supplemental vapor retarder.
- standard 8” R30 fiberglass batt insulated 2” space (vent chutes at the soffits) leading to a mushroom vent.