Above Sheathing Ventilation In Tile Roof Installations

PAC Presentation

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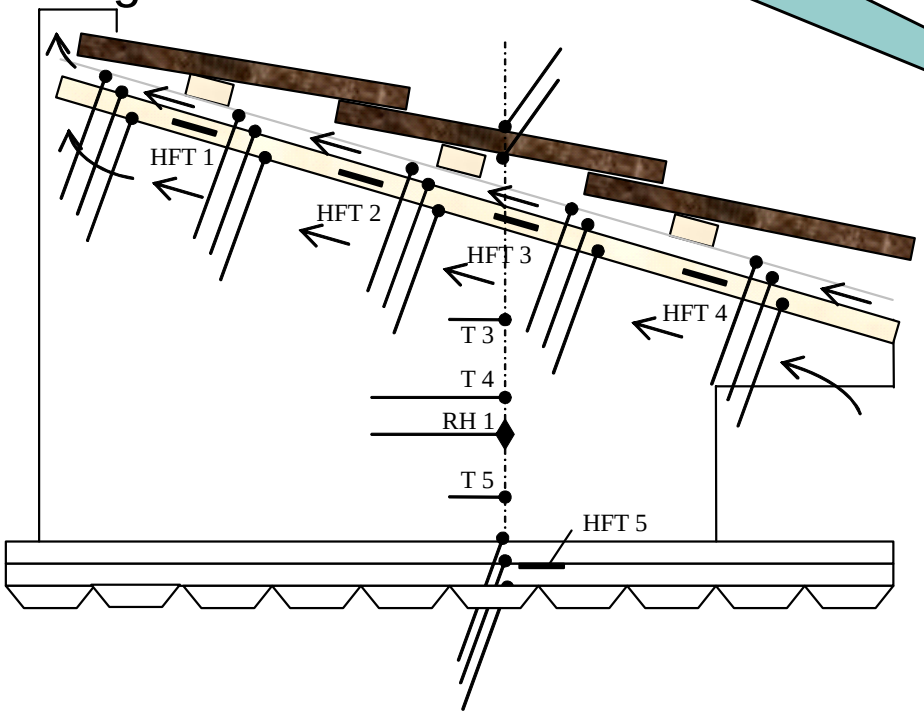
Steep-Slope Assembly on ESRA at Oak Ridge National Laboratory

Underside of Tile Instrumented for Temperature and Heat Flow Measures

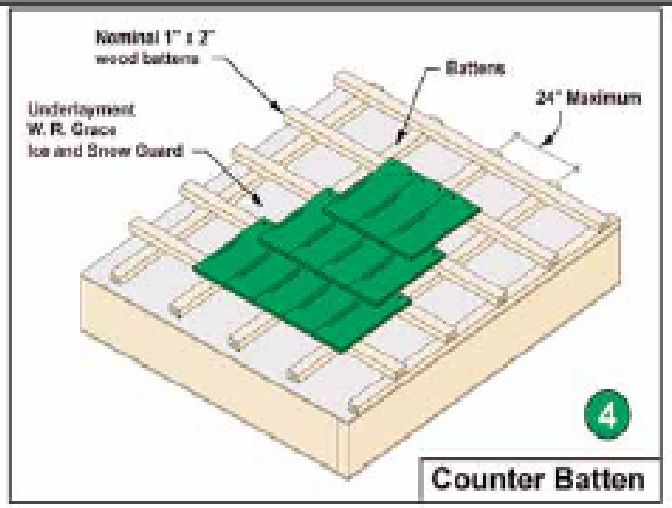
Winter Ra^*_H= 33,000

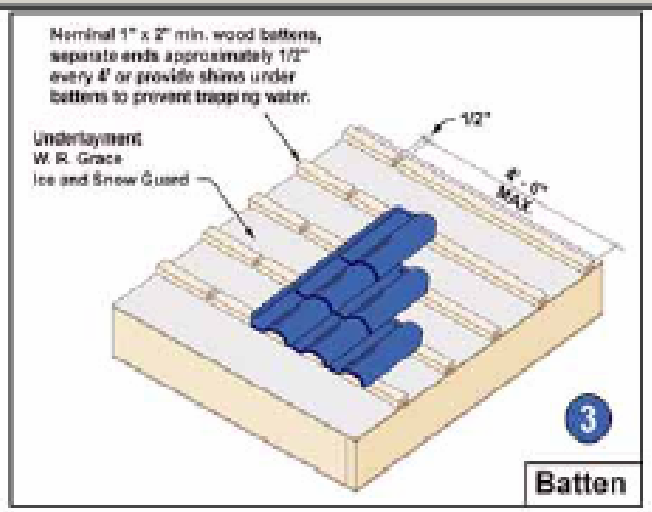
Summer Ra^*_H= 50,000

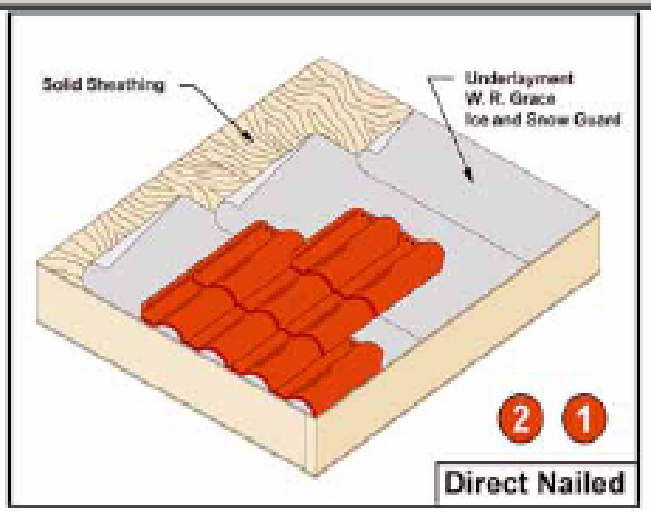
Ridge Closed

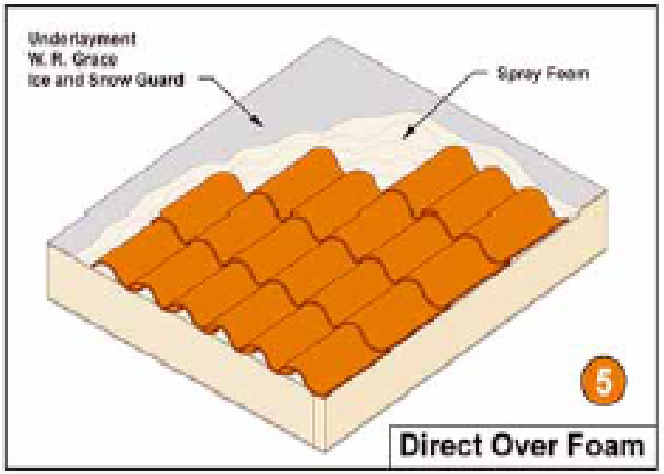


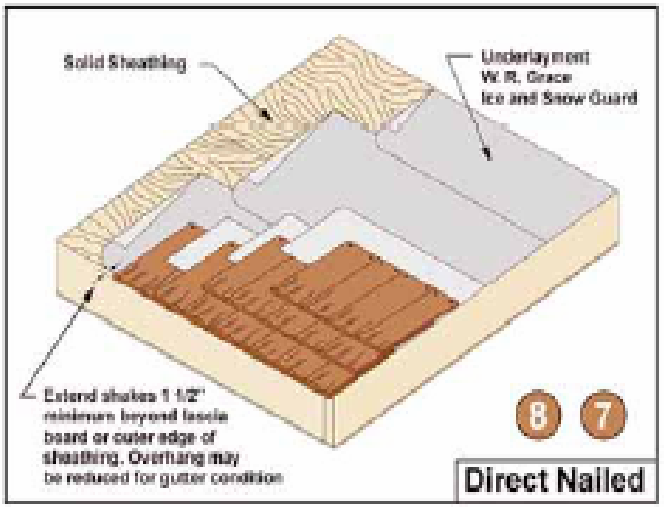
Envelope Systems Research Apparatus

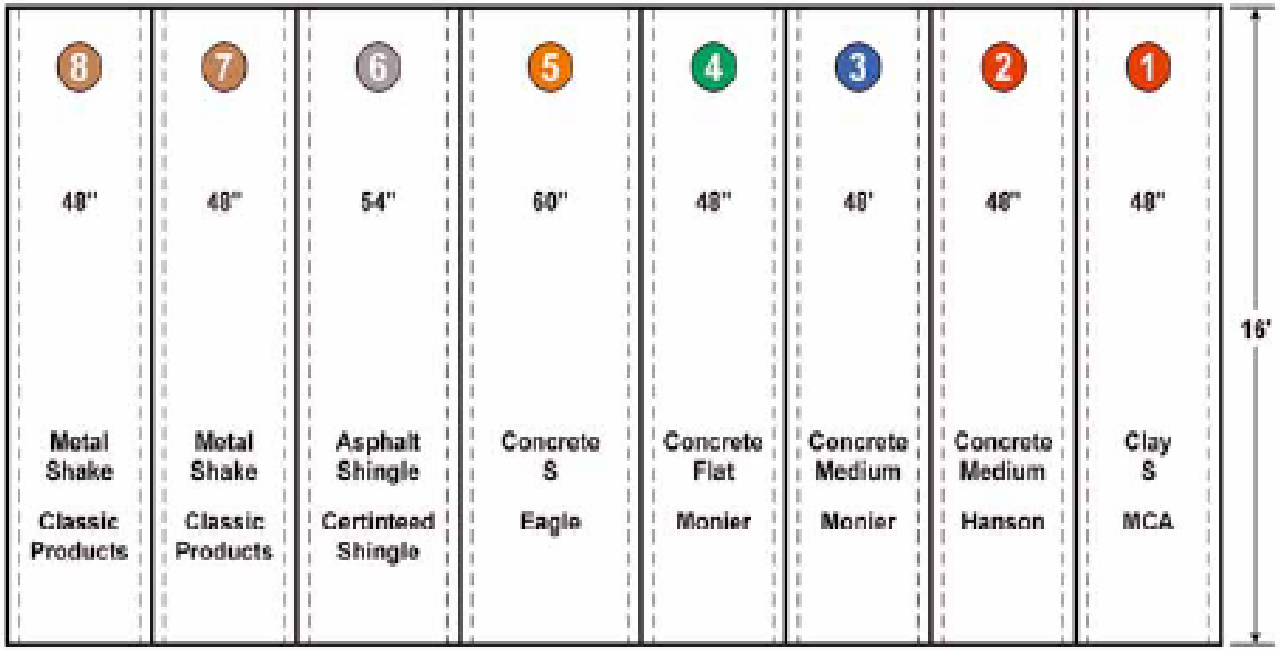






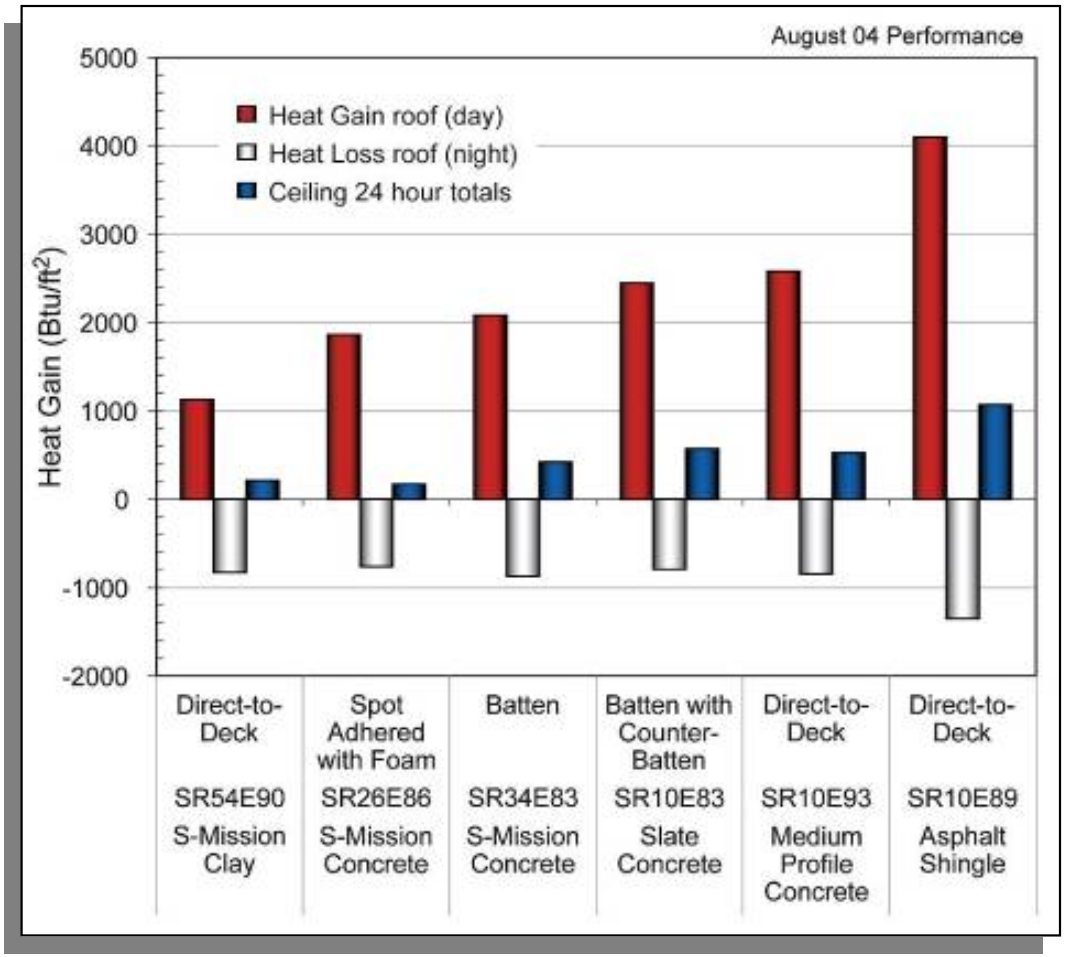






Plan View of Steep-Slope Assembly

S-Mission Tile Reduce Daytime Heat Gain by 50 to 75% of Gain for Shingle Roof



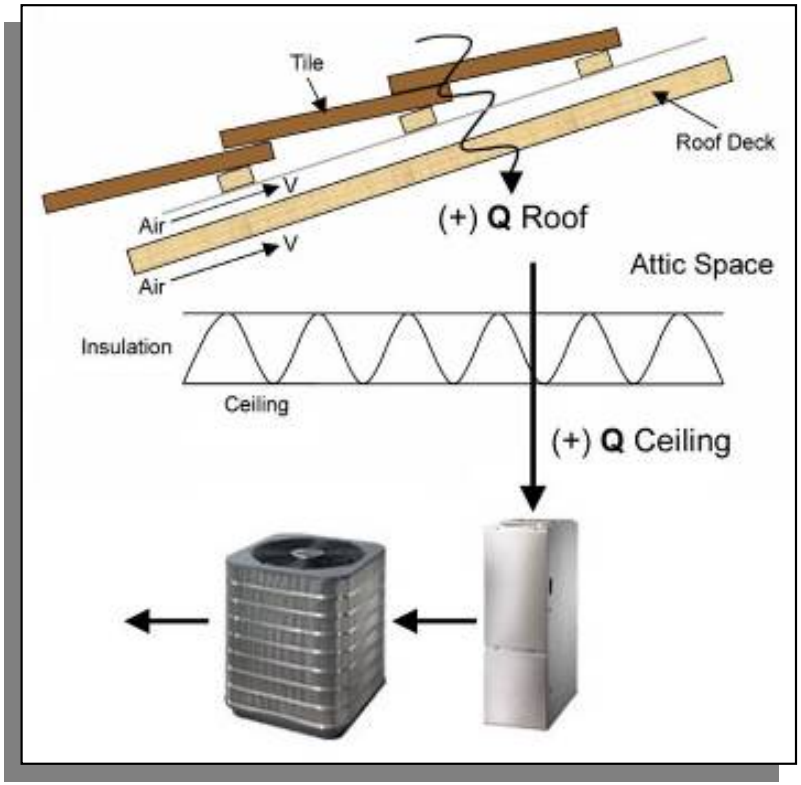
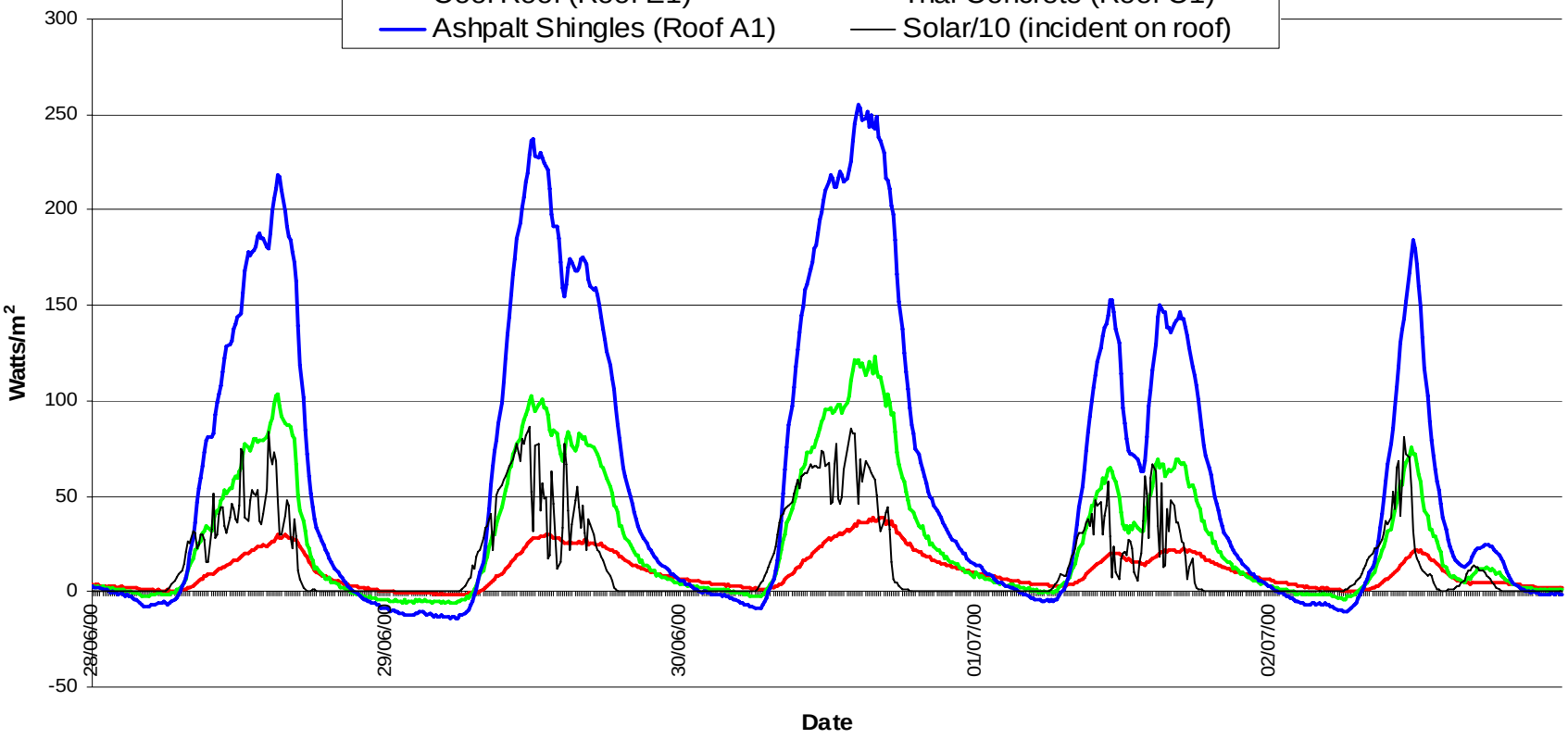
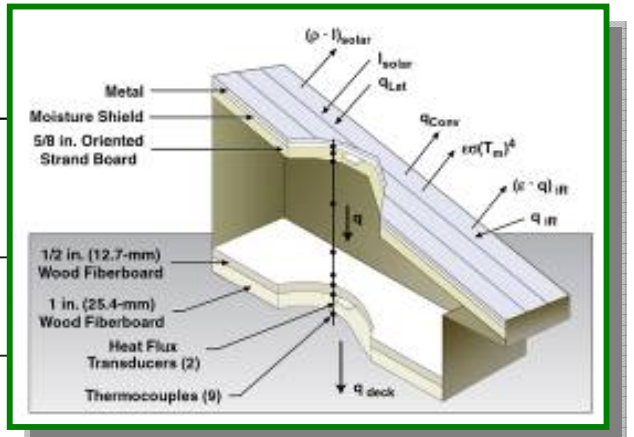


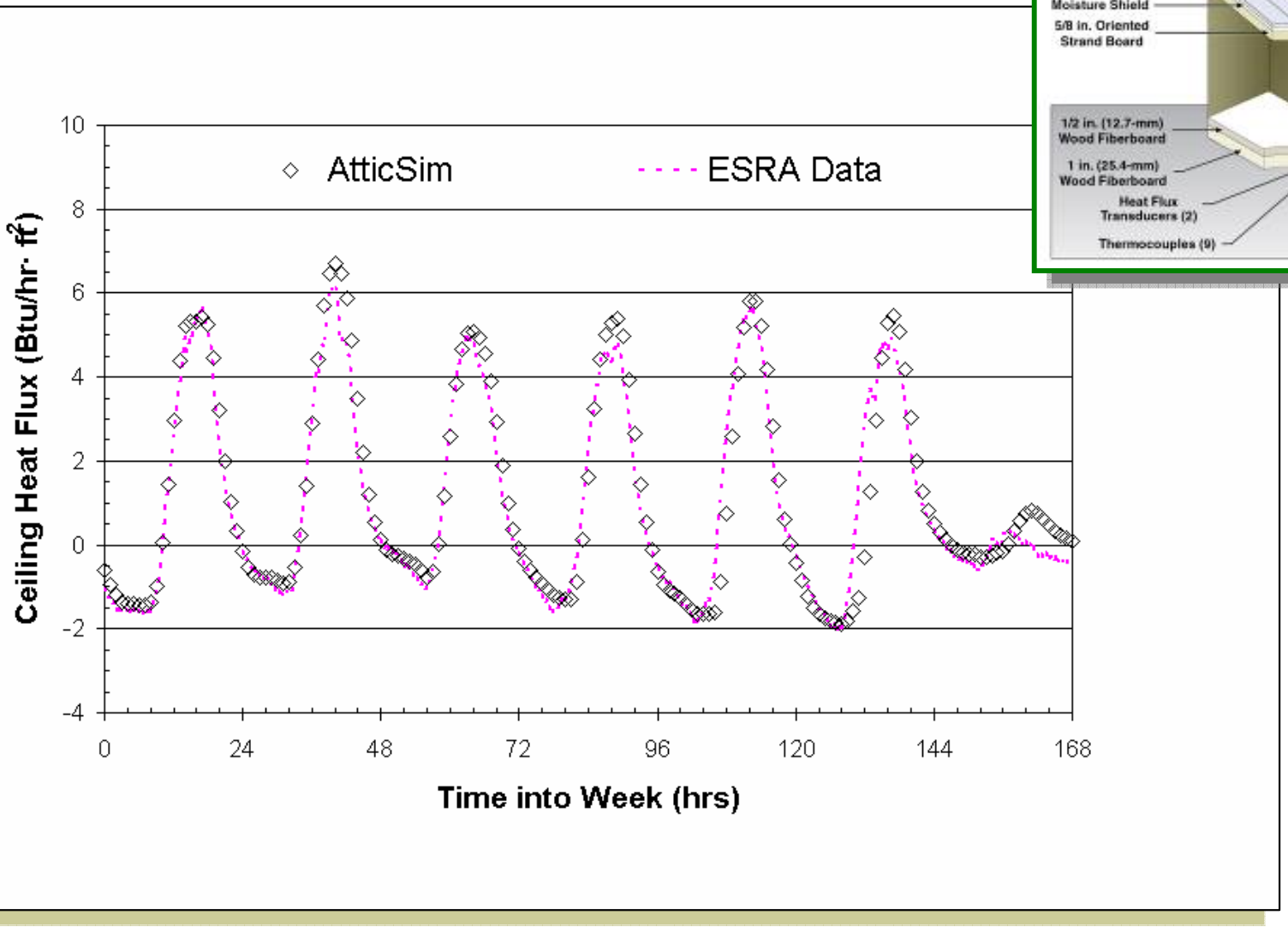
Figure 25: Heatflux Through Ceiling Panel Over Several Days (Air Conditioning ON)



- Note - the Cool Roof transfers much less heat into the living space.

AtticSim Heat Flux Validation





Florida Solar Energy Center

- FSEC July 6, 1992 Report
  - Test Criteria
    - Black asphalt shingles were used as a baseline comparison
  - Test Conclusions
    - Counter batten system reduced ceiling heat flux by 48%
    - Direct deck system reduced ceiling heat flux by 39%

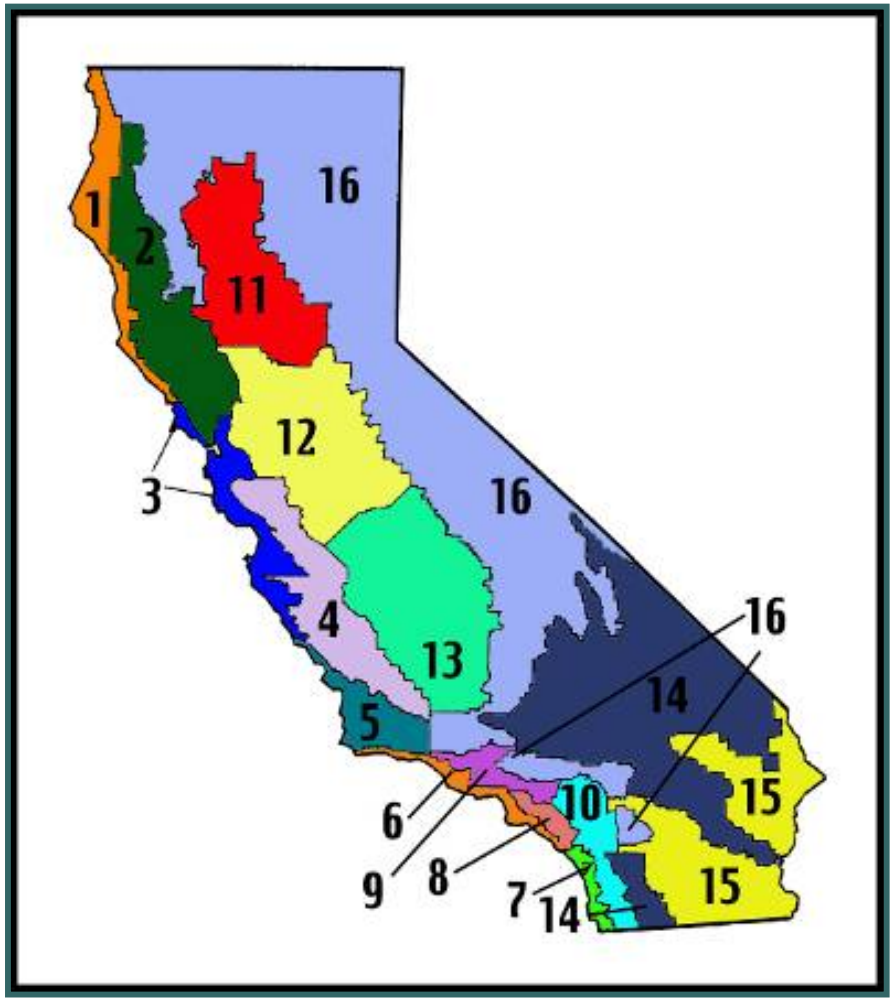
“THE COOL ROOF”

- Light colored high profiled tiles, (if possible with reflective coating).
- Tiles laid on counter battens
- Ventilation of the batten space at the eaves level and at higher level.
- Radiant barrier at rafter height.
- Roof space ventilation at eaves, ridge and gable.
- Insulation at ceiling or rafter height

What makes a roof “Cool”?

- High surface reflectivity
- High emissivity
- Air circulation – Above Sheathing Ventilation (AVS)

California Climate Zones

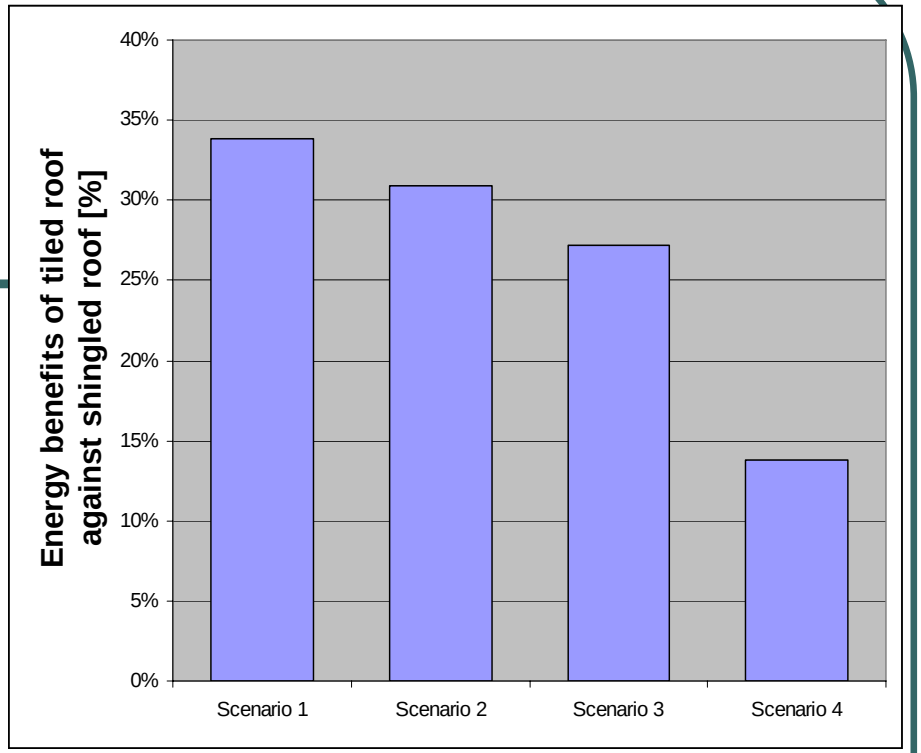


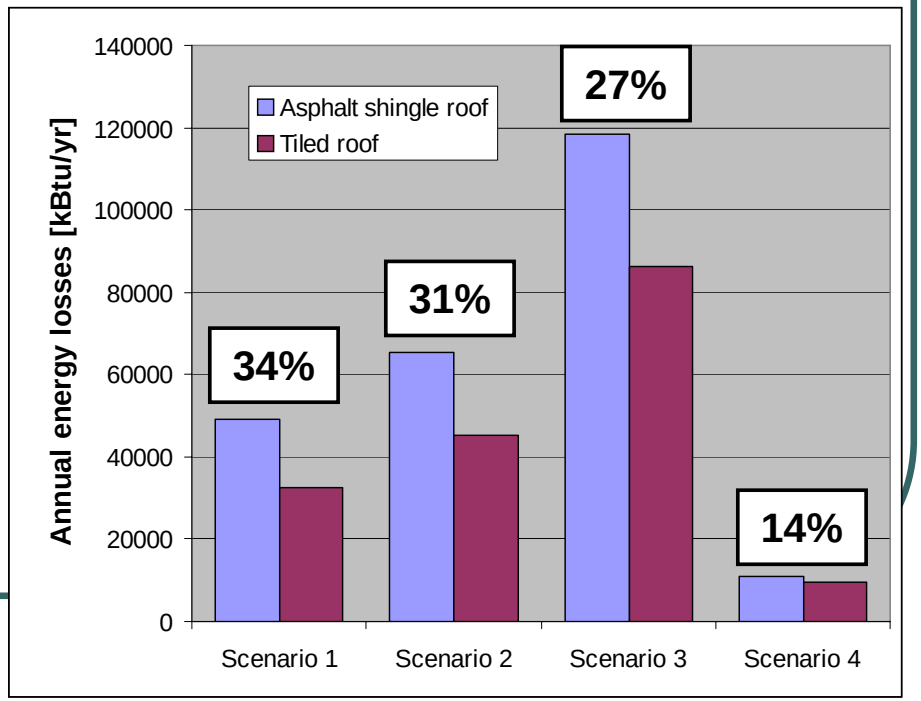
- Climate Zones 9-15 represent greatest challenge for energy savings.
- Tile roofs most common new construction roofing material.
- Compare existing methods of installation to methods that employ enhanced air flow between the roof deck and roofing material.
- Analyze Above Sheathing Ventilation (AVS)

Energy benefits of a tiled roof compared with shingle roof (in climate 15 – El Centro)

- with/without insulation, radiant barrier & duct work

- Scenario 1 – benefit **34**% –
  1. Annual cooling energy only
- Scenario 2 – benefit **31**% –
  1. Annual cooling energy plus
  2. Annual heating energy
- Scenario 3 – benefit **27**% –
  1. Annual cooling energy plus
  2. Annual heating energy plus
  3. Annual duct losses
- Scenario 4 – benefit **14**% –
  1. Annual cooling energy plus
  2. Annual heating energy plus
  3. Annual duct losses plus
  4. Attic with insulation & radiant barrier





Profile Comparison

Flat Tile

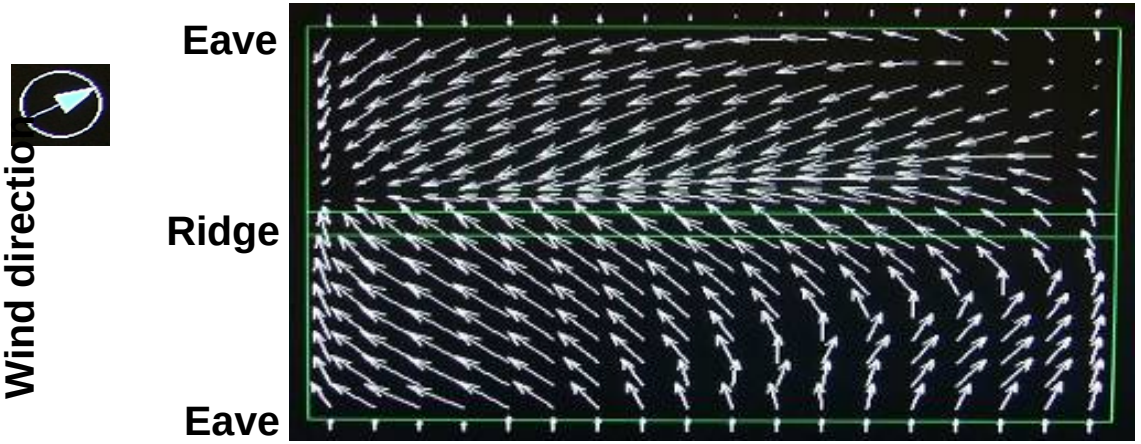
Medium Profile

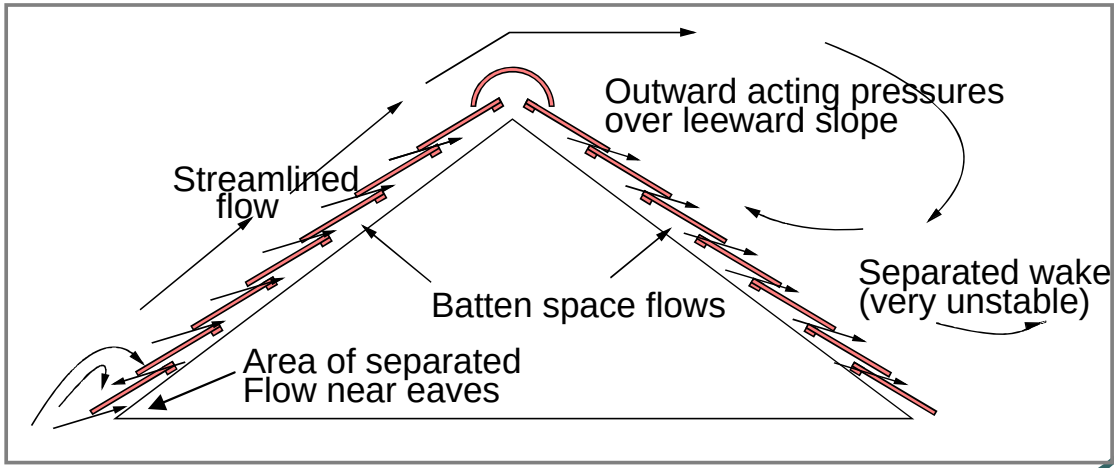
S-tile / High Profile

The role of air movement in the batten-space Study conducted by Lafarge Roofing Technical Centers

- Tiles and slates are air permeable providing an air permeability of approximately 0.5% to 1% of the laid area.
- Complicated flow networks are found between tiles and underlayment
- The flow between tiles and underlayment will influence:
  - The energy performance of the roof
  - The wind loading on the tiles
  - The driving-rain performance
  - The dispersion of moisture

Plan view of the roof showing air flows between tiles and underlayment





Limited ASV versus full ASV
Main findings

- A flat tile with limited Above Sheathing Ventilation meets the performance of the default construction.
- The higher thermal mass of the tile also contributes to the benefit:
  - Tile mass: 10.2 lb/ft^2 Default construction: 1.7 lb/ft^2
- Improved ASV under the roof tiles reduces the annual energy losses - the tile roof is then always at least equal to the default construction
- **Improved ASV is achieved by:**
  - Elevating the roof tiles with counter-battens.
  - Using profiled tiles instead of flat tiles.
  - Increasing the ridge & eaves ventilation.
- **All** of these improvements reduce the air flow resistance under the tiles and improve the energy benefits from ASV.

Above Sheathing Ventilation

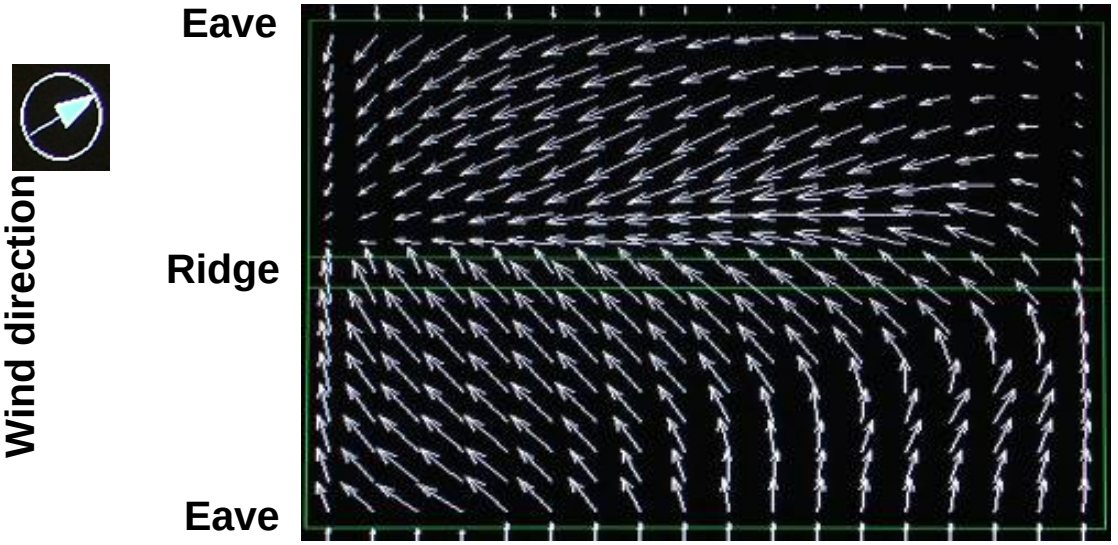
- As the temperature under the tile increases, the heated air rises toward the ridge, drawing cooler air into the system through the vented eave risers.
- The heated air exhausts through the vented ridge assembly. The high profile tile allows more heated air to exhaust from beneath the cap tiles.

Flat tiles attached direct to deck

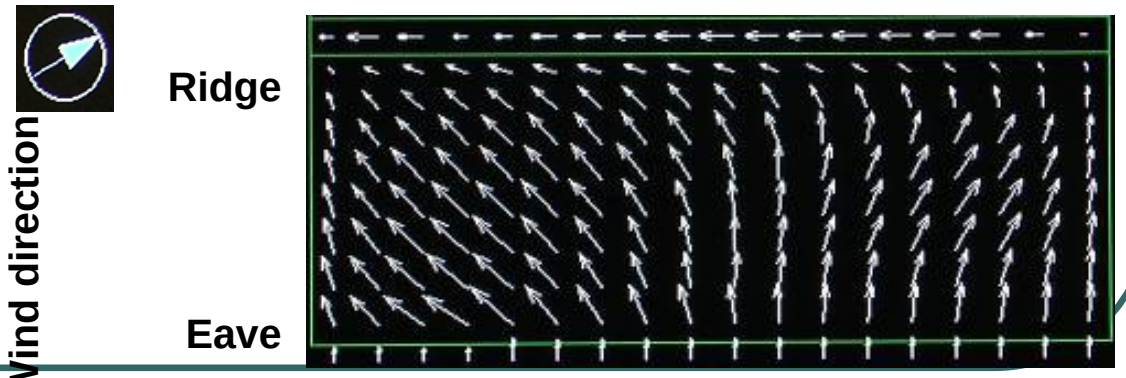
Air movement in the batten-space; mono-pitch vs. duo-pitch

- Complicated flow networks are found in both mono-pitch & duo-pitch roof types
- The ventilation rate & heat benefits from wind driven air flows are broadly similar for both roof types.

Plan view of the **duo-pitch** roof



Plan view of the **mono-pitch** roof



Cut Away of Installed Raised Fascia Eave Treatment

Anti-ponding mechanism required at all raised fascias.

Minimal air intake at eave.

Birdstop- supports first course, closes opening, weep holes provide drainage.

Vented Eave Riser

- Birdstop modified to increase airflow.

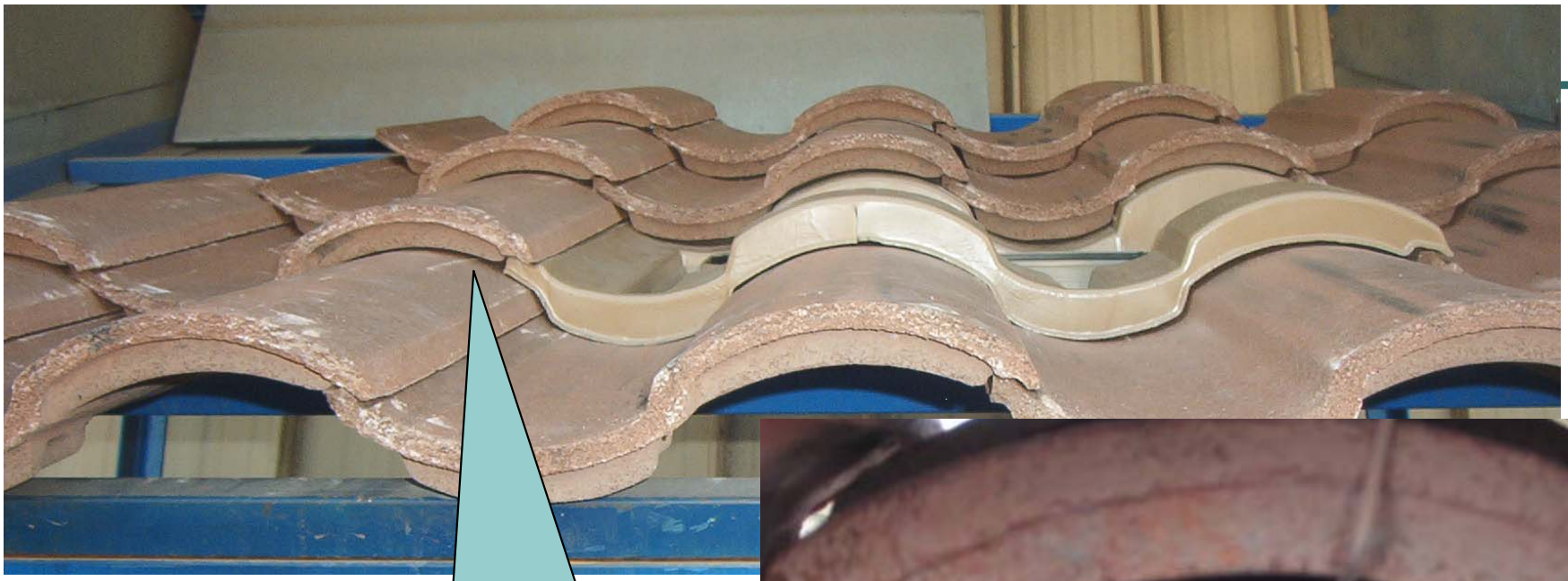
- Protects against the entry of birds or rodents.
- Prevents entry of blowing embers.

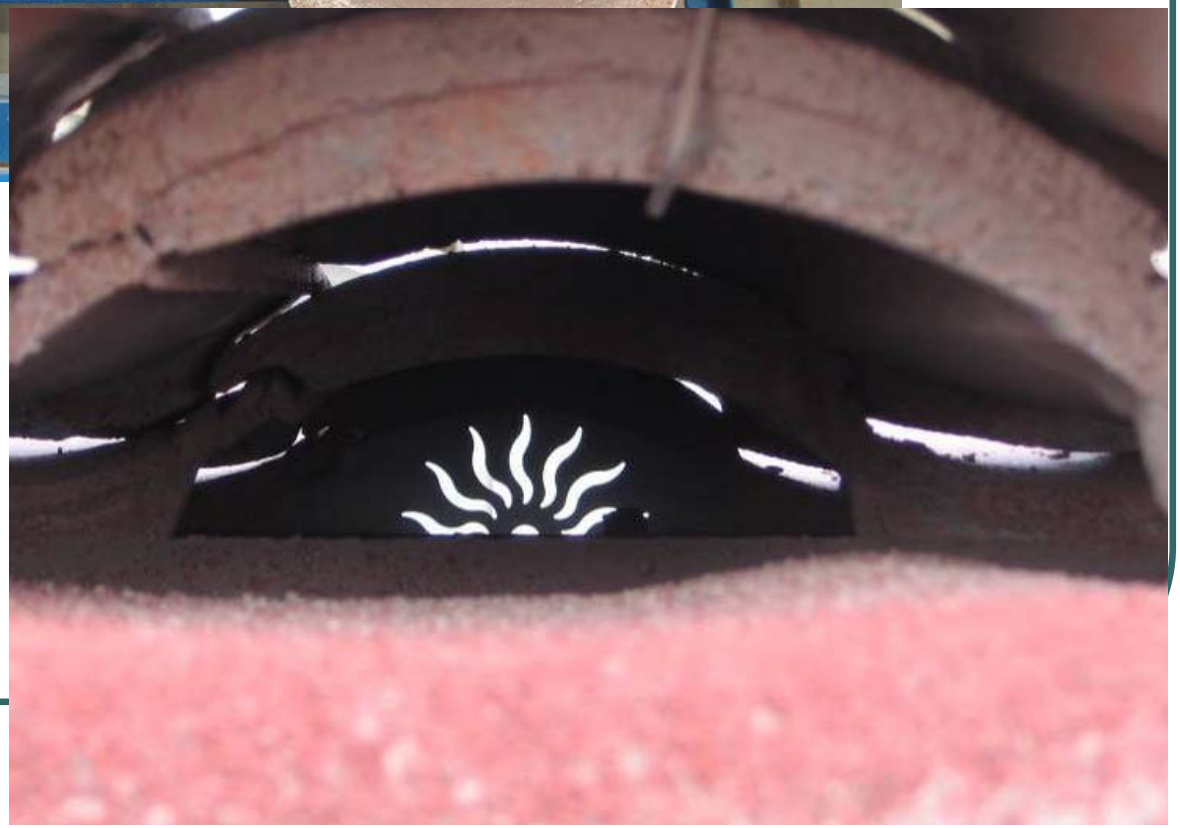
Single Batten Installation

Flat tiles on battens

S-tile on single batten.

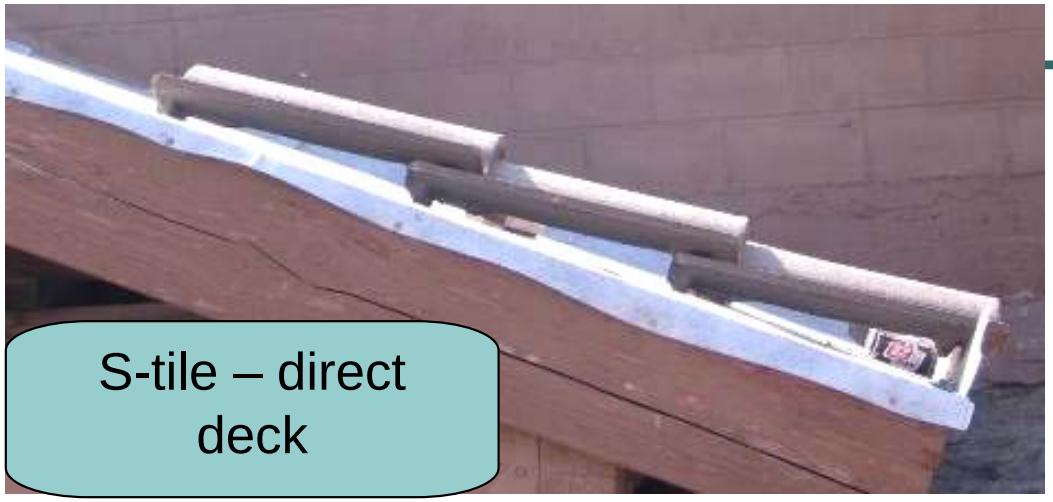
Airspace beneath S-tile





Natural airspace along with air permeability of installed tiles promotes air flow beneath and around tiles.

Natural Airspace



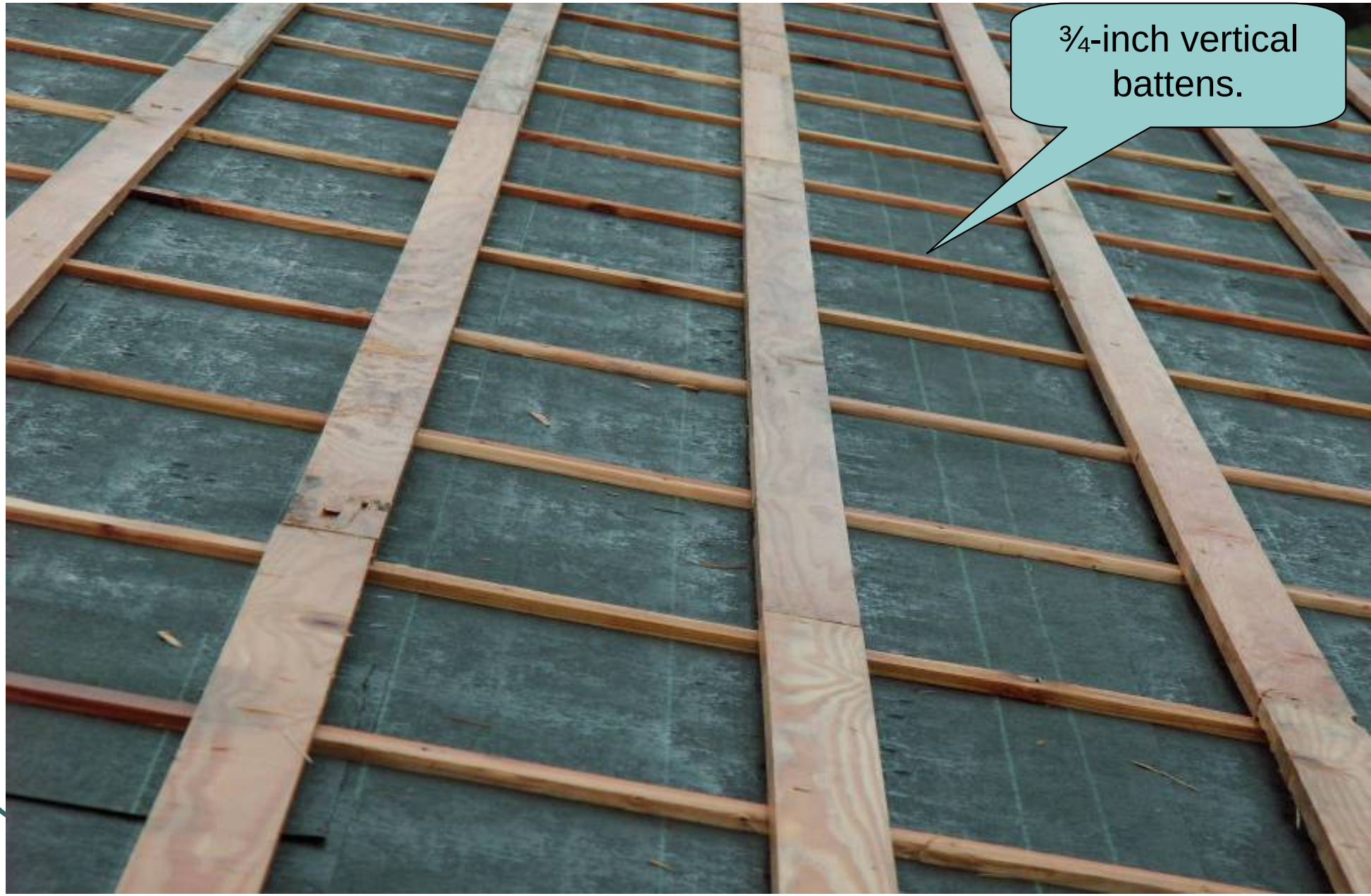
S-tile – direct deck

S-tile on elevated batten

Medium Profile on elevated batten

Counter Batten on Low slope

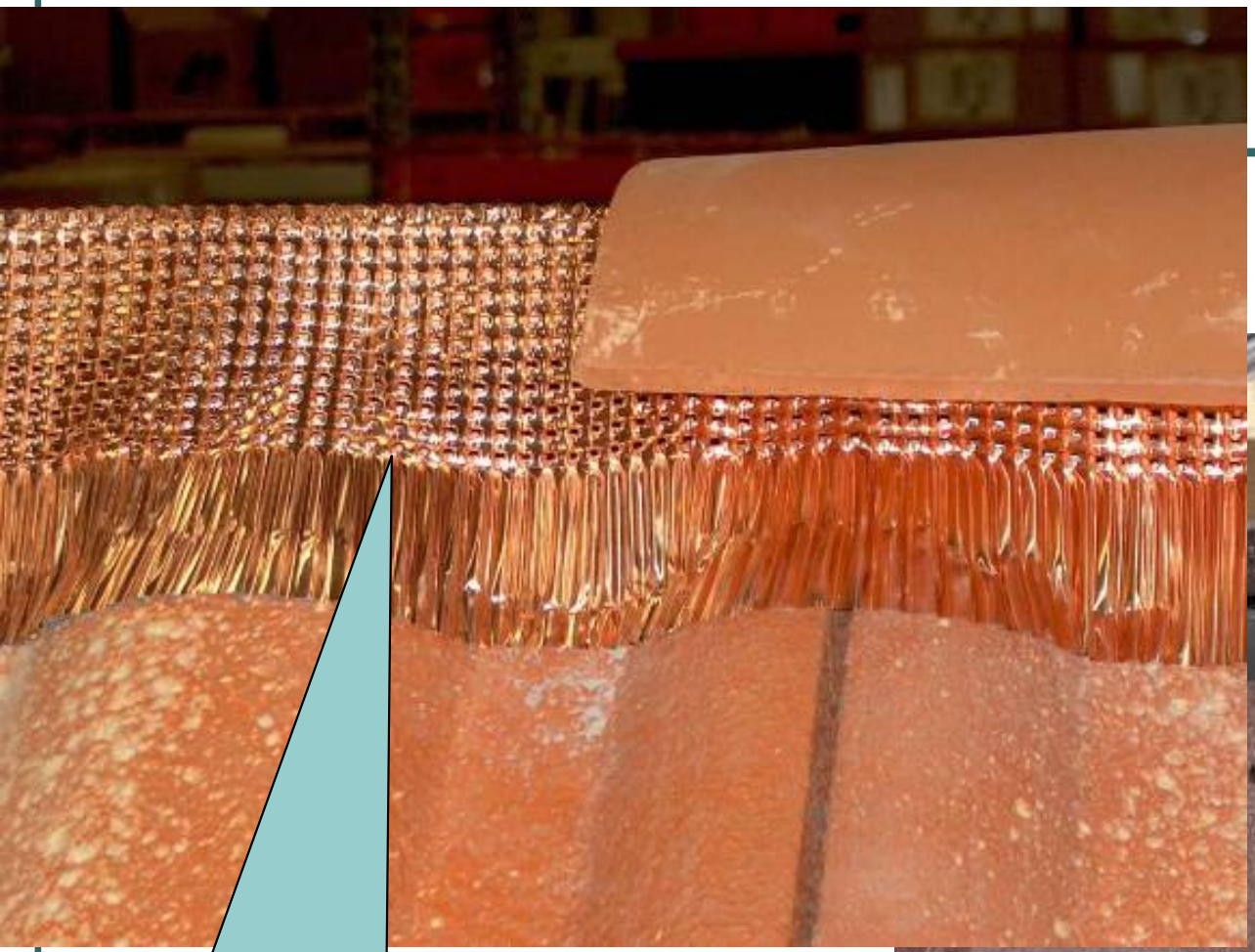
Counter Batten System



Optimized Systems

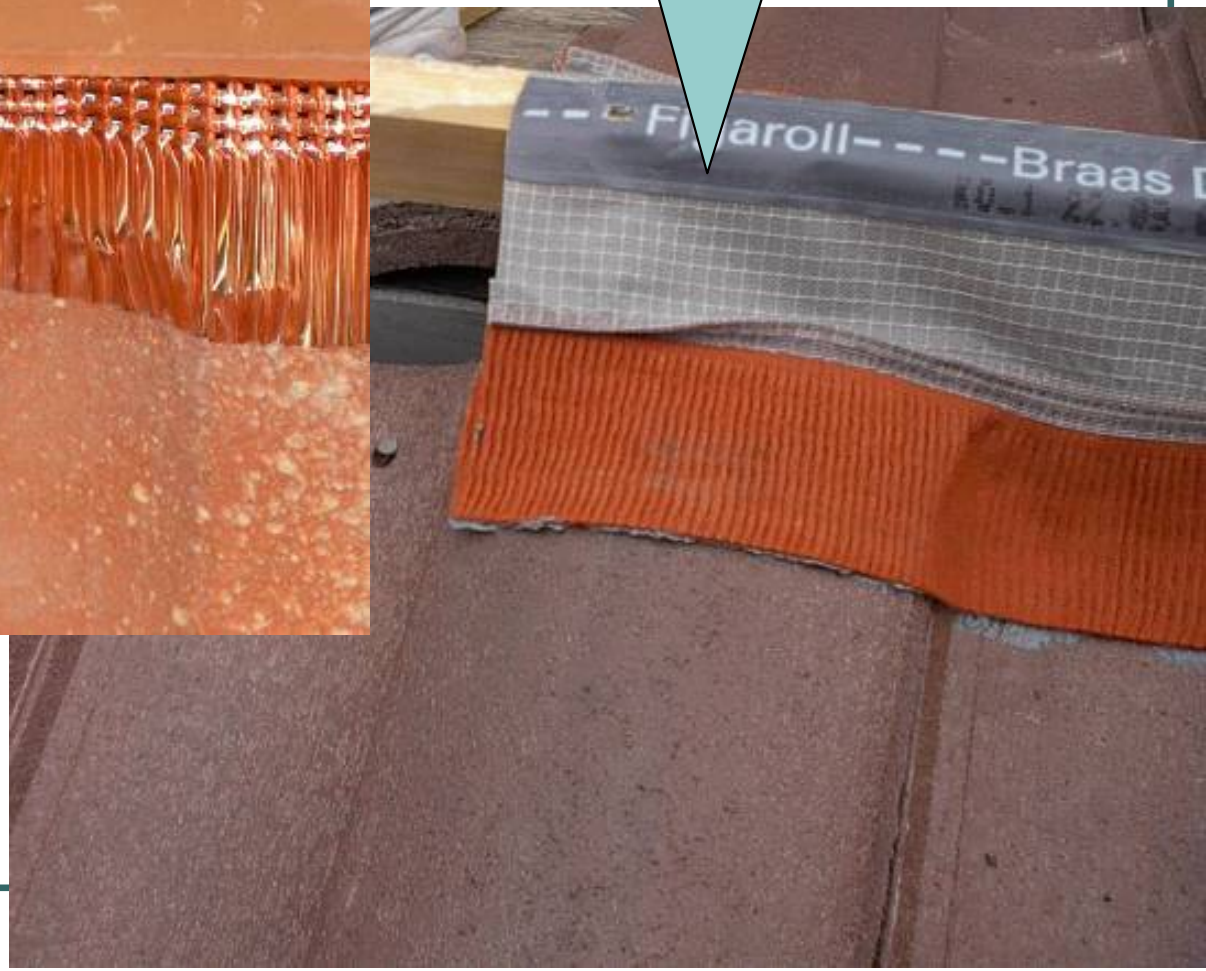
Typical Ridge Detail.

Rollable Ridge Vents



Vents through perforated metal.

Vents through air permeable fleece.



Standard vs. Cool Roof

- Dark Colored Tiles
- Asphalt underlayment
- Direct to deck attachment
- Minimal ventilation

- Light Colored Tiles
- Radiant Barrier
- Counter battens
- Balanced Ventilation