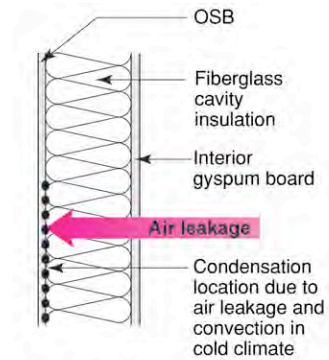


Joseph Lstiburek, Ph.D., P.Eng, ASHRAE Fellow

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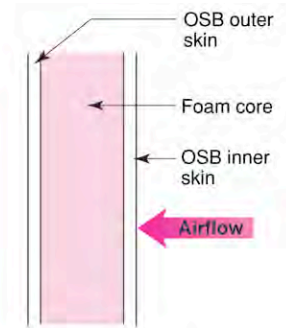
Interesting Stuff

presented by www.buildingscience.com



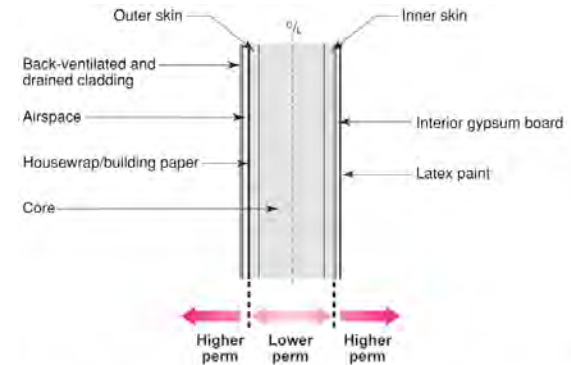
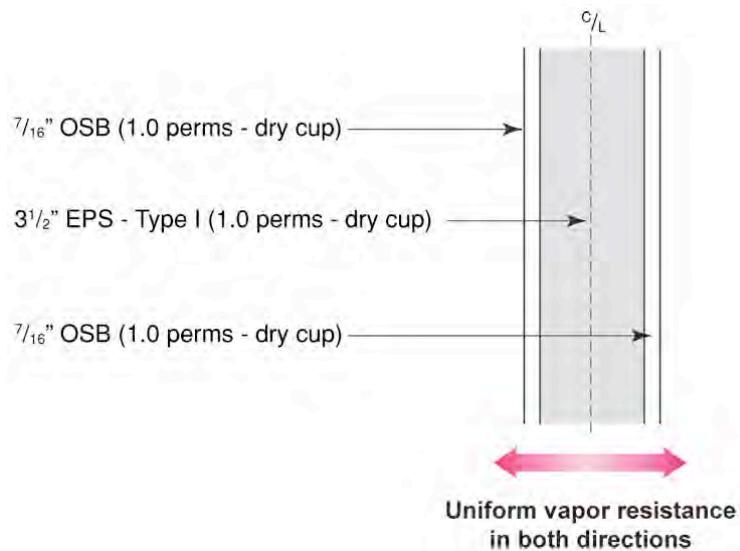
Typical Stick Frame Wall

- Cavity within typical frame wall is prone to airflow and convection
- Condensation can occur at exterior sheathing in cold climates



SIP Wall

- Core is "solid" and "homogenous" and "air impermeable"
- Convection and air leakage is not possible within SIP
- Condensation due to convection and air leakage within SIP is not possible



Outer Layer Towards Cladding

- Outer layer should be more vapor permeable than core
- Housewrap/building paper should be more permeable than outer layer
- Back-ventilating and draining exterior cladding makes exterior cladding more permeable than housewrap/building paper

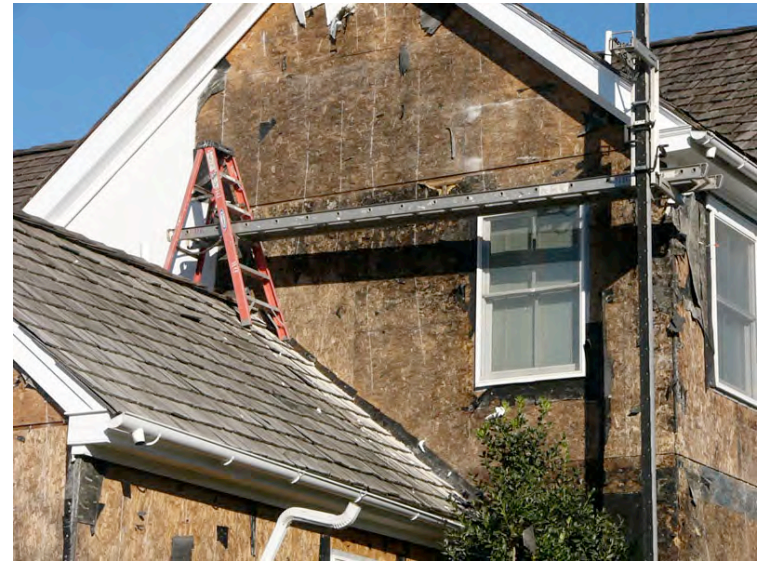
Inner Layer Towards Interior Gypsum Board

- Inner layer should be more vapor permeable than core
- Painted interior gypsum board should be more vapor permeable than inner layer



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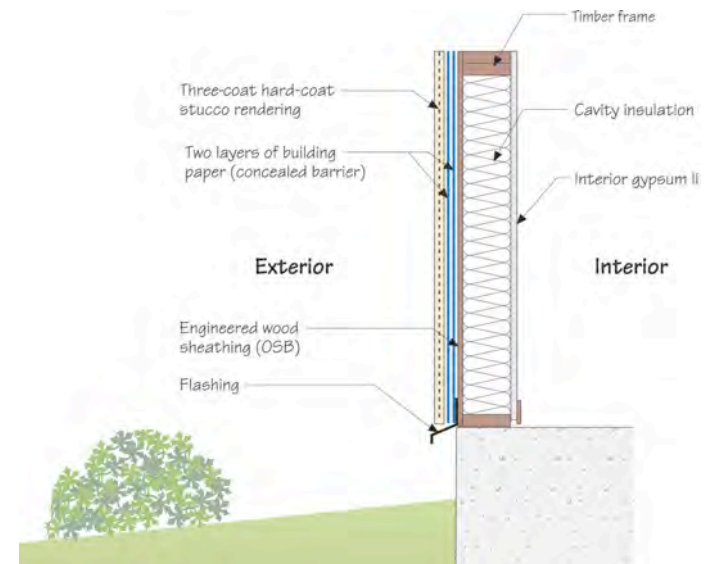
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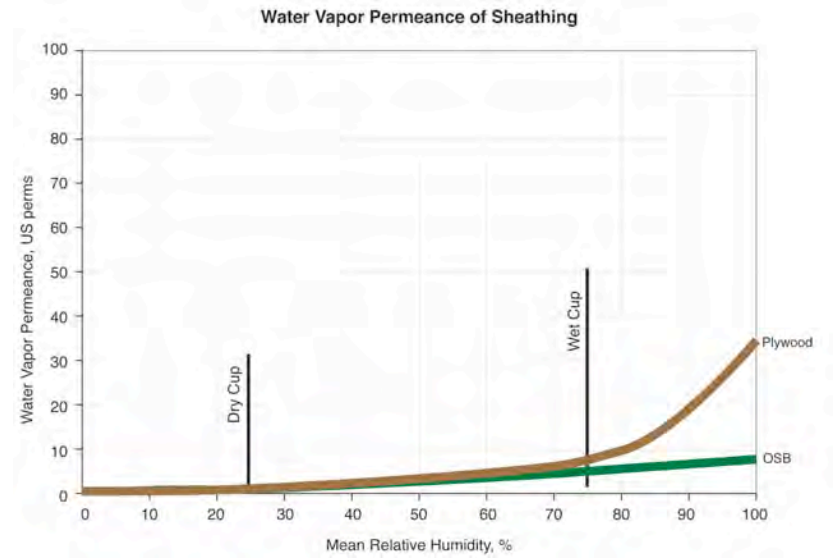
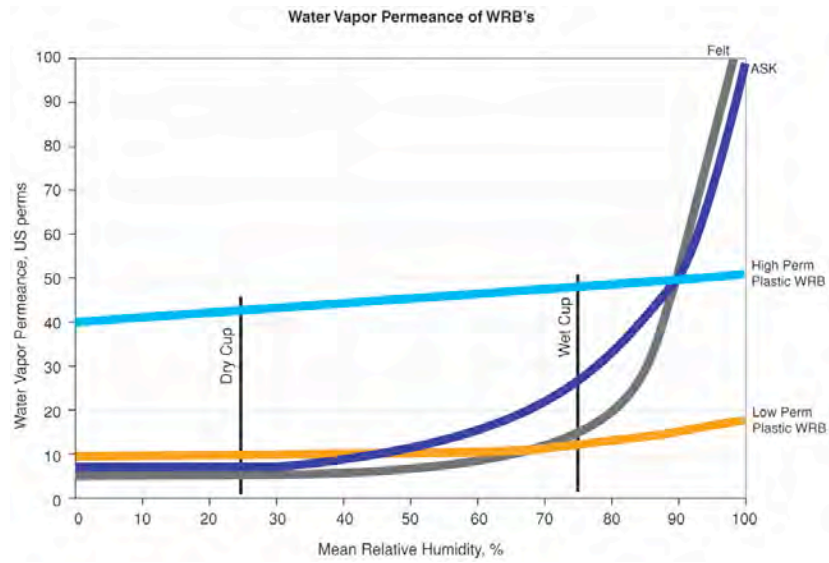
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Surface Tension



- | | |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> • "non-wetable" surface • water repellent surface • hydrophobic surface • water more attracted to itself than to surface • surface energy of water greater than surface energy of surface • water "beads up" • "greasy" surface • high contact angle "θ" | <ul style="list-style-type: none"> • "wetable" surface • non-water repellent surface • hygroscopic surface • water more attracted to surface than itself • surface energy of surface greater than surface energy of water • water "spreads out" • "non-greasy" surface • low contact angle "θ" |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|





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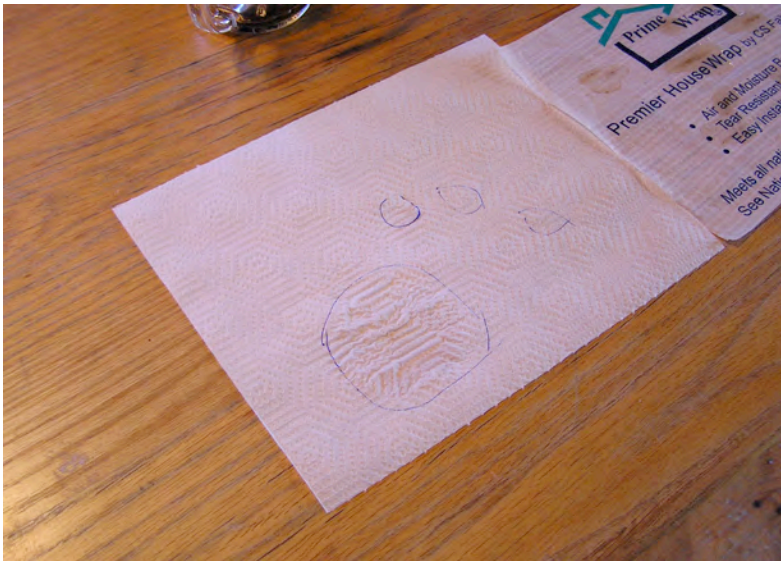
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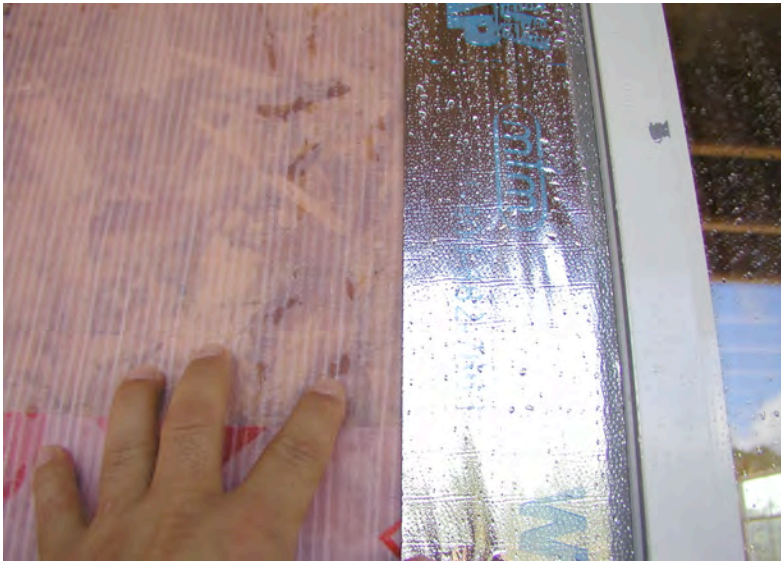
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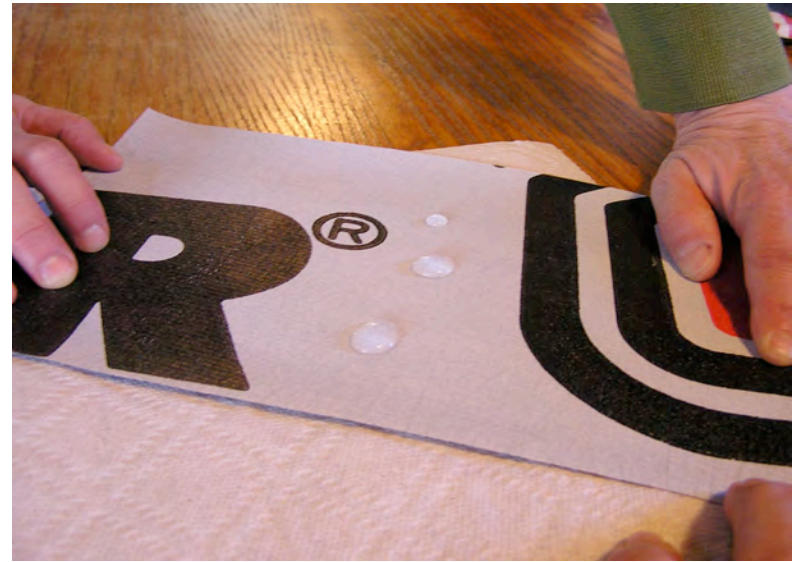
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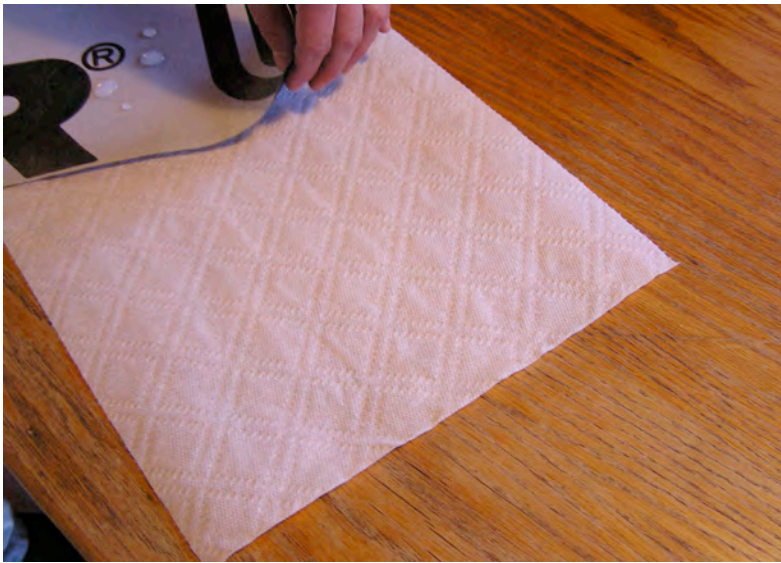
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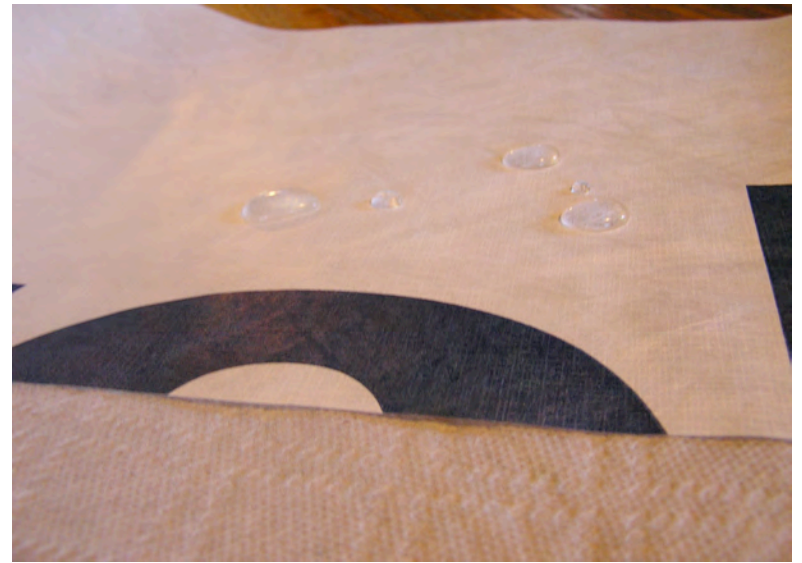
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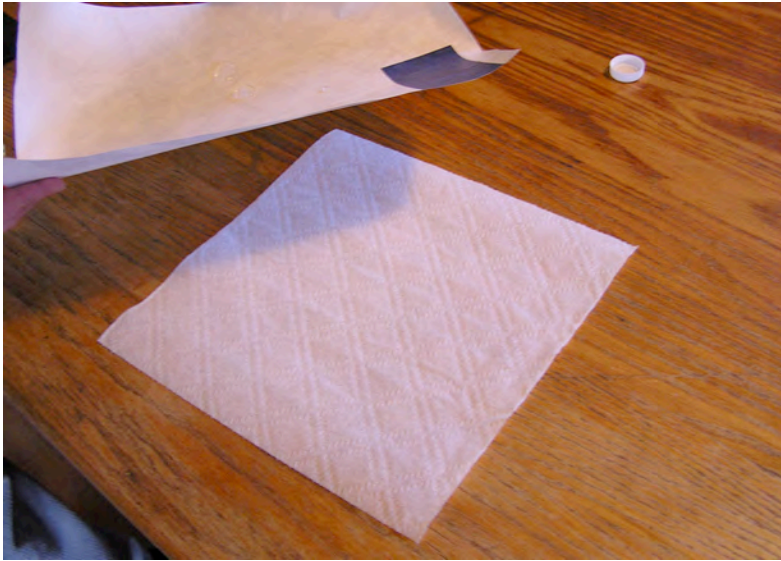
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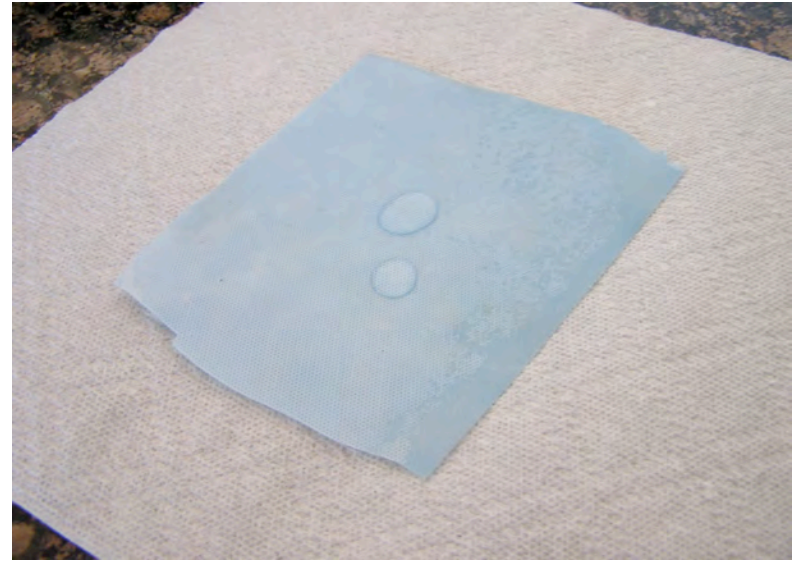


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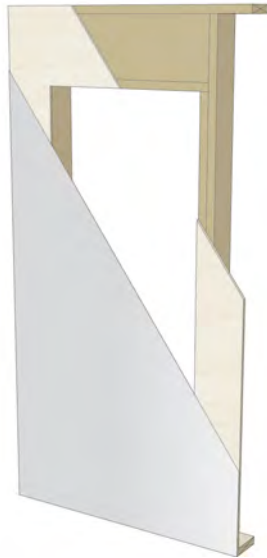
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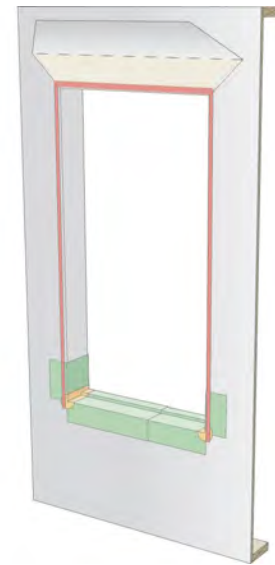
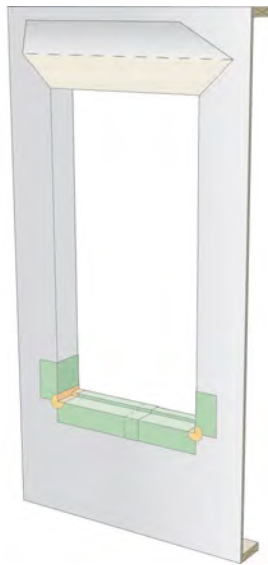
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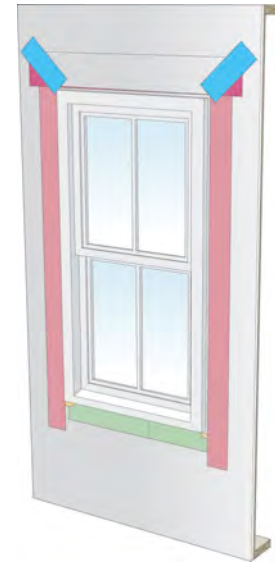


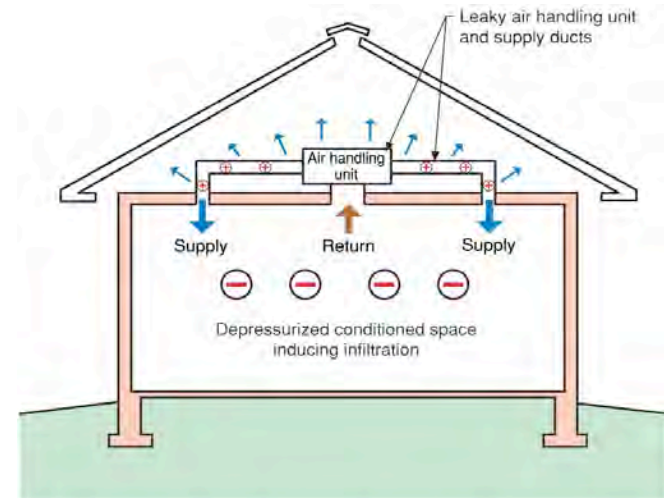
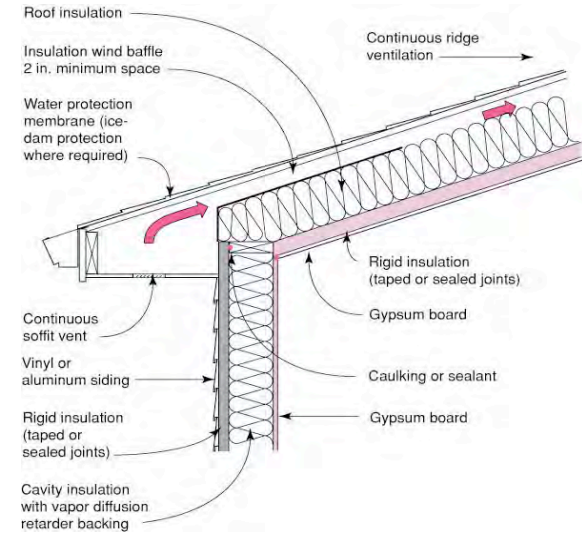
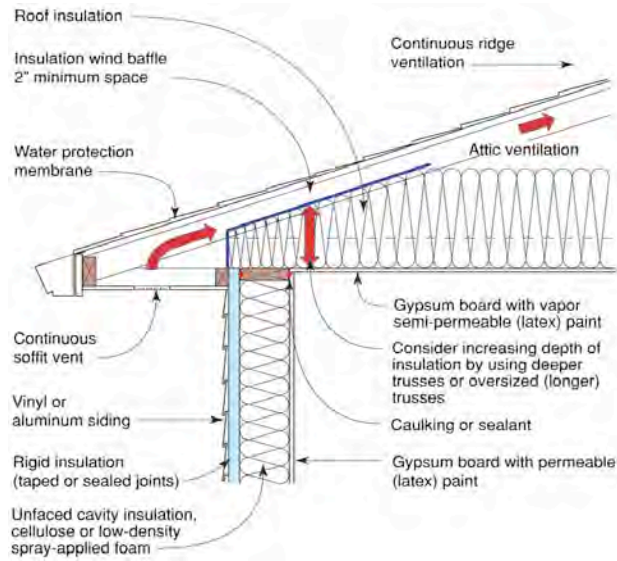
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Note: Colored shading depicts the building's thermal barrier and pressure boundary. The thermal barrier and pressure boundary enclose the conditioned space.



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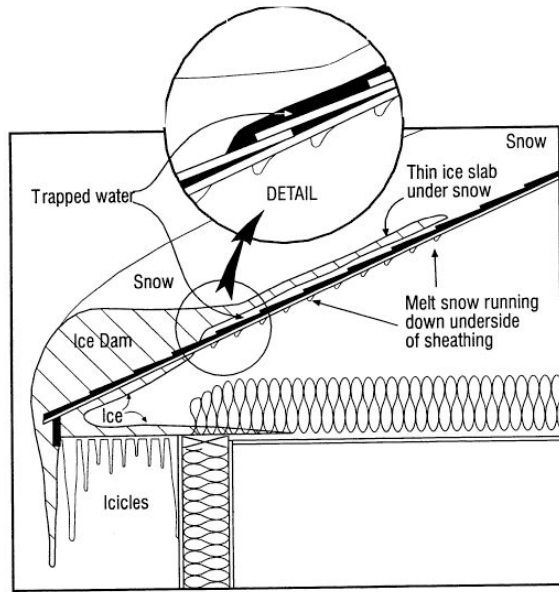
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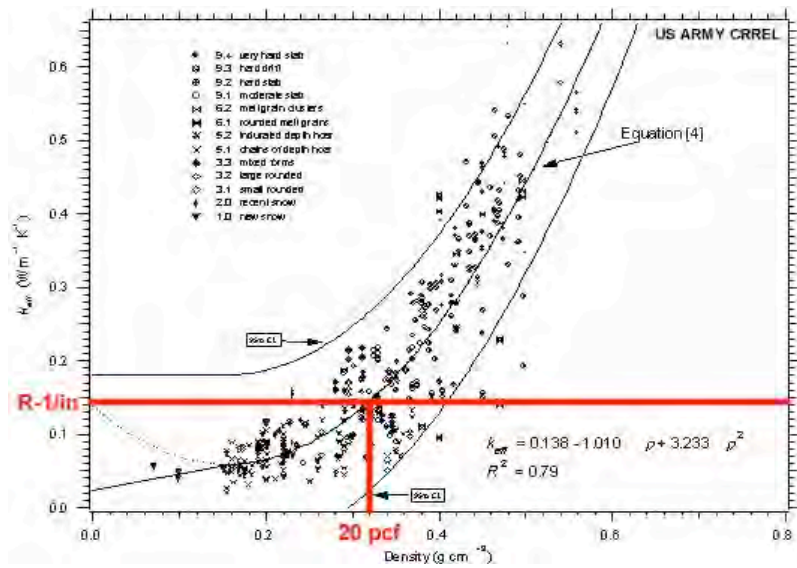




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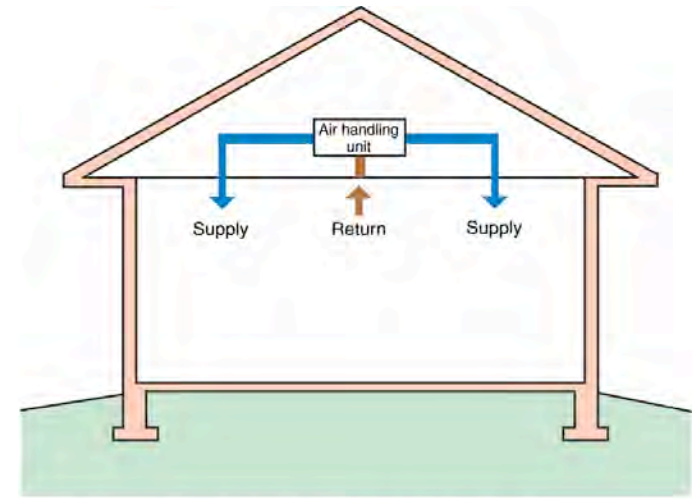
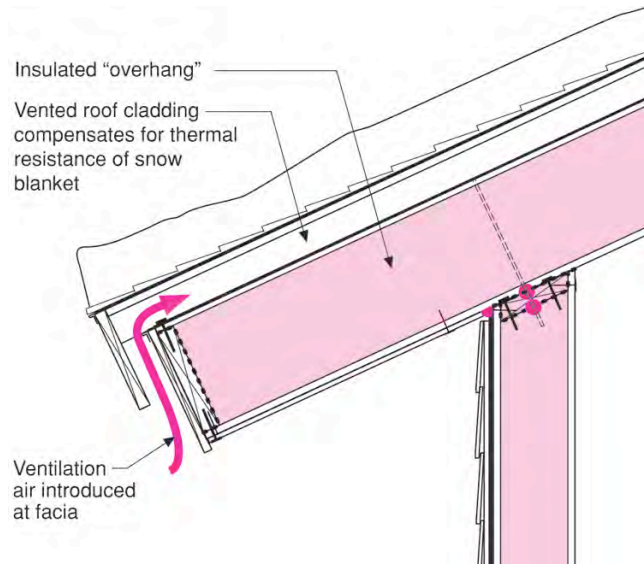
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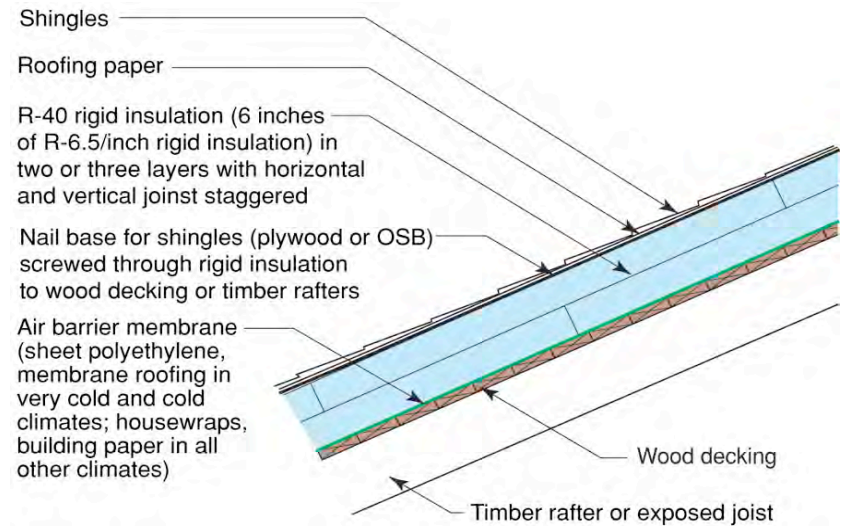
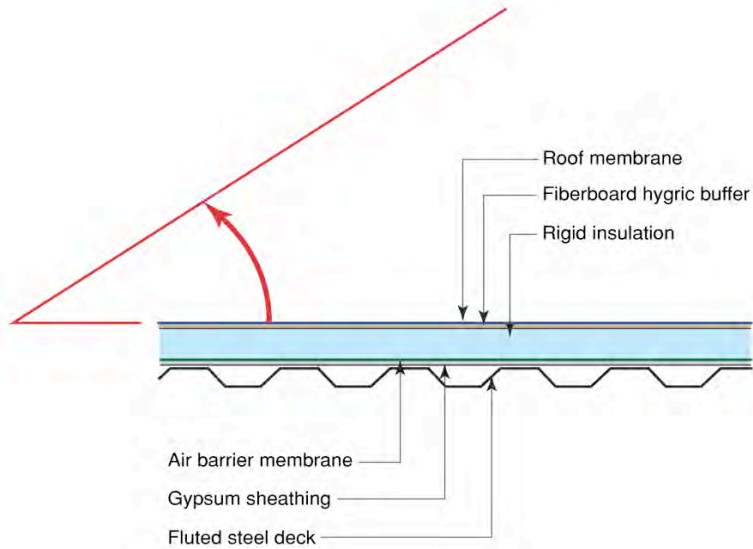


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Note: Colored shading depicts the building's thermal barrier and pressure boundary. The thermal barrier and pressure boundary enclose the conditioned space.





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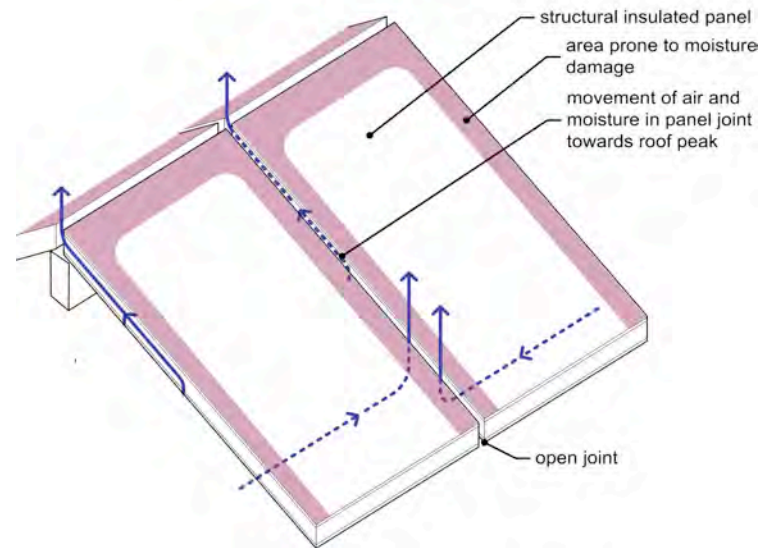
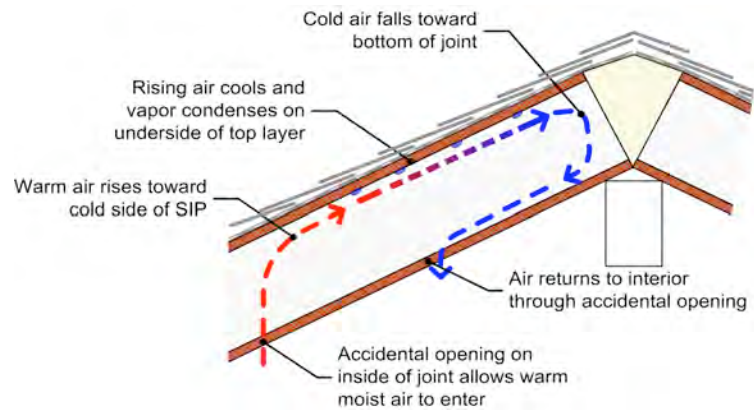
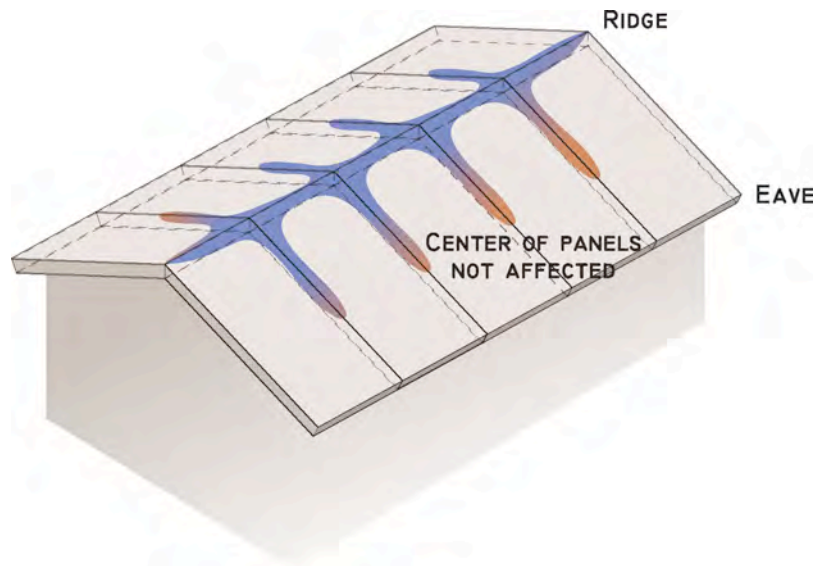
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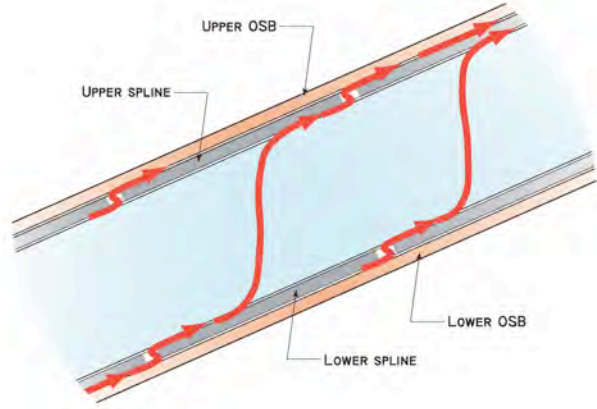


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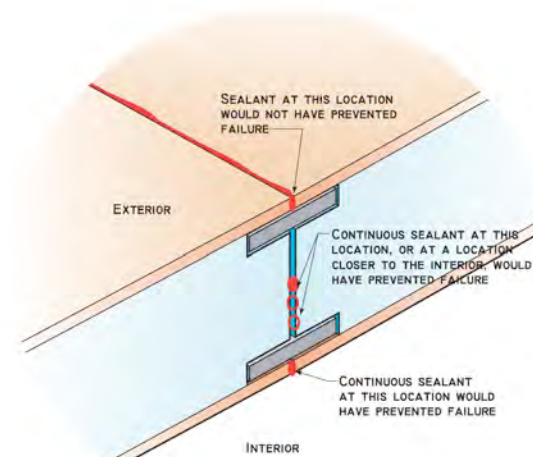
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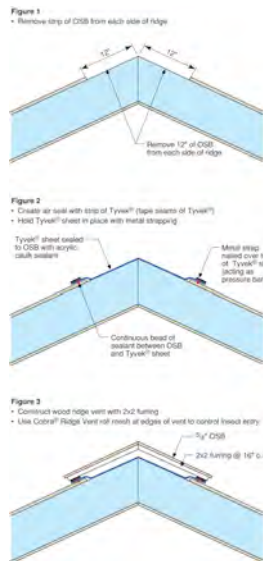
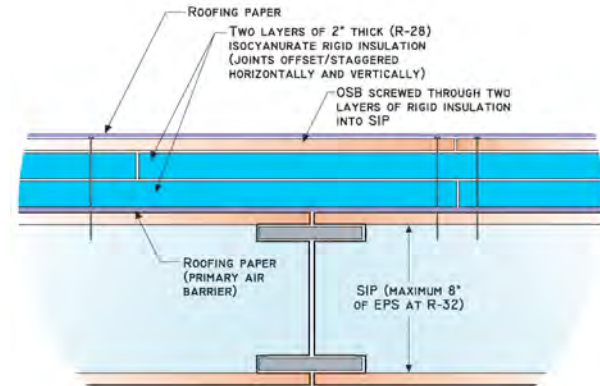
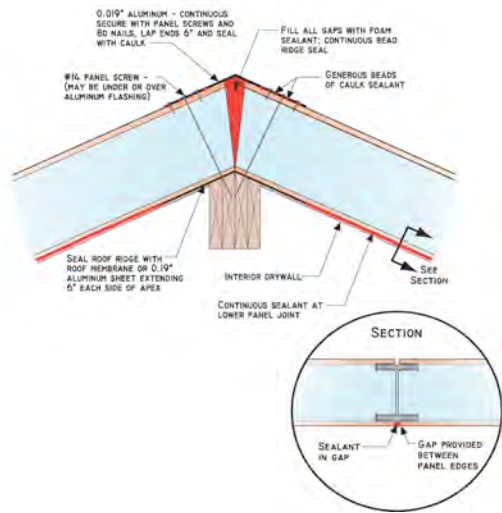
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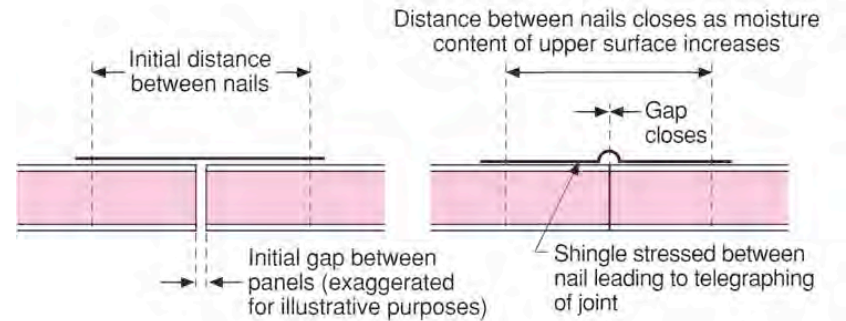
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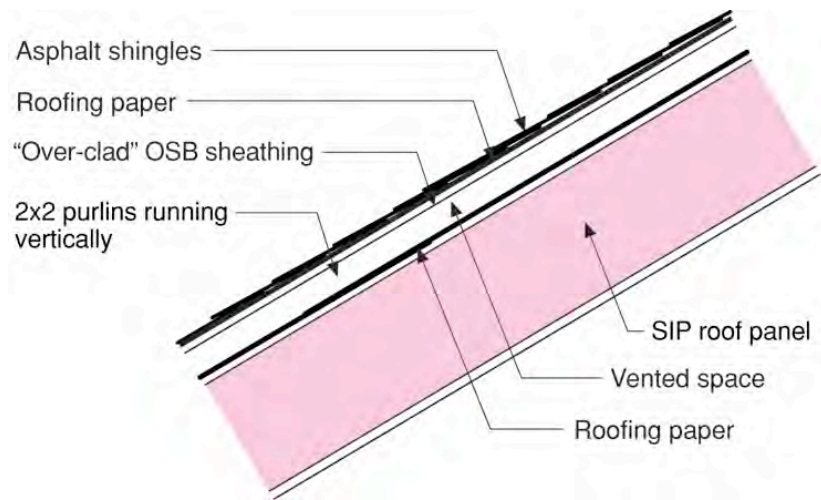
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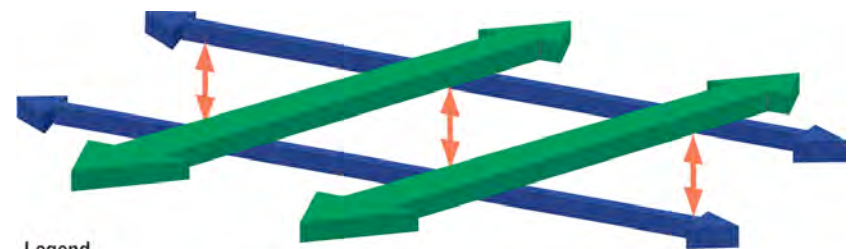
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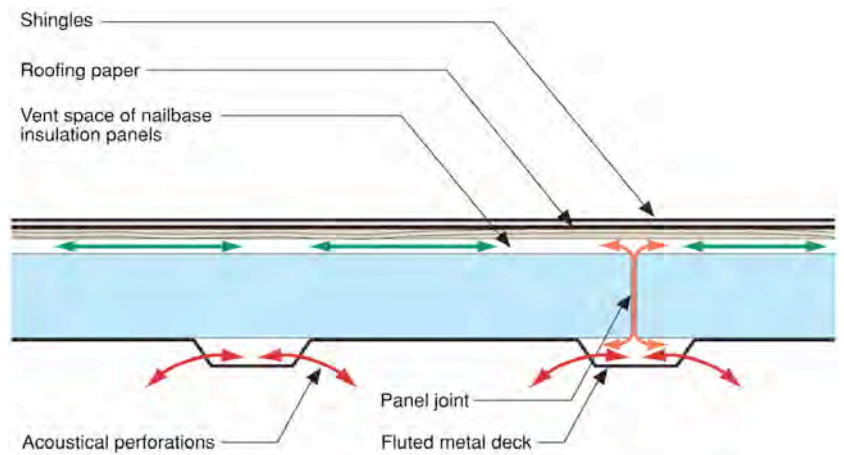
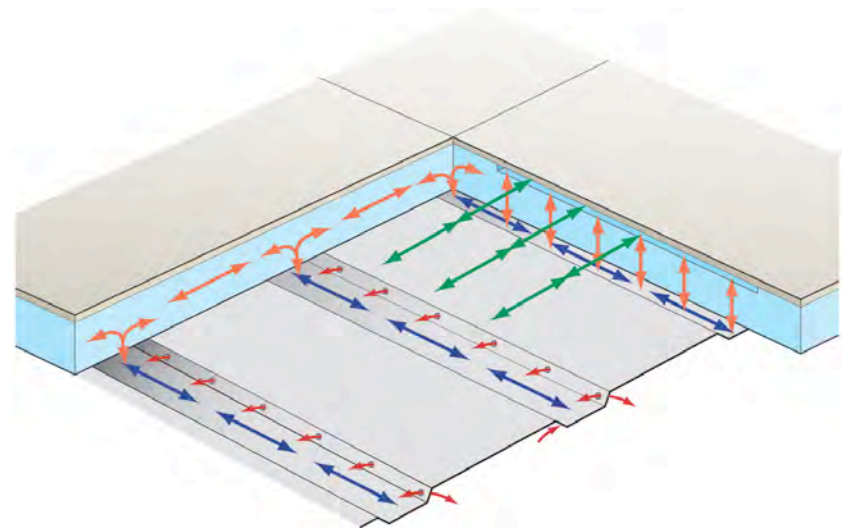
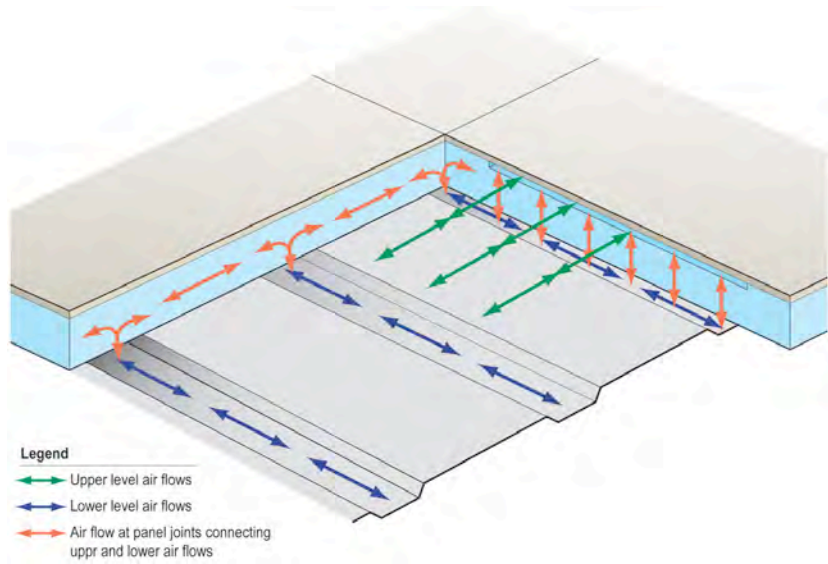


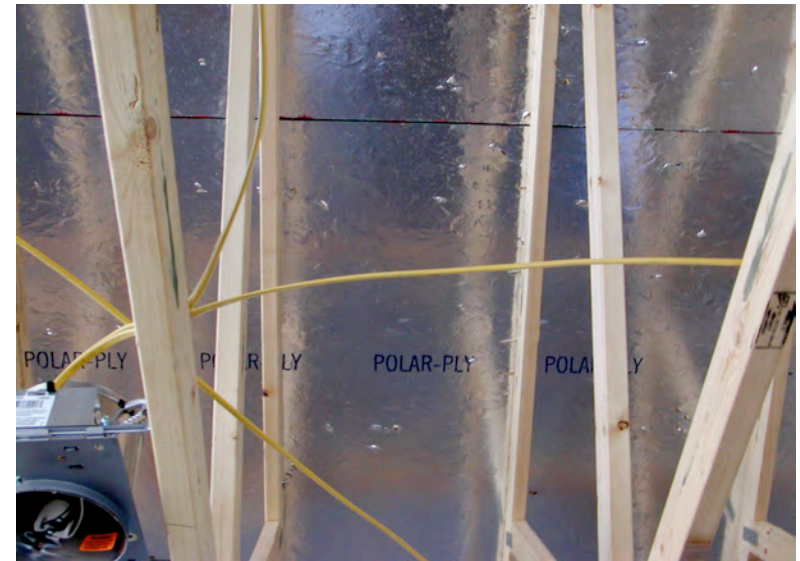
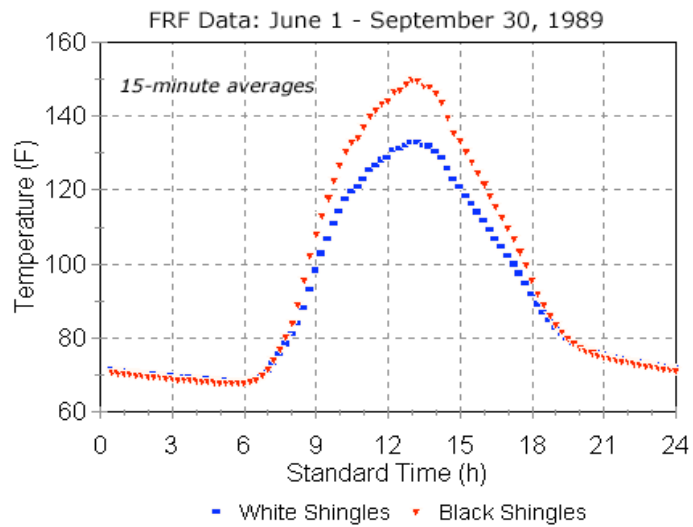
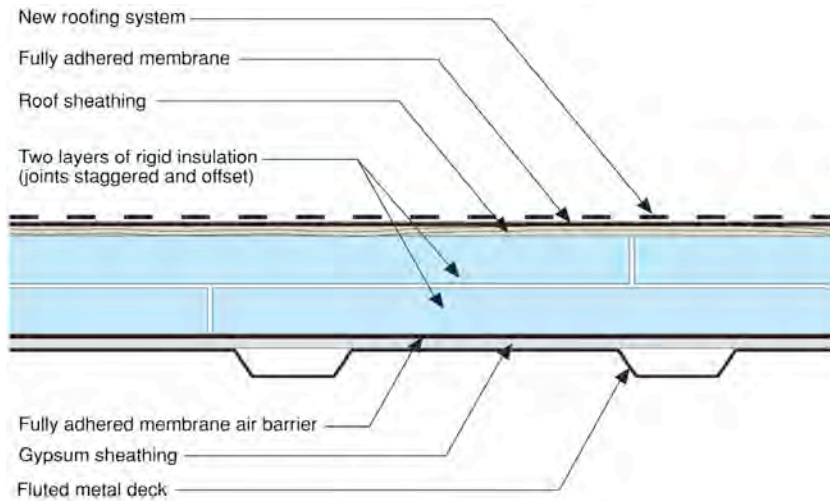
Legend

- ←→ Upper level air flows
- ←→ Lower level air flows
- ↕ Air flow at panel joints

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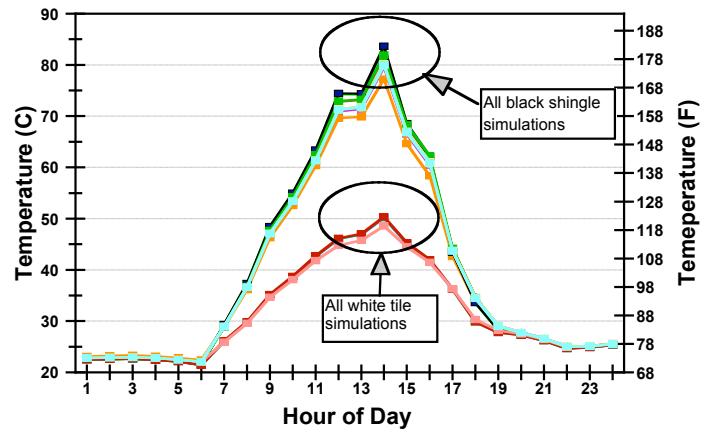
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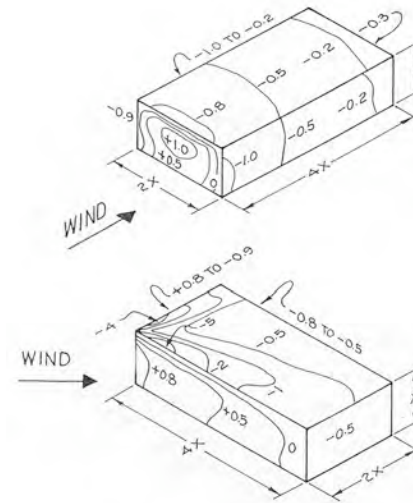


Roof Shingle Temperature

FSEC 3.0: Orlando, 1-Aug



Soffit ventilation lead to wind driven rain entry into roof assemblies



Pressure coefficients on walls and roof of rectangular buildings without parapets.





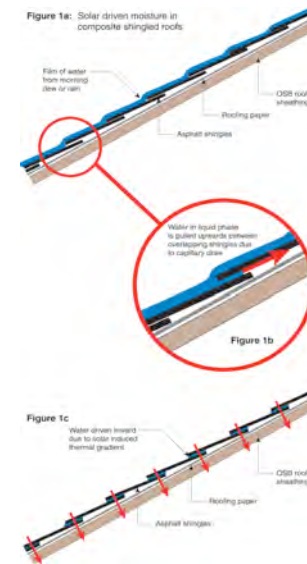
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Figure 2a: Shingle buckling due to solar driven moisture

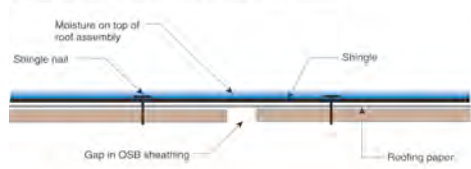


Figure 2b

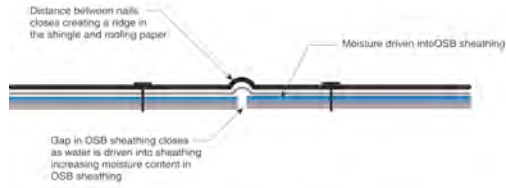
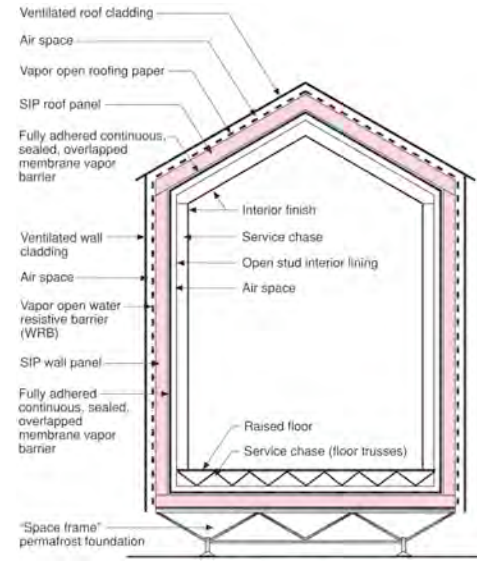


Figure 2c

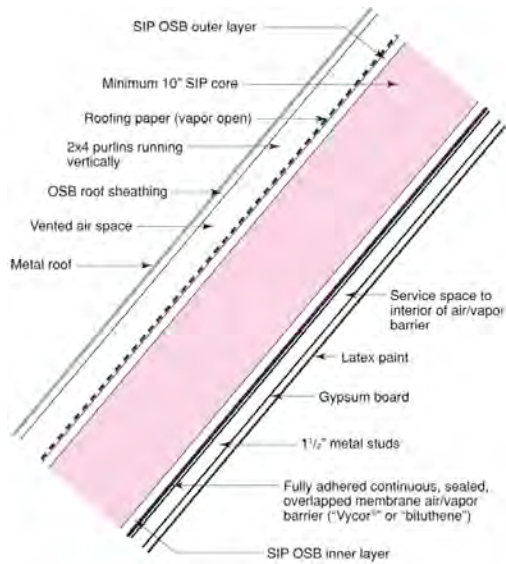




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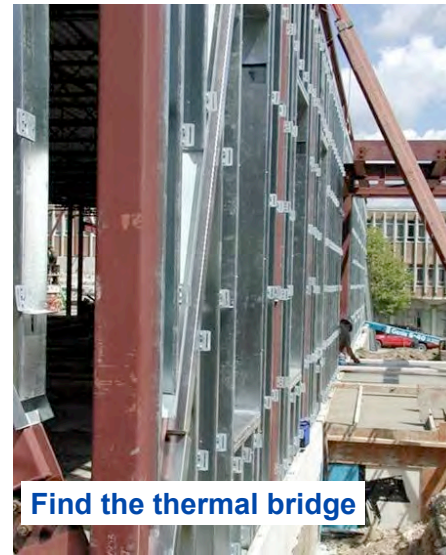
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“The Problem”

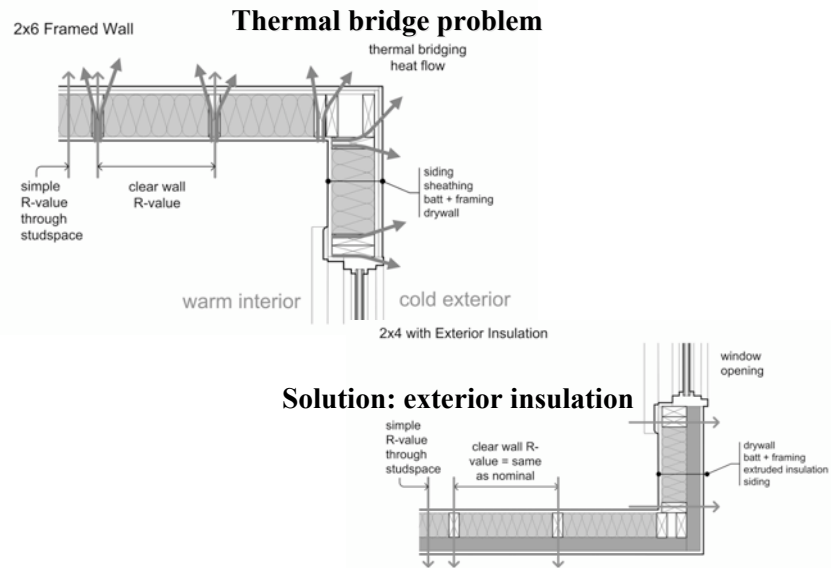
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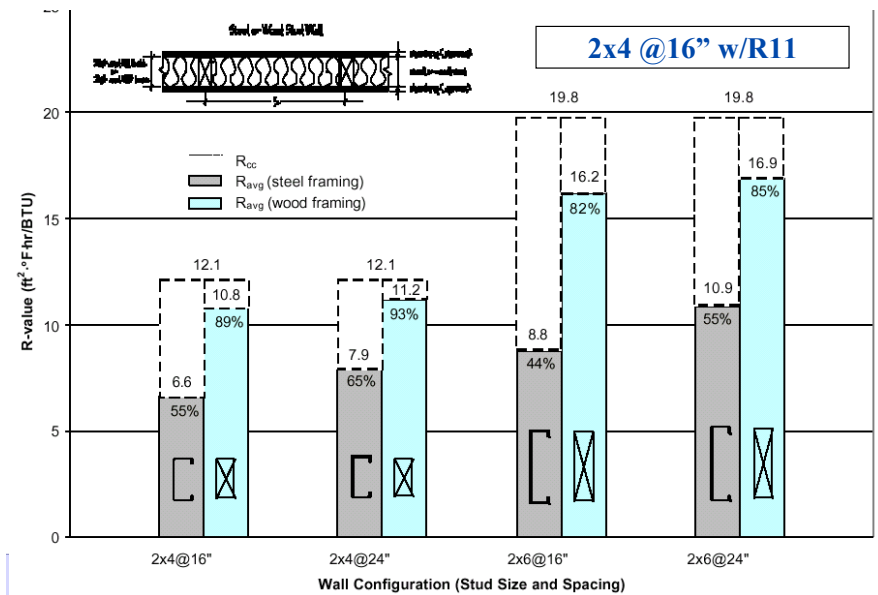


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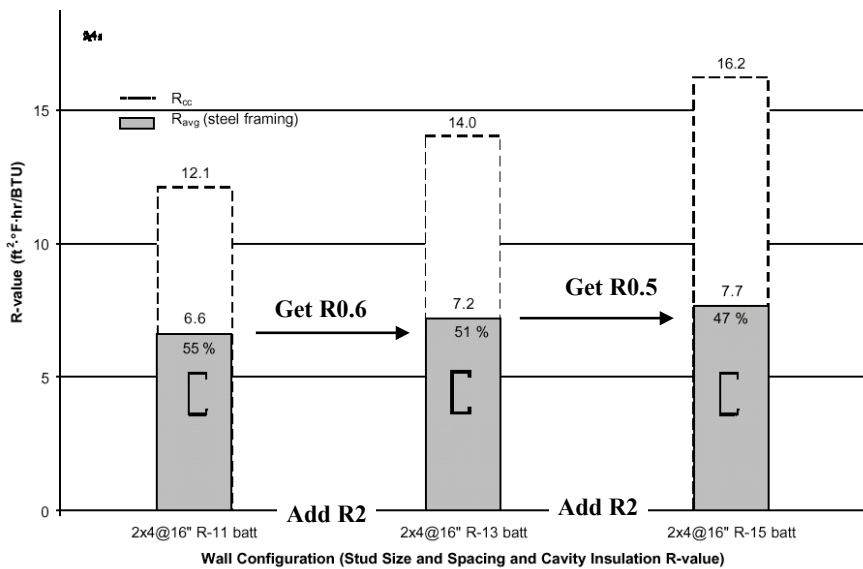


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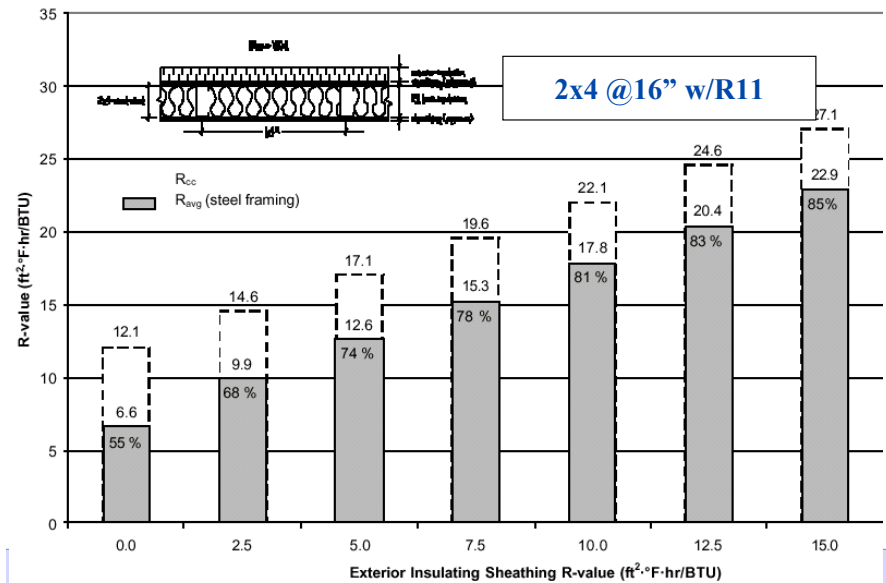
R-value Comparison



Adding studspace insulation is not helpful!

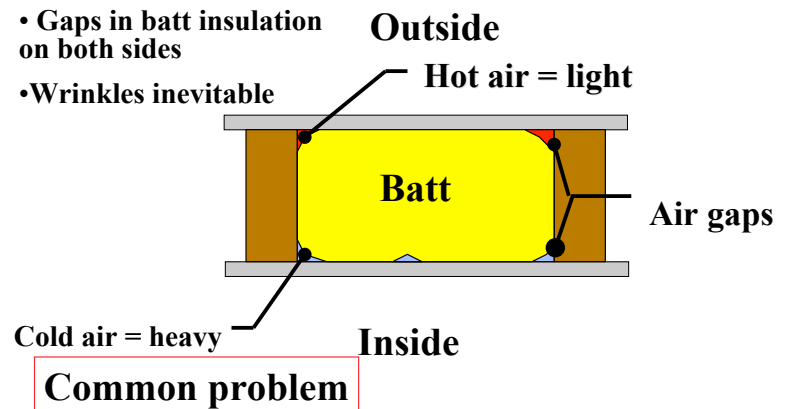


Impact of Insulating Sheathing



Internal Stack Effect & Insulation

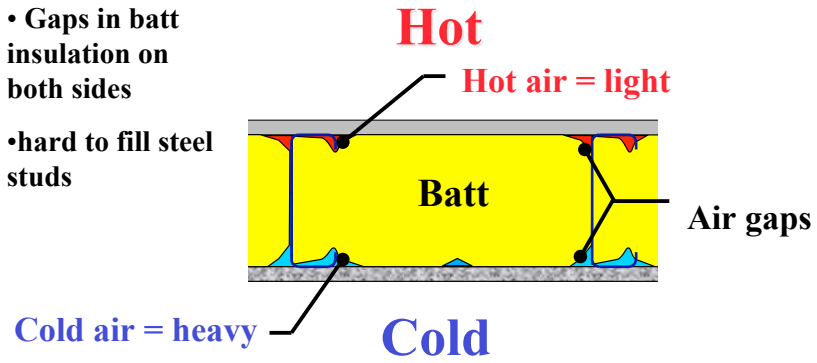
- Gaps in batt insulation on both sides
- Wrinkles inevitable



Steel studs are even "better"

- Gaps in batt insulation on both sides

- hard to fill steel studs





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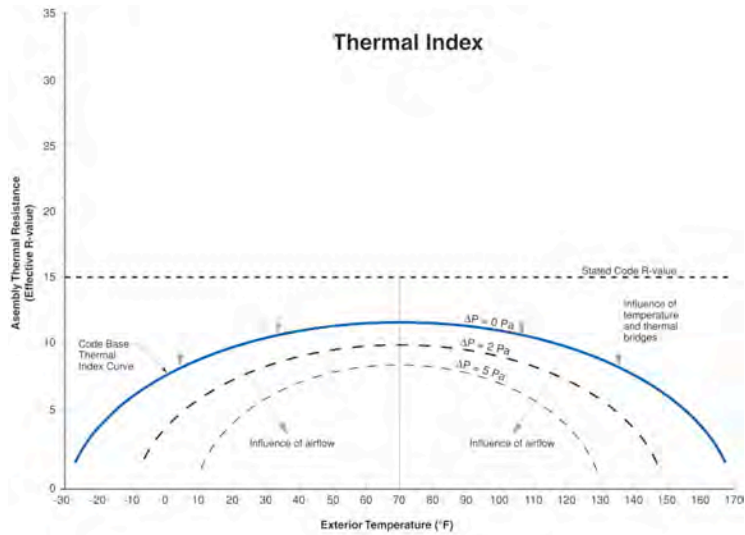


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“The Thermal Index”

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Thermal Index



Thermal Index

