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Building Science

Air-Vapor Moisture Physics

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Fungal Growth

Warm and over 80%RH surface (20% MC)

Heat Air and Moisture No. 4/78

Freeze-Thaw

Waterloo, Patio

Batavia, NY

Below 20°F & near saturation

Heat Air and Moisture No. 5/78

Decay

Warm & over 28%MC

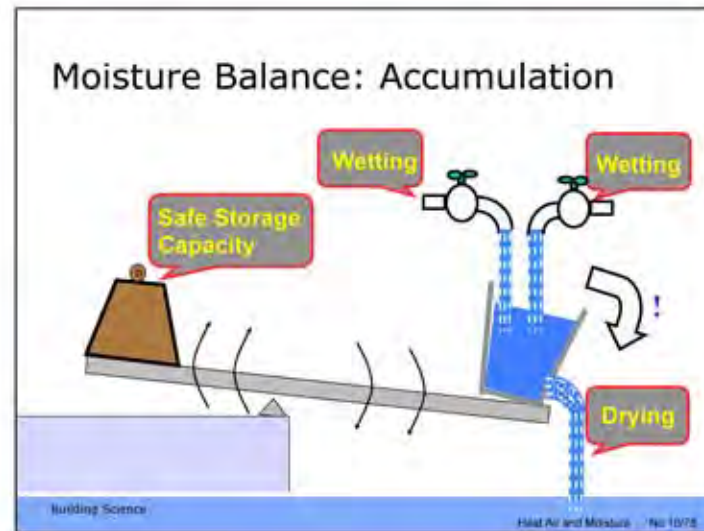
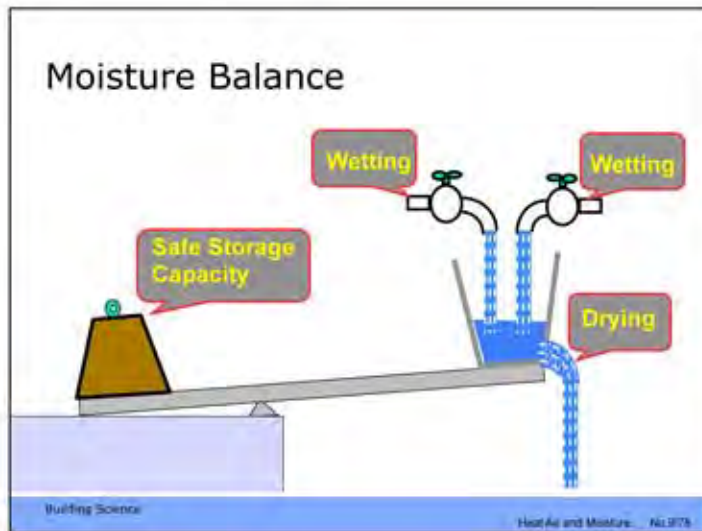
Heat Air and Moisture No. 6/78

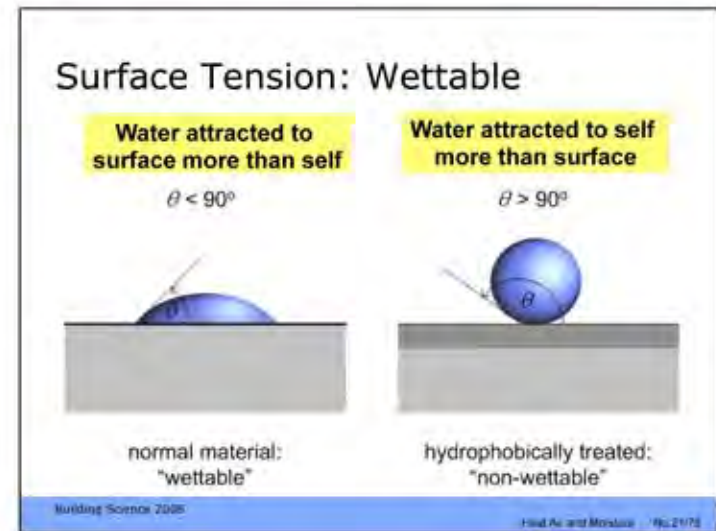
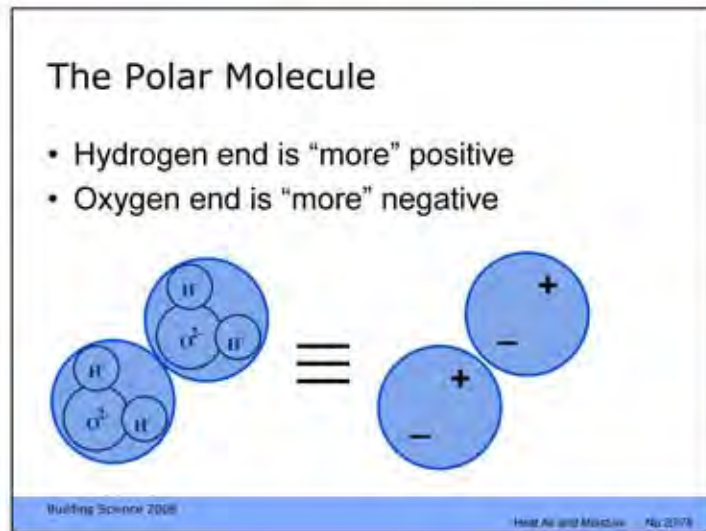
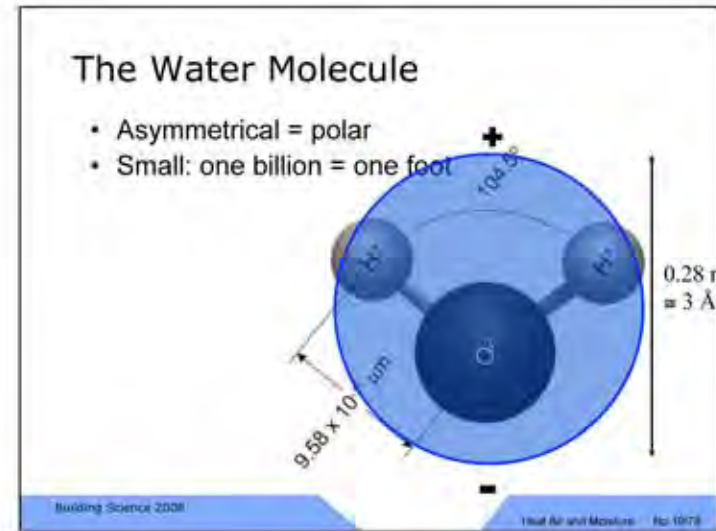
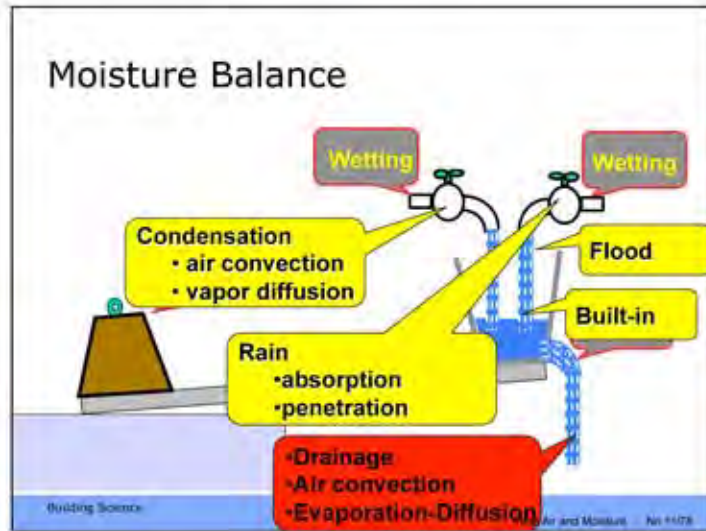


Moisture Control

- Moisture-related Problems
 1. **Moisture** must be available
 2. There must be a route or **path**
 3. There must be a **force** to cause movement
 4. The material must be **susceptible** to damage
- Theory:
 - eliminate any one for complete control
- Practice:
 - control as many as possible

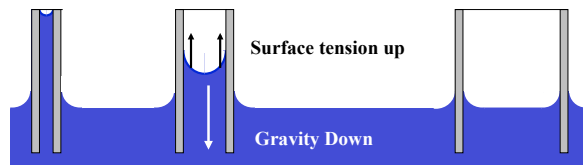
Building Science: Heat Air and Moisture No 873





Capillary Pressures

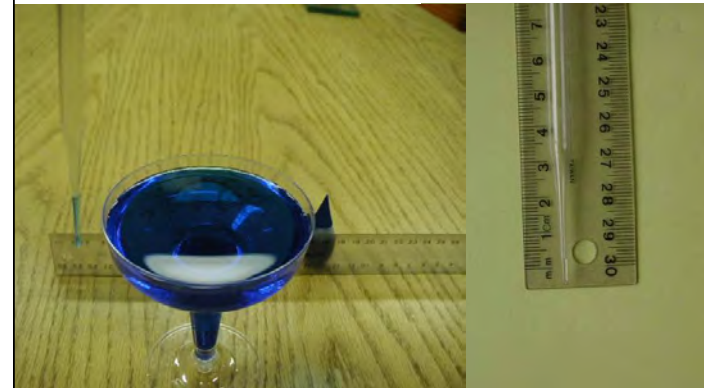
- Result of surface tension = attraction to surfaces
 - pressure varies with pore size
 - e.g., height rise in a glass tube



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Heat Air and Moisture No.22/78

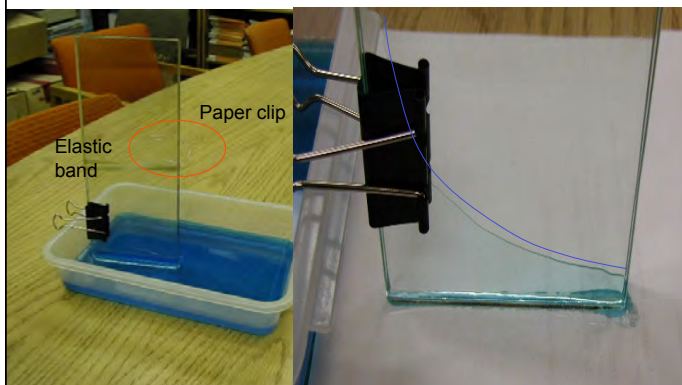
Surface Tension



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Capillary rise between glass sheets



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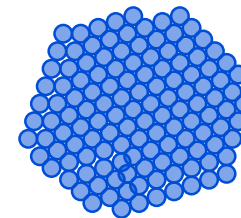
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Water: Liquid vs Vapor

- Vapor is a single molecule
- Liquid is molecular clumps, 60 or more
- Tyvek vs asphalt



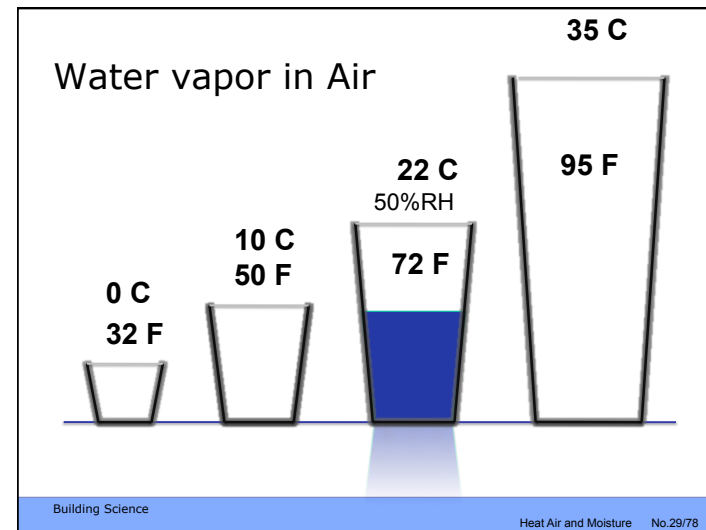
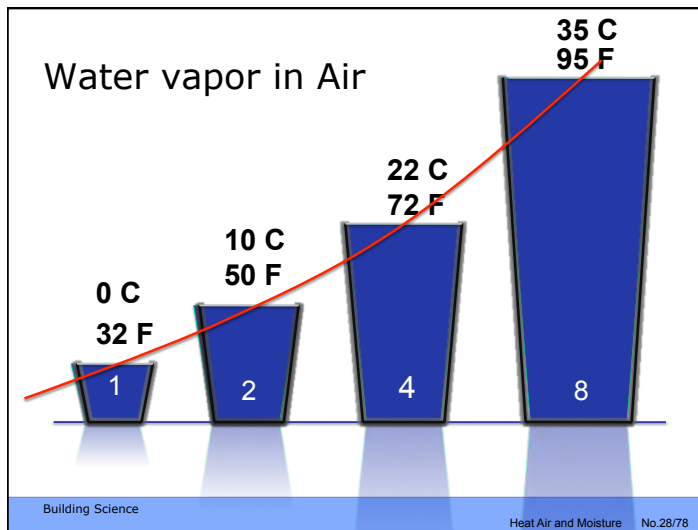
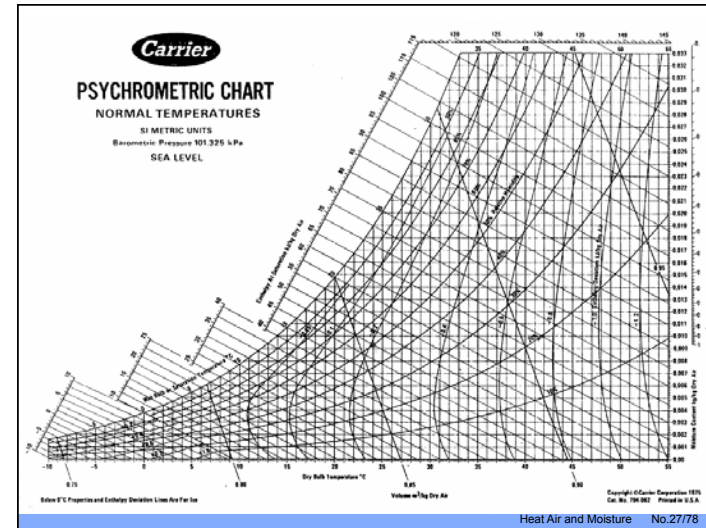
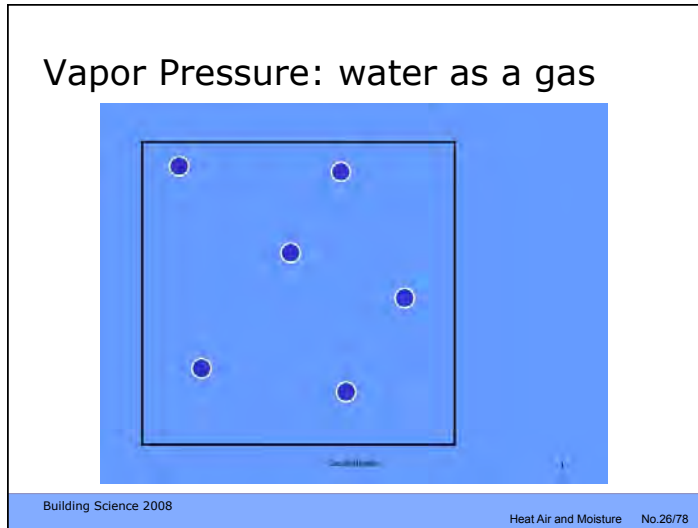
Vapor

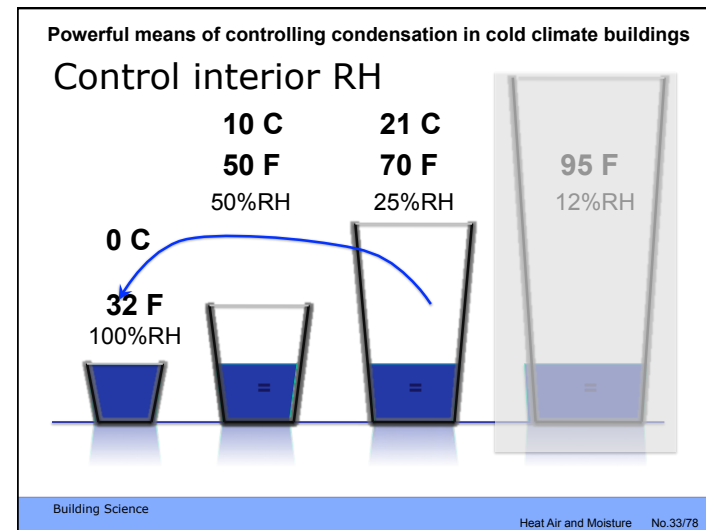
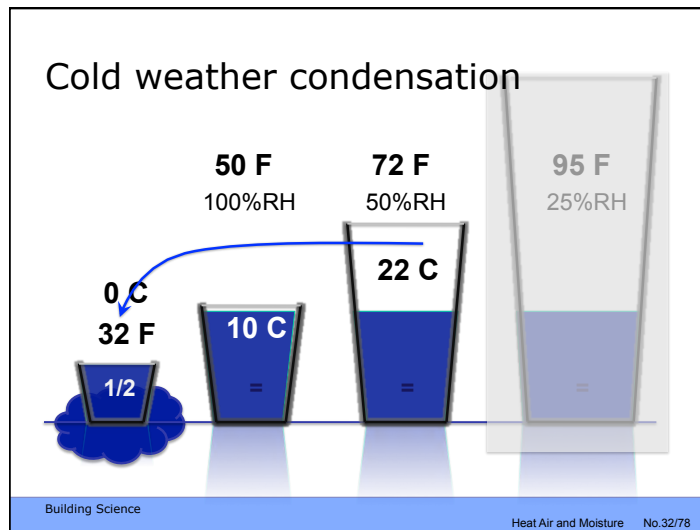
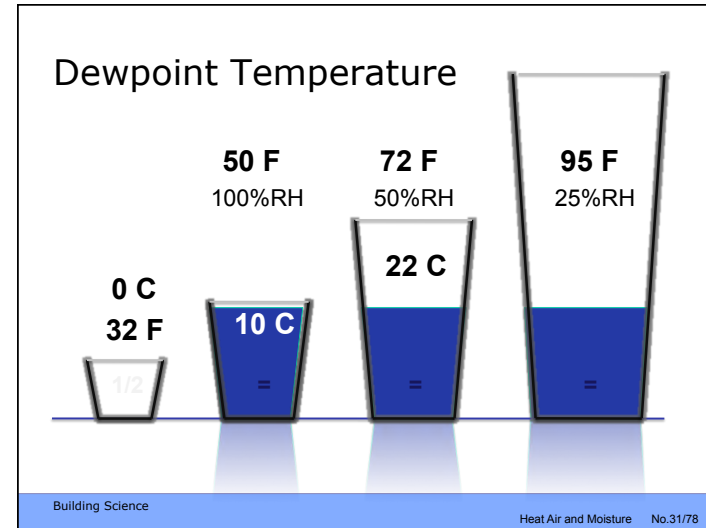
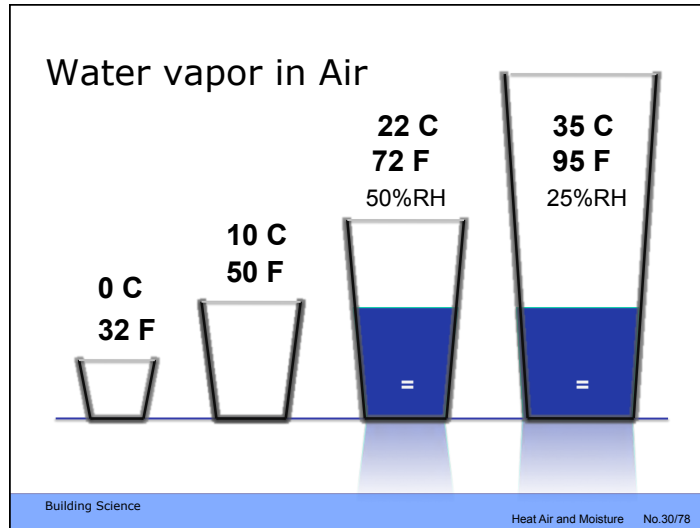


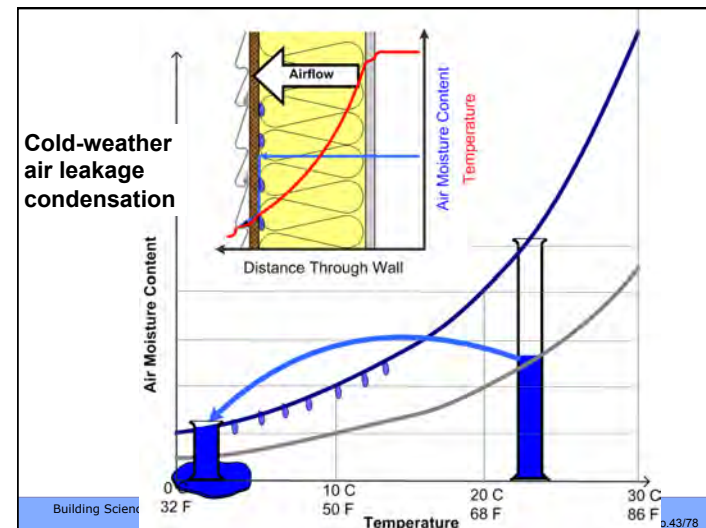
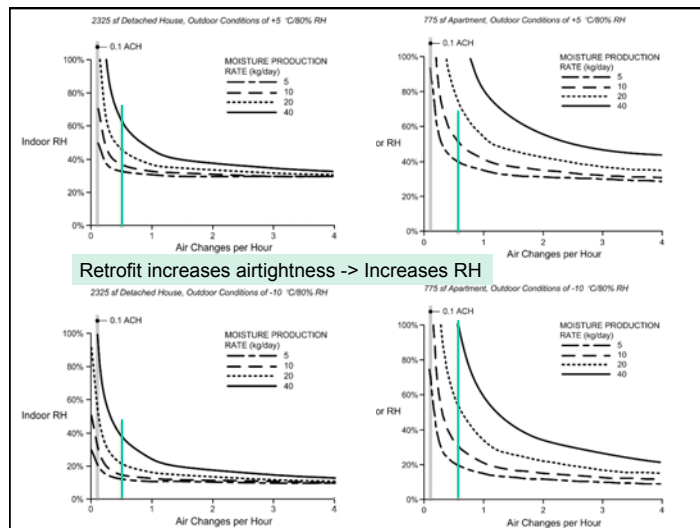
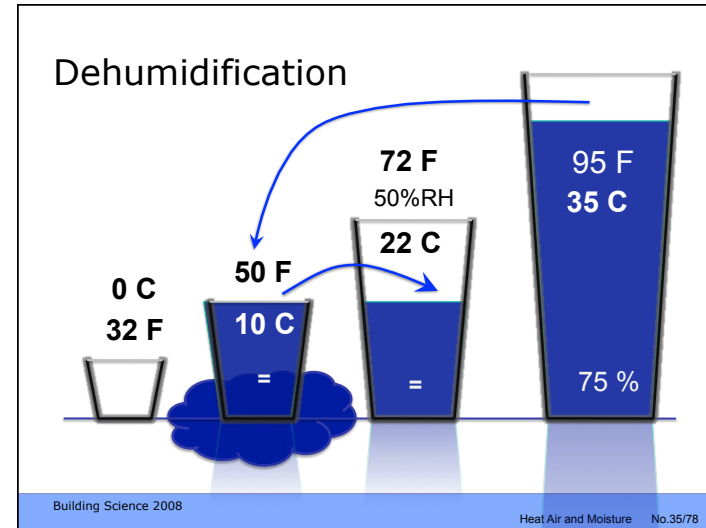
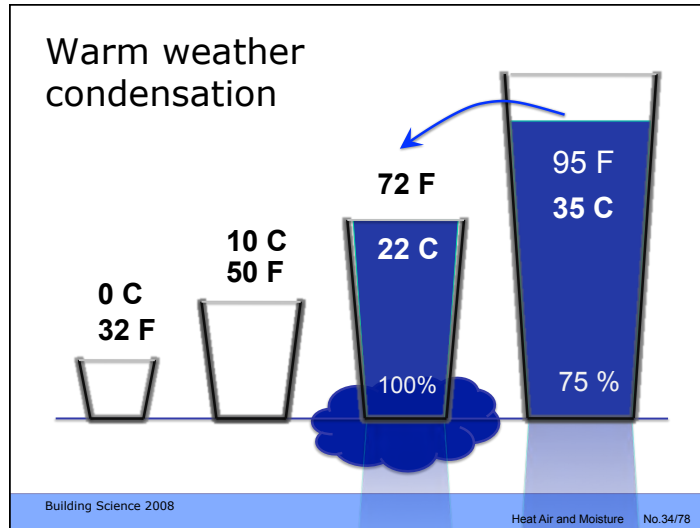
Liquid

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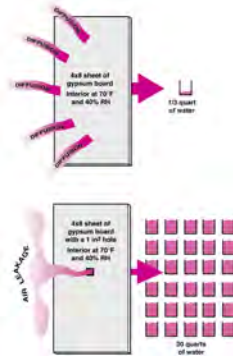




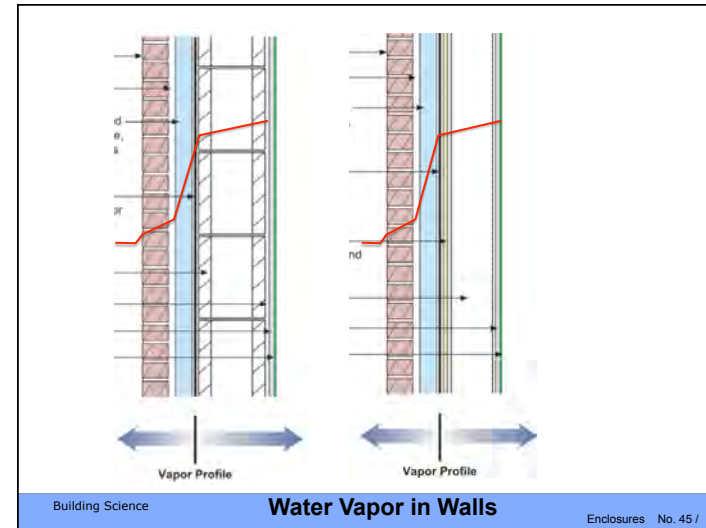


Air leakage

- Much more vapor can be carried on back of air flow than diffusion
- Condensation only happens if air flows towards cold surface



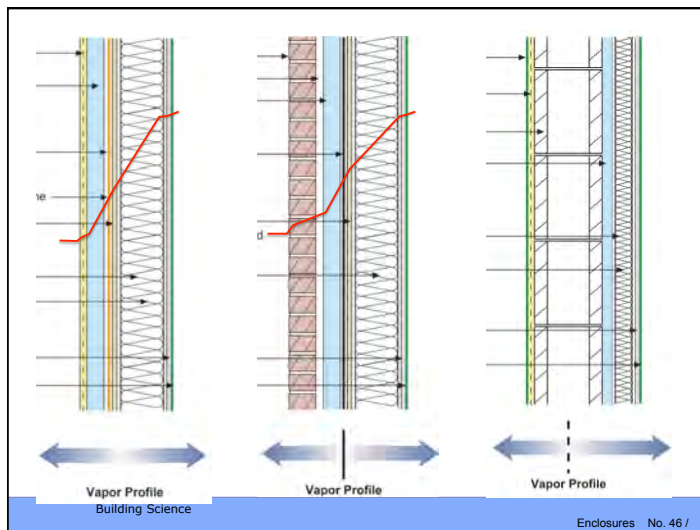
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Water Vapor in Walls

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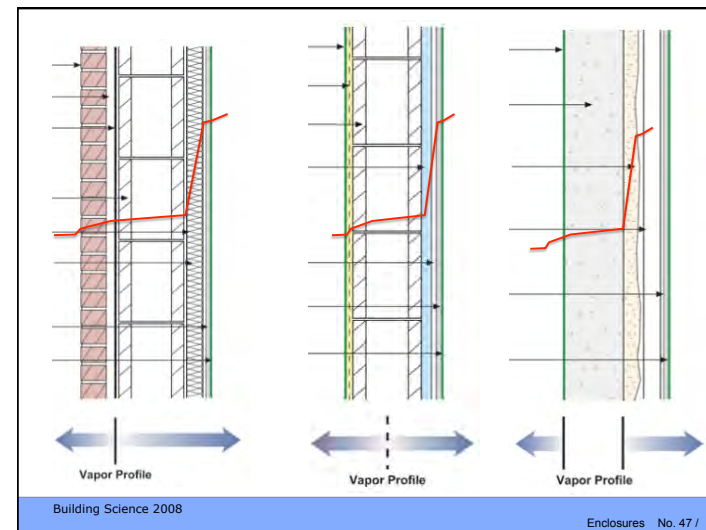


Vapor Profile
Building Science

Vapor Profile

Vapor Profile

Enclosures No. 46 /



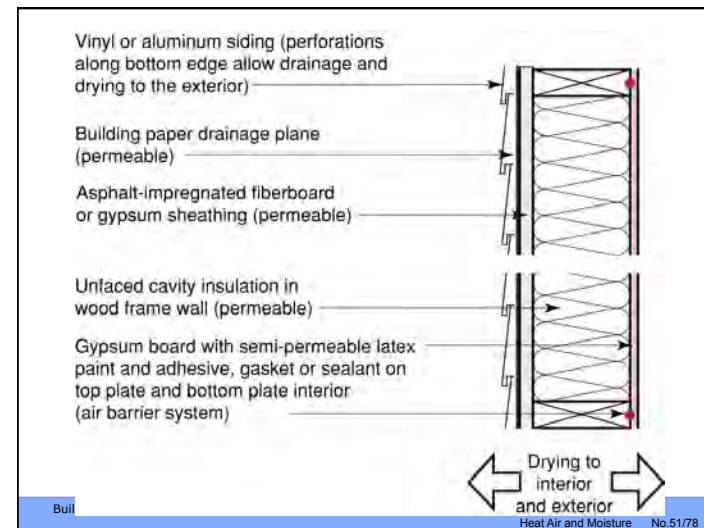
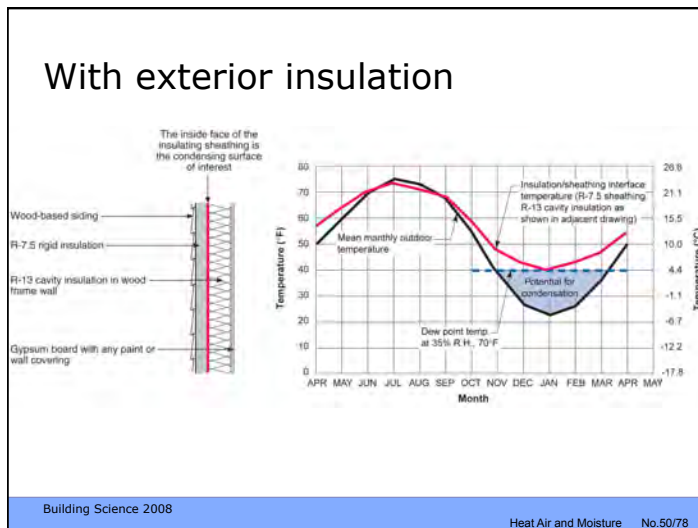
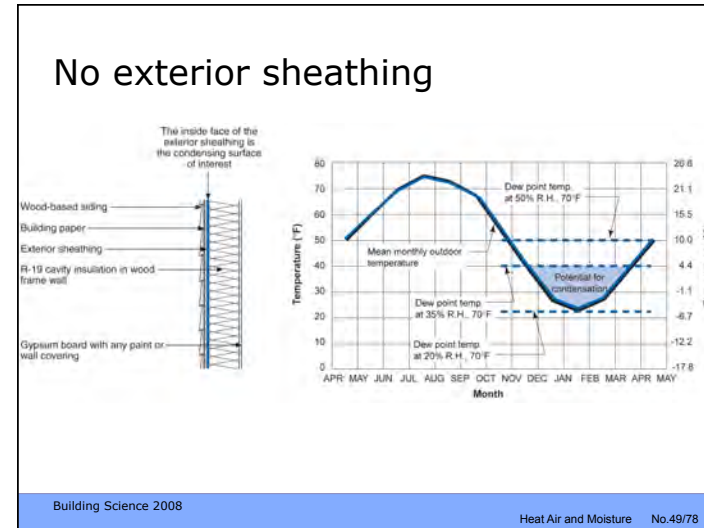
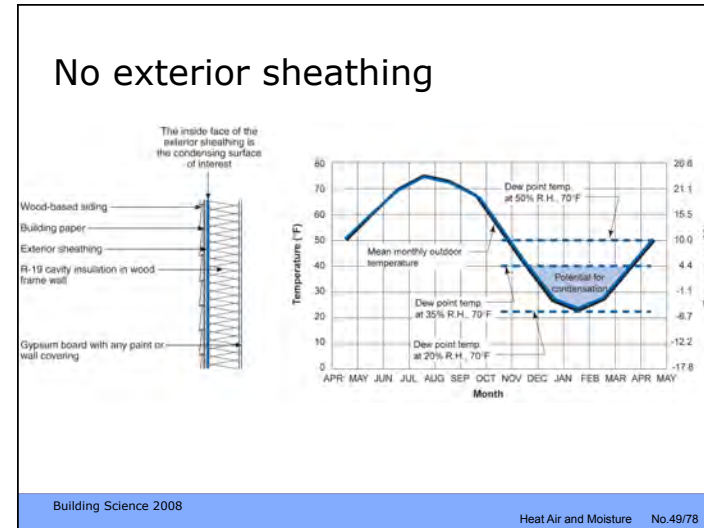
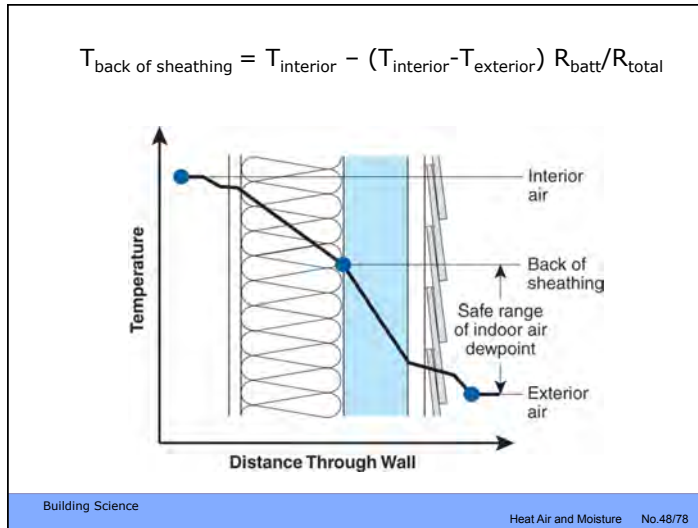
Vapor Profile

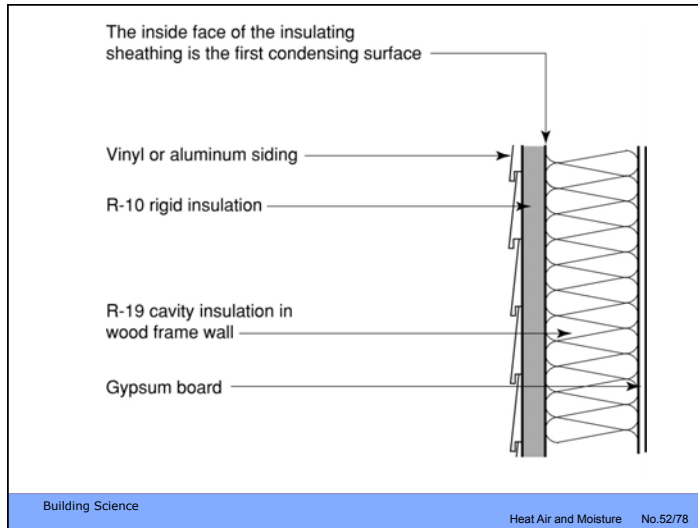
Vapor Profile

Vapor Profile

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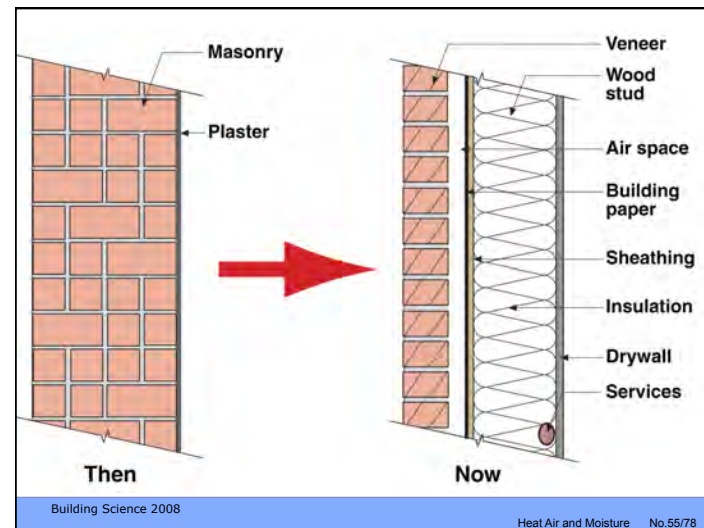
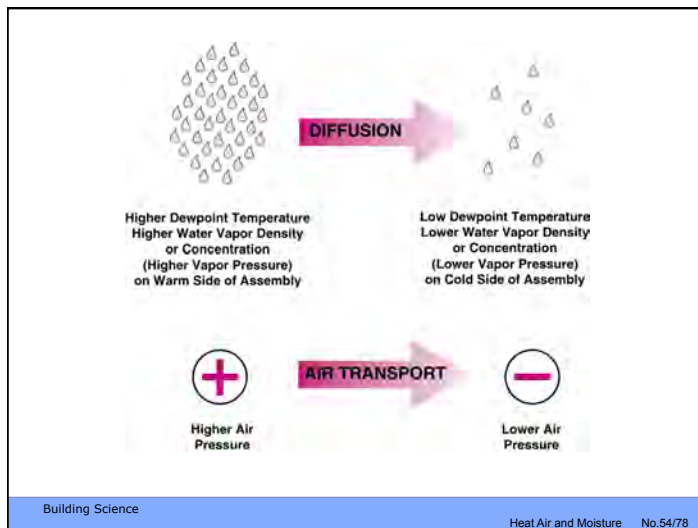


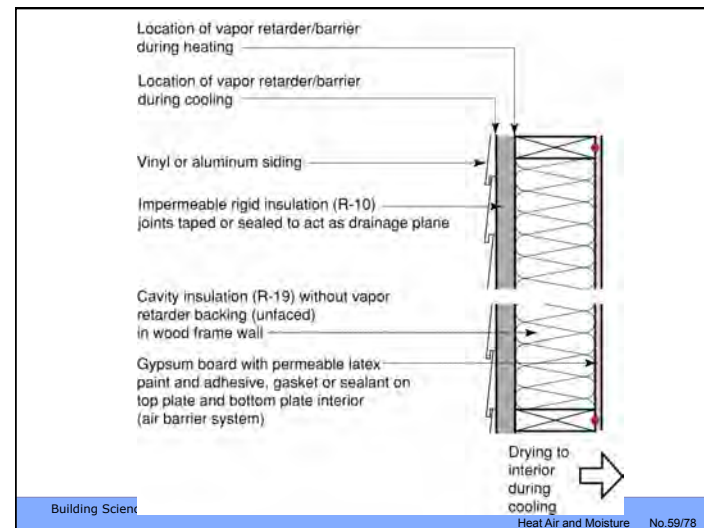
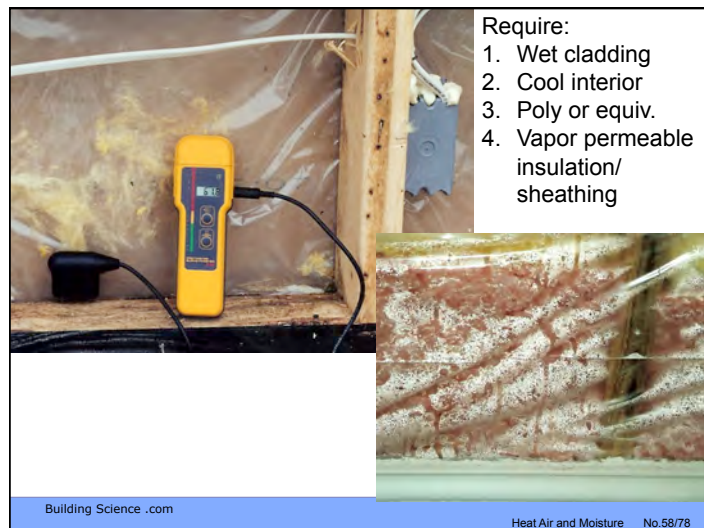
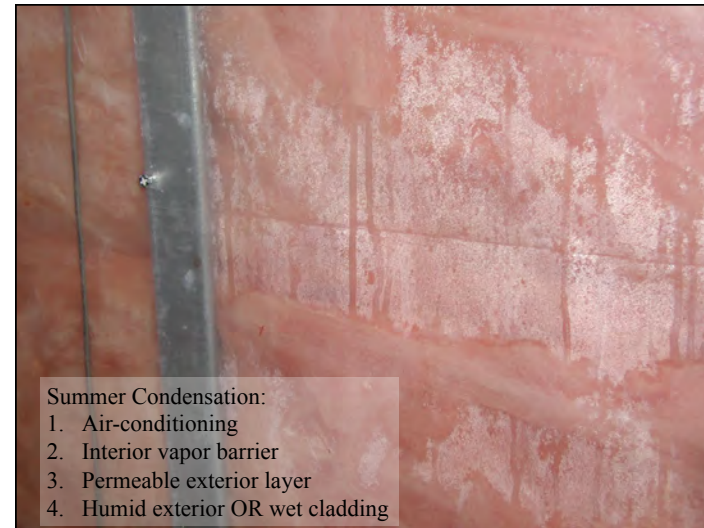
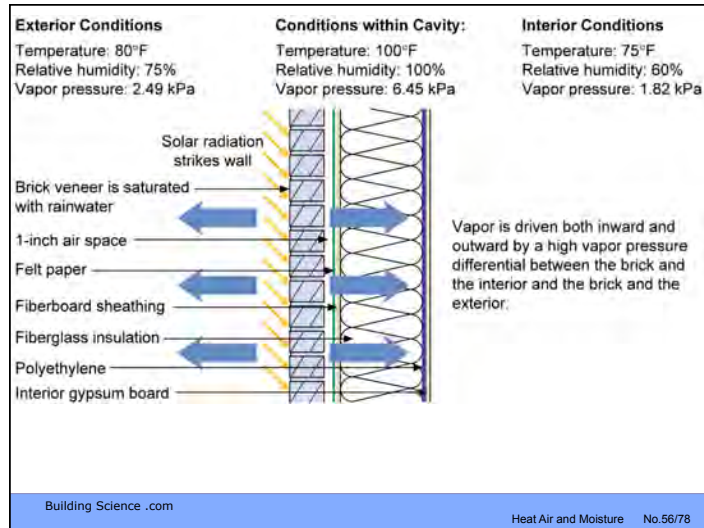


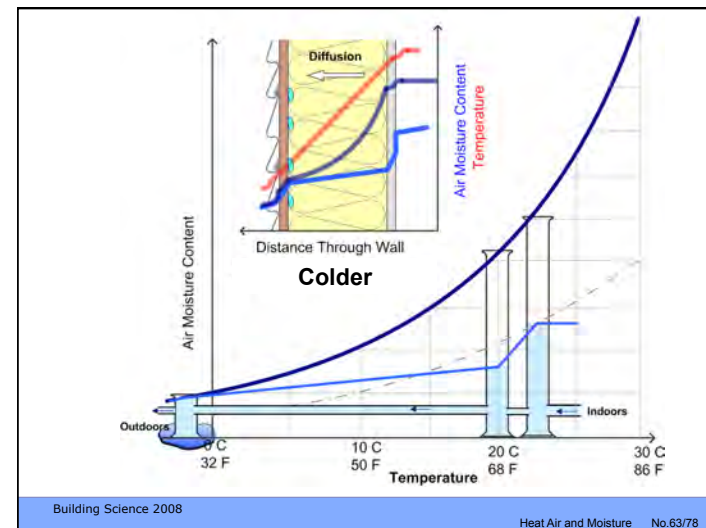
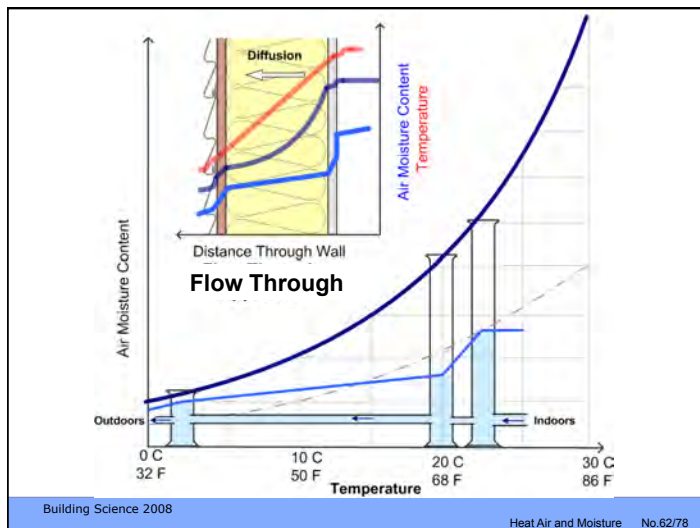
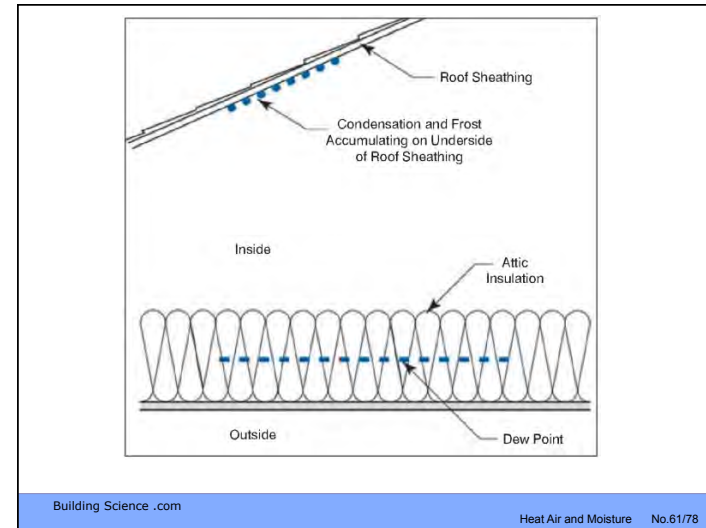
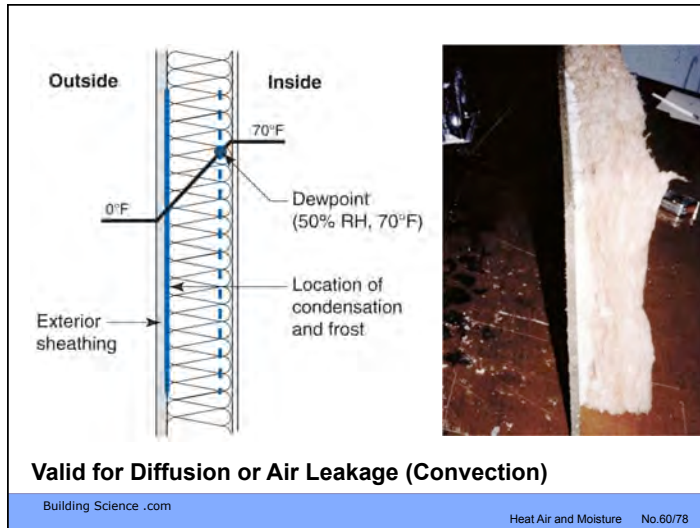
Water Vapour Transport

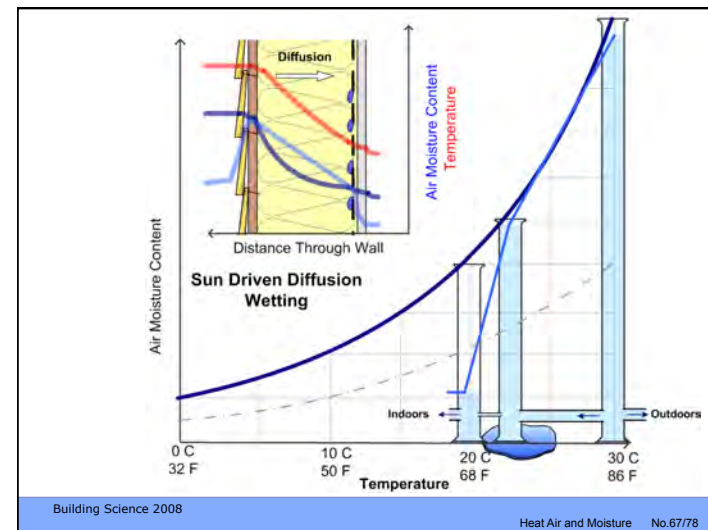
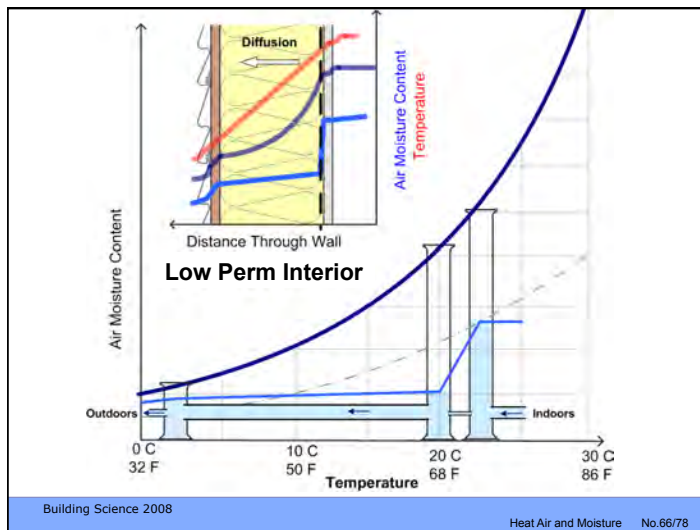
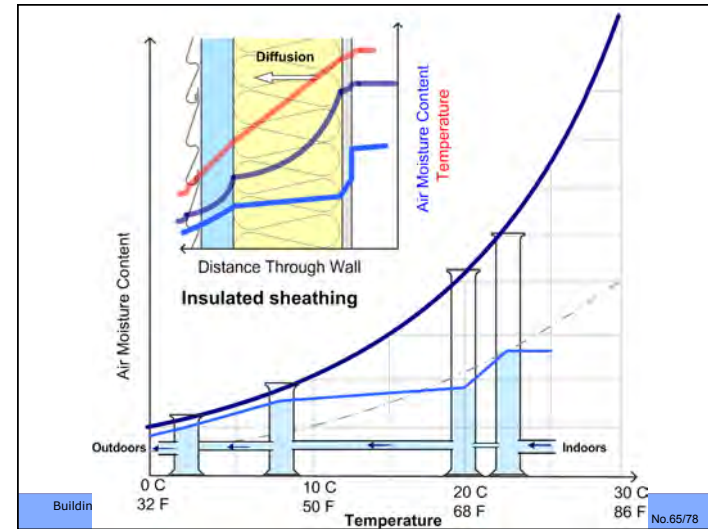
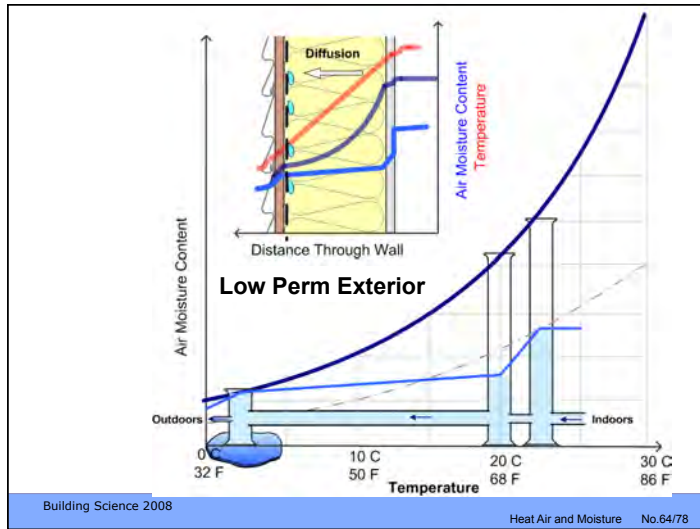
- Vapour Diffusion (like heat conduction)
 - more to less vapor
 - No air flow
 - Flow through tiny pores
- Air Convection (like heat convection)
 - more to less air pressure
 - flow through visible cracks and holes
 - vapour is just along for the ride

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Conclusions

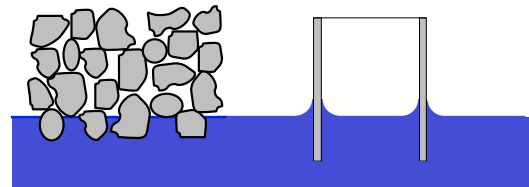
- Air can store much more water vapor as temperature increases
- Water vapor moves in two modes
 - Diffusion (vapor control)
 - Air Leakage (air control)
- Vapor control is less important
- Air control requires all holes sealed

Liquid Transport: Capillary Flow

- Surface tension drives water uptake
- Flow rate depends on size of opening
 - Small pores – high suction, low flow
 - Large pores – low suction, high flow

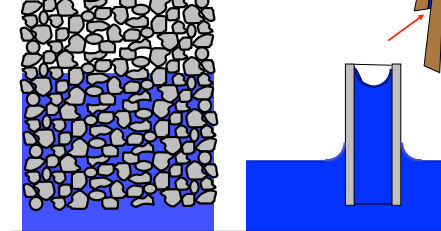
Capillary Flow

- Solution: use gaps
- Large pores - no suction (no “wicking”)
- Eg. : Crushed stone, air gaps
- Gravity flow allows drainage



Capillary Flow

- Example: Sand, siding laps**
Smaller pores
 - some wicking (inches to feet)



Capillary Flow- concrete sucks

Example: Clay or silt
Wicking (dozens - hundreds of ft)

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To do

- Dynamic drawing of diffusion and air leakage comparison
- Balloon prick vs deflation
- Joe Vapor permeance cup test- photo of Coke Fridge
- Do more psych charts steps

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Methods to get Condensation

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