

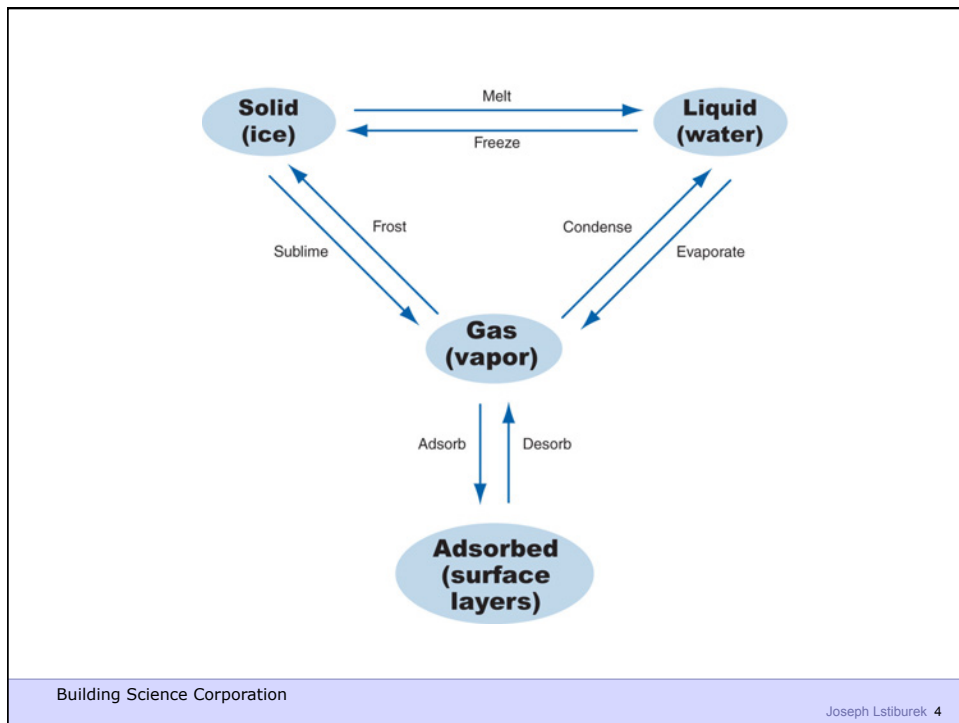
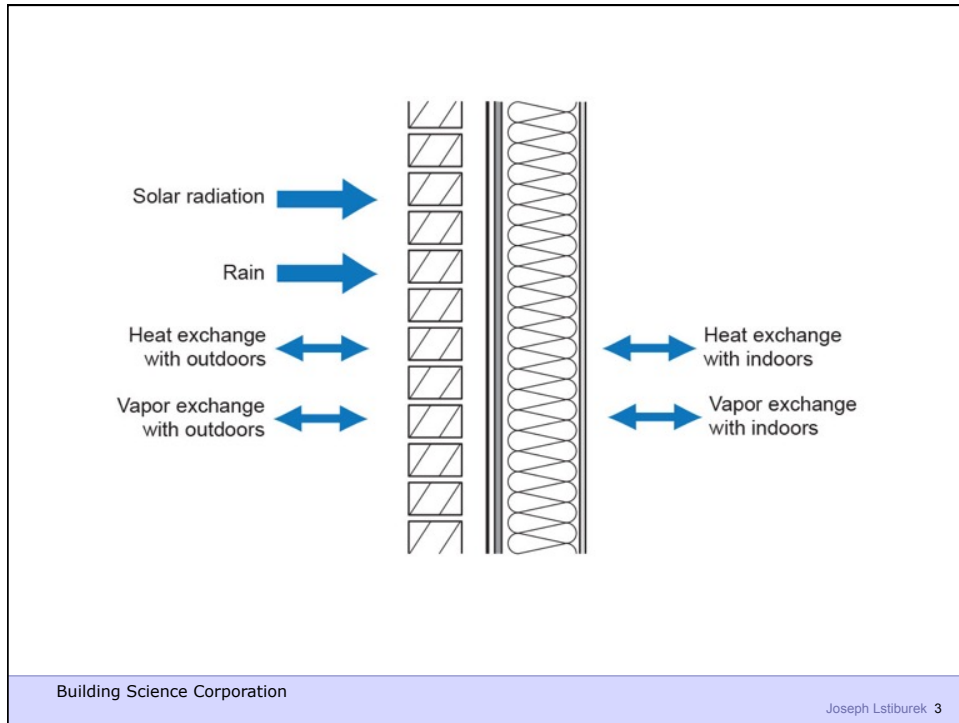
Joseph Lstiburek, Ph.D., P.Eng, ASHRAE Fellow

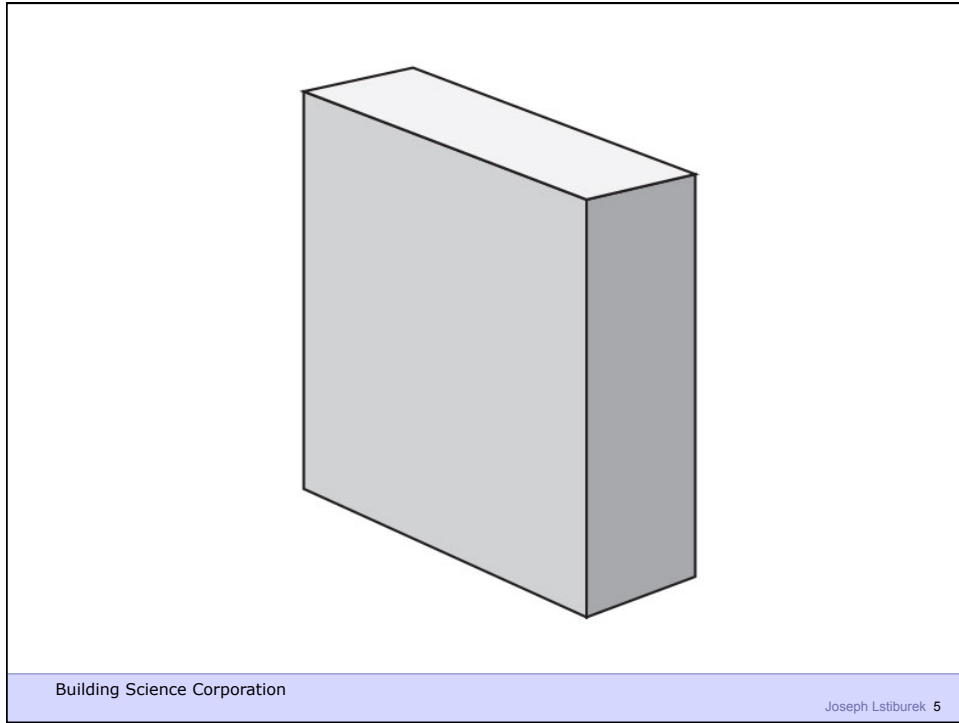
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## Hygrothermal Analysis



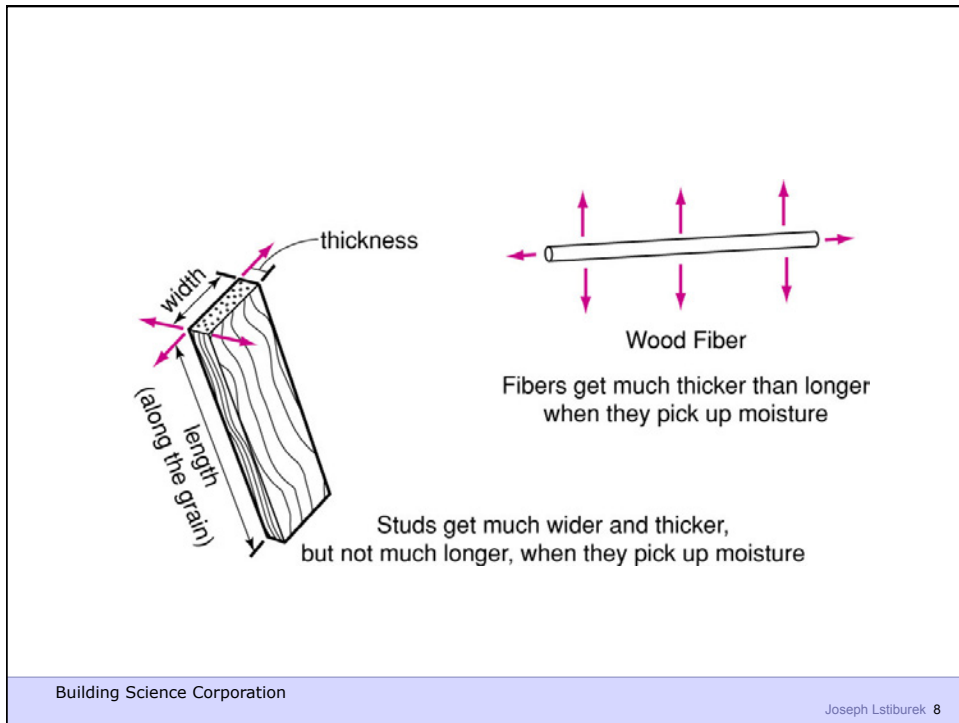
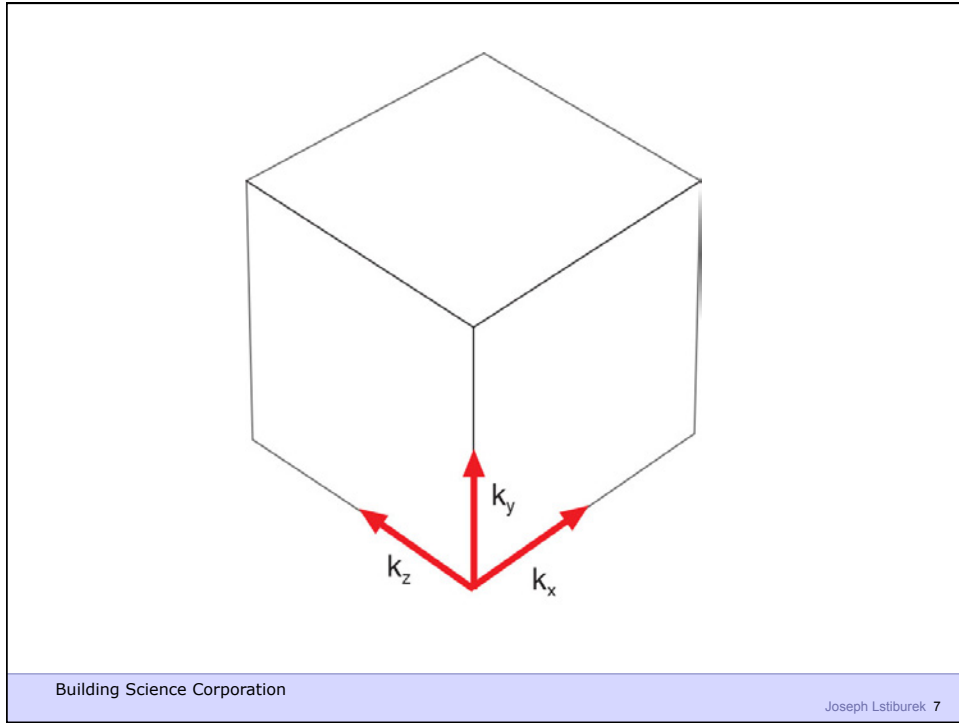


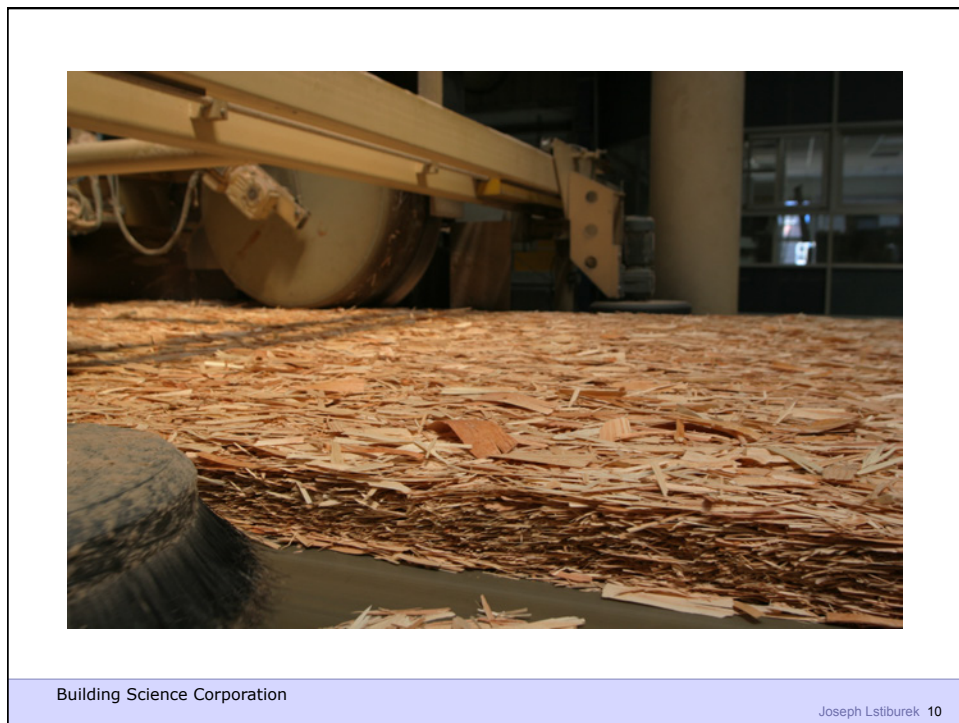
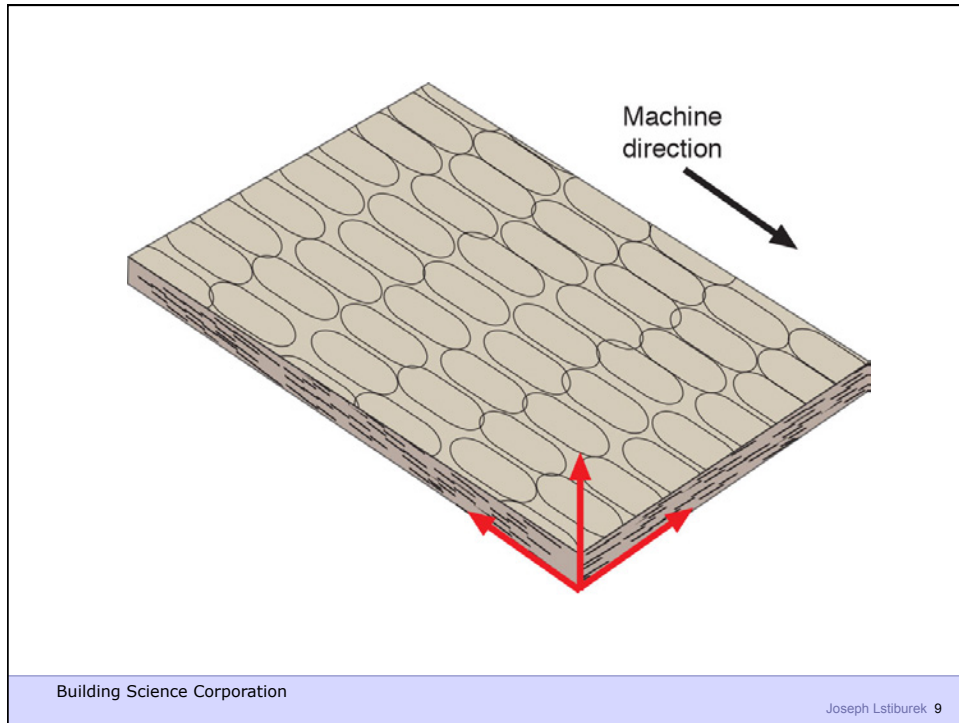
**Moisture Transport in Porous Media**

<b>Phase</b>	<b>Transport Process</b>	<b>Driving Potential</b>
<b>Vapor</b>	Diffusion	Vapor Concentration
<b>Adsorbate</b>	Surface Diffusion	Concentration
<b>Liquid</b>	Capillary Flow	Suction Pressure
	Osmosis	Solute Concentration

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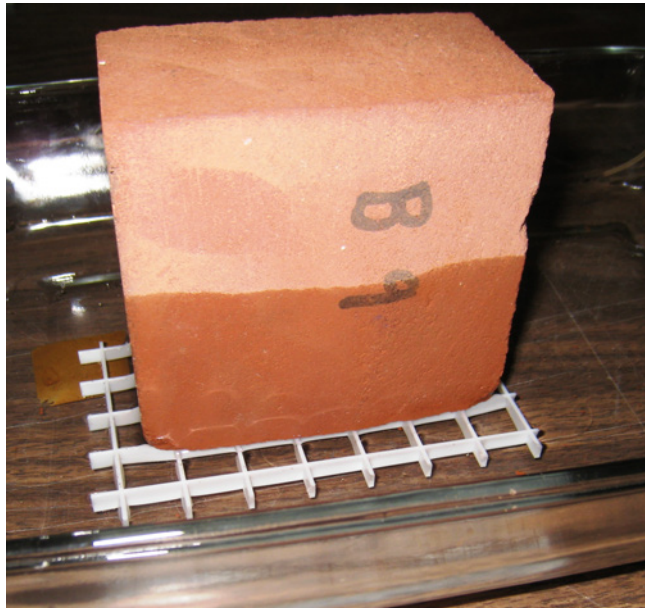






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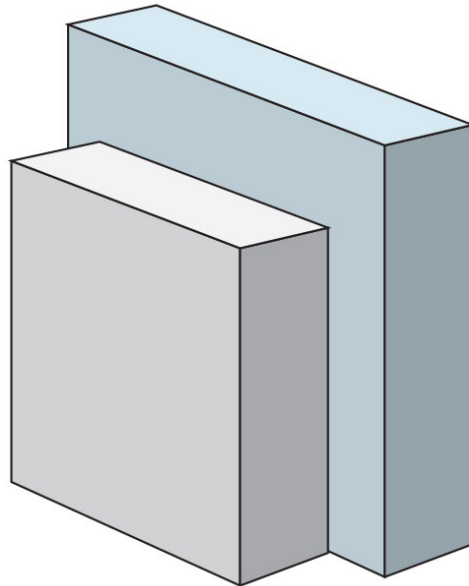
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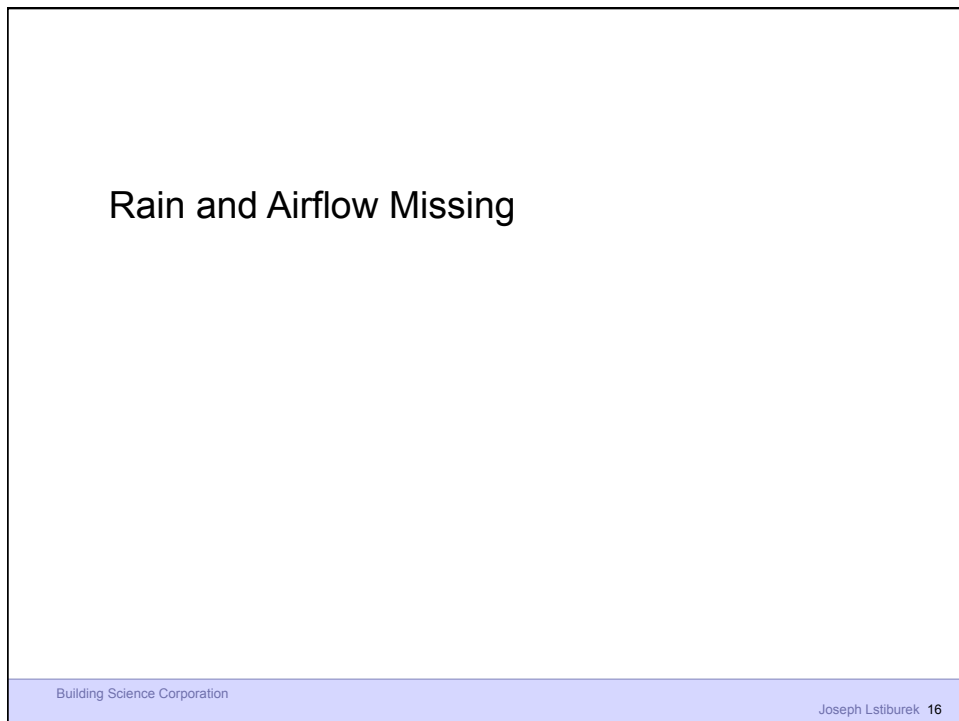
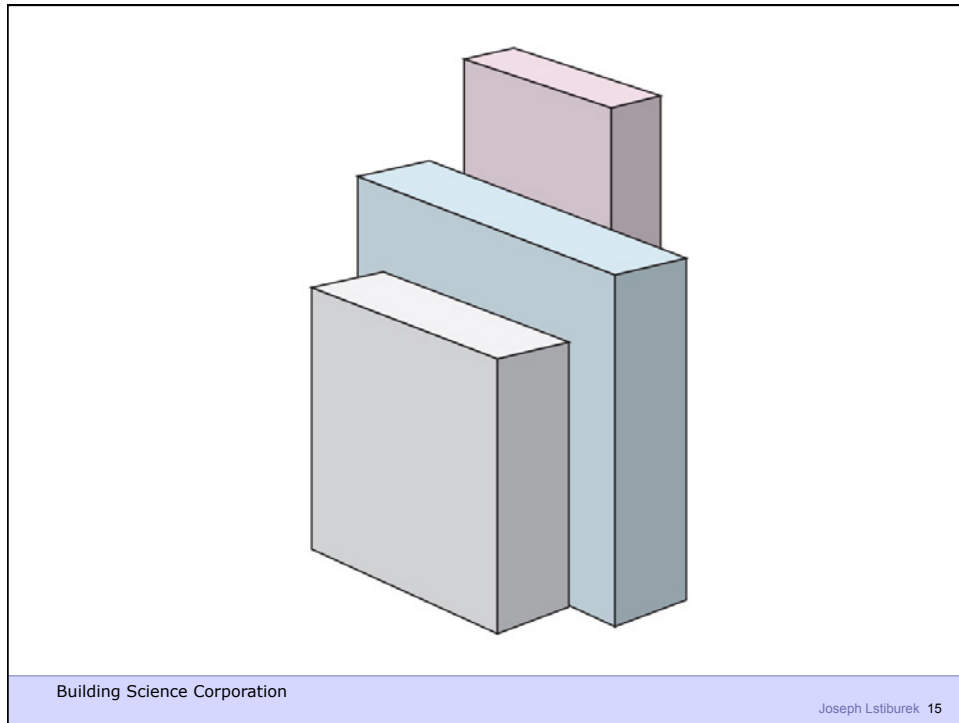
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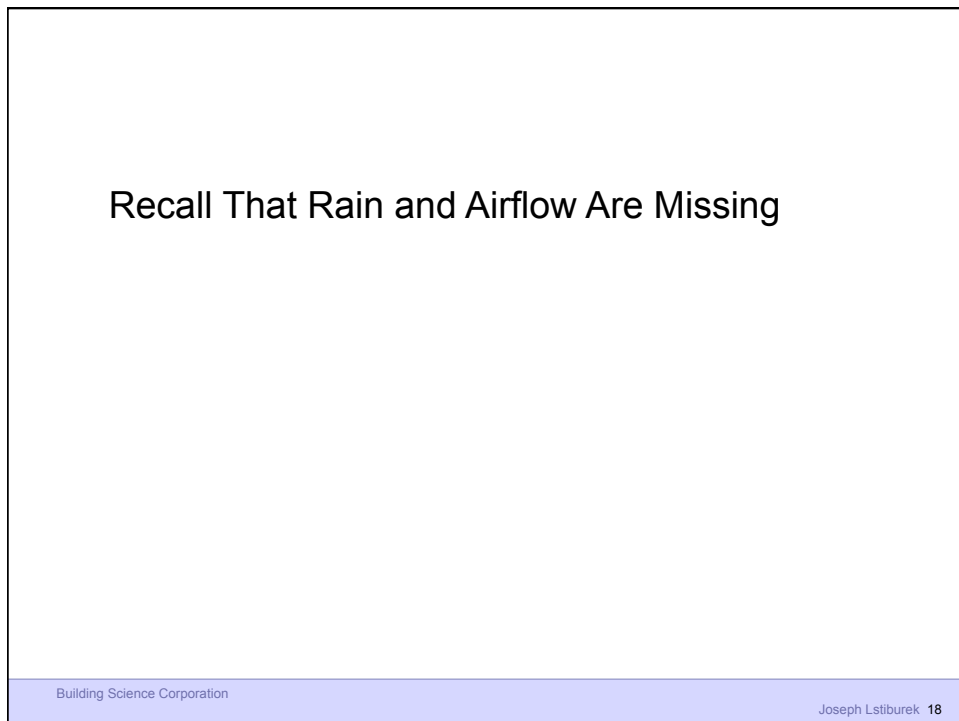
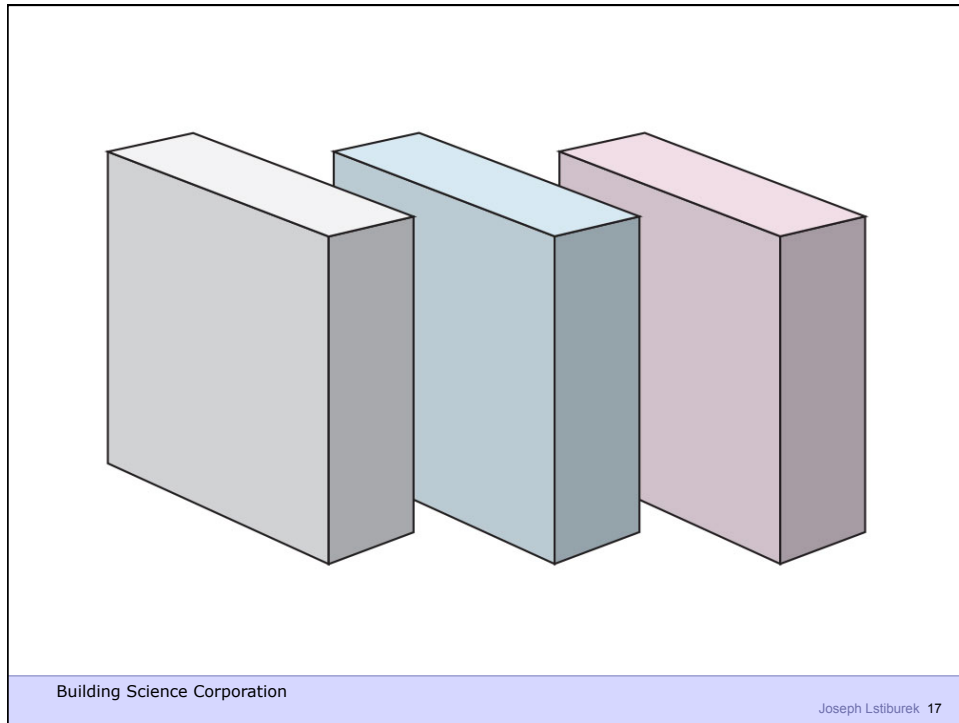


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Moisture Transport in Assemblies		
Phase	Transport Process	Driving Potential
<b>Vapor</b>	Diffusion	Vapor Concentration
	Convective Flow	Air Pressure
<b>Adsorbate</b>	Surface Diffusion	Concentration
<b>Liquid</b>	Capillary Flow	Suction Pressure
	Osmosis	Solute Concentration
	Gravitational Flow	Height
	Surface Tension	Surface Energy
	Momentum	Kinetic Energy
	Convective Flow	Air Pressure

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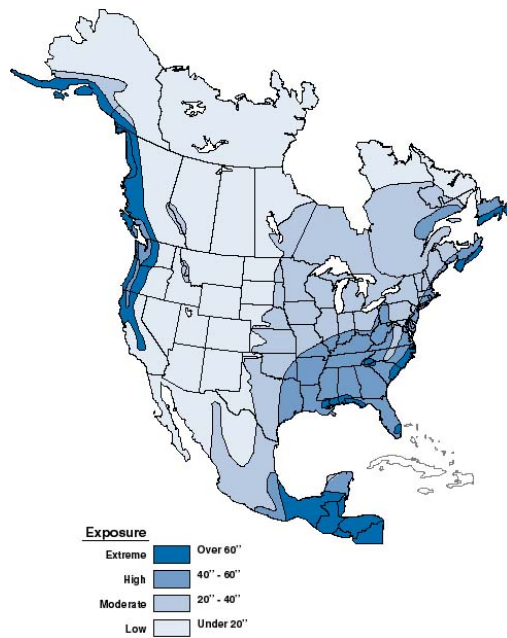
All We Have To Figure Out Is How Much Hits  
The Wall

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All We Have To Figure Out Is How Much Hits  
The Wall  
We Need Straube and Kuenzel

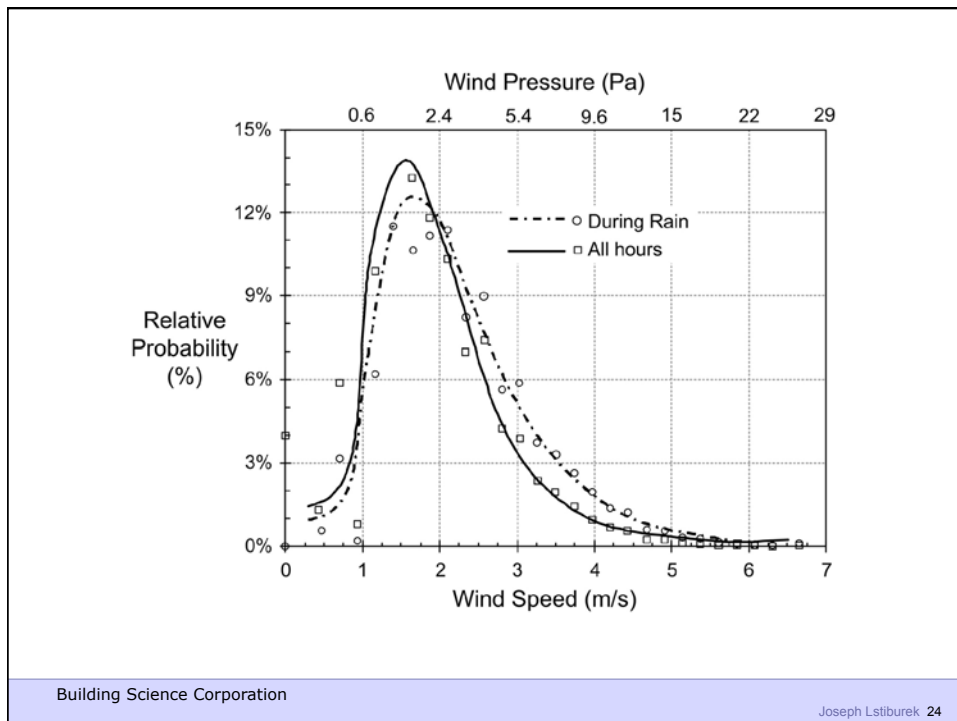
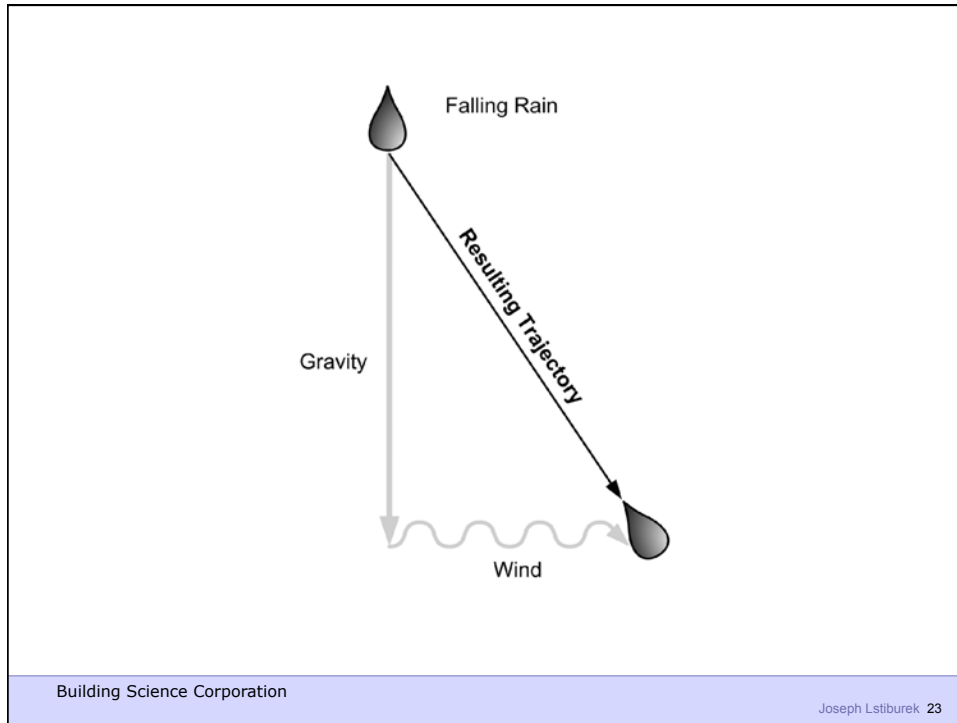
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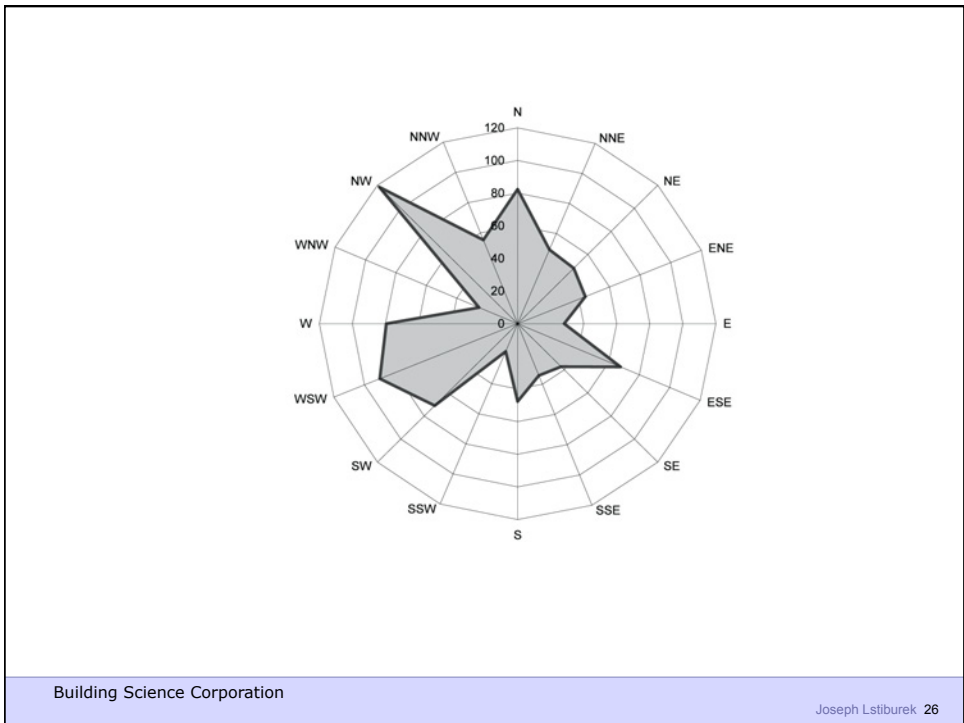
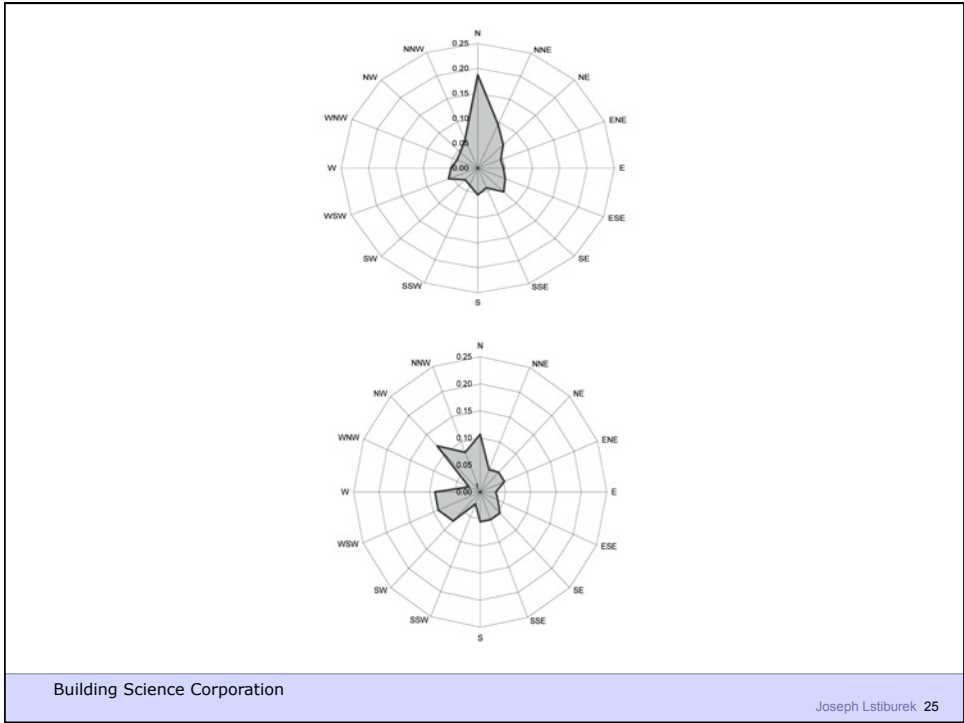
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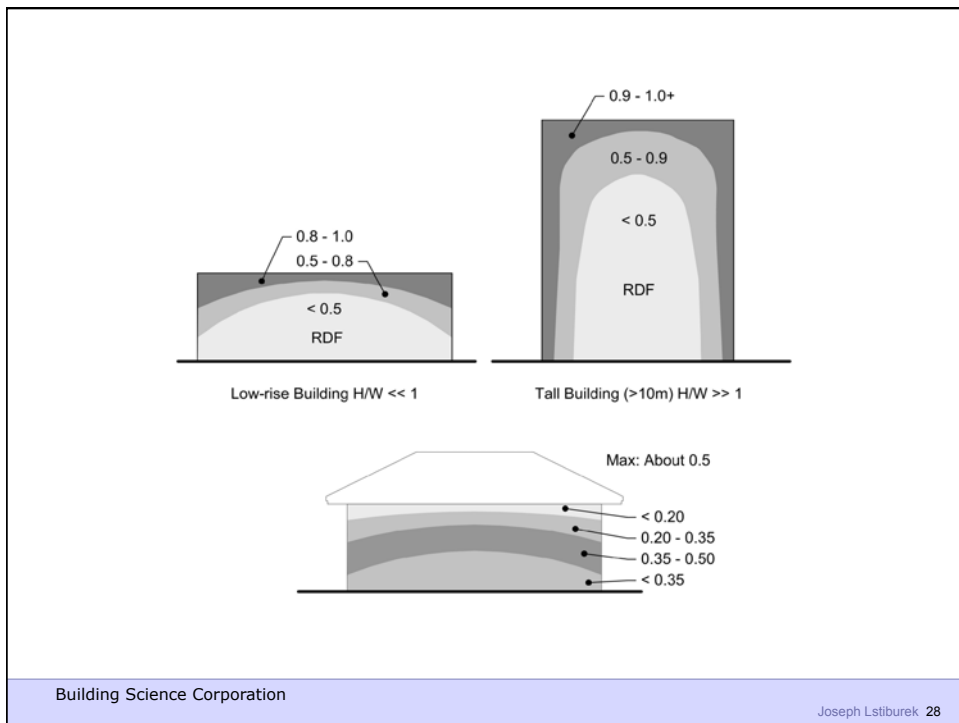
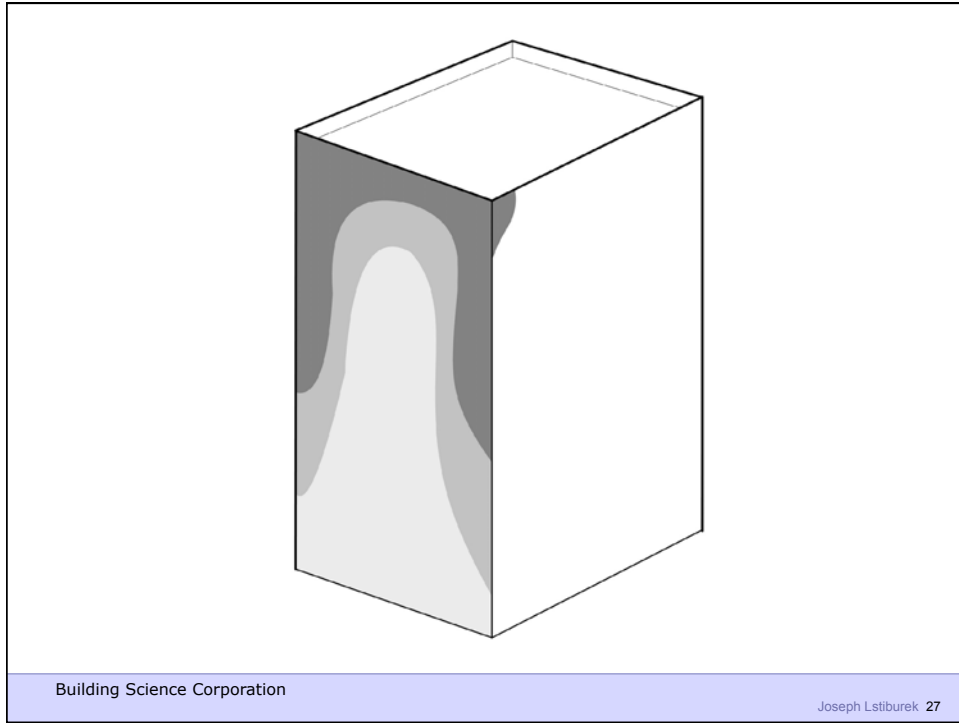


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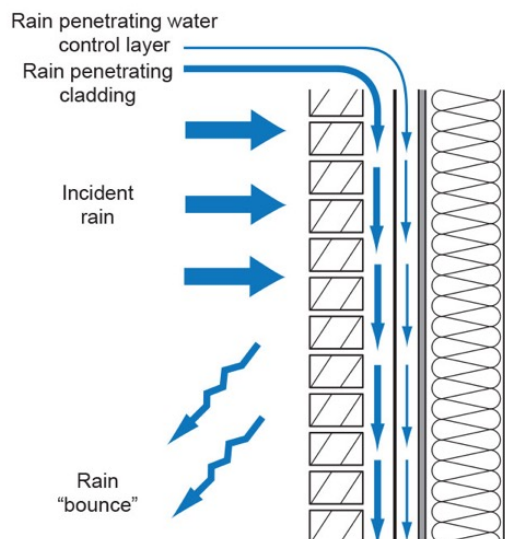
We use Straube/Kuenzel to determine how much rain water impinges on the wall.

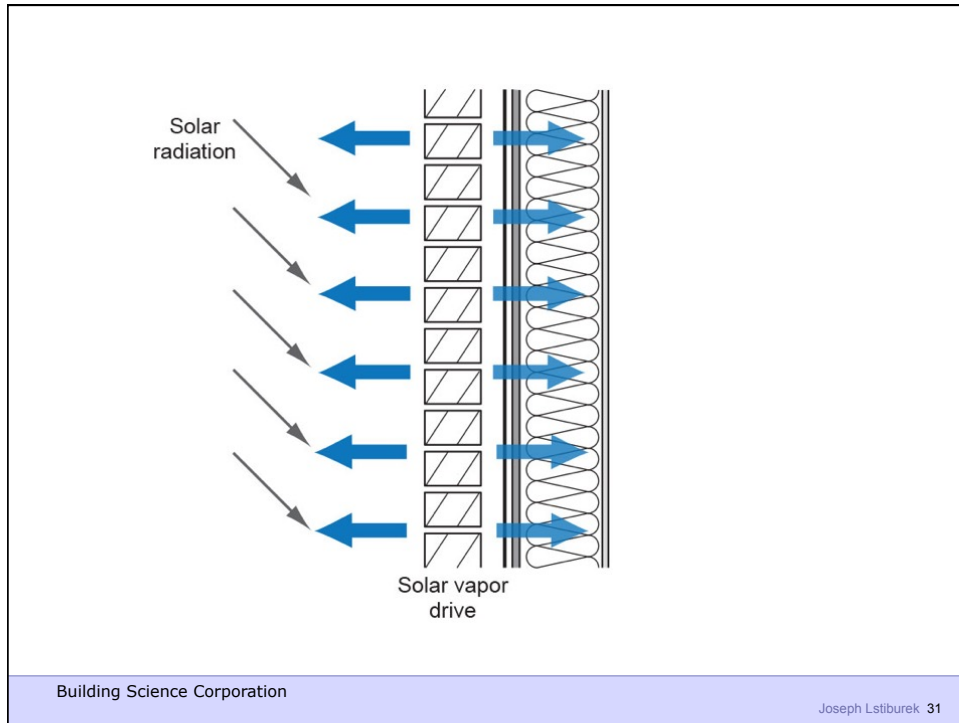
We assume 30% bounces off  
70% stays on the wall.

The 70% that stays on the wall is addressed by liquid conductivity (capillary flow) and vapor diffusion.

We assume 1% of the 70% penetrates to the back side of the cladding.

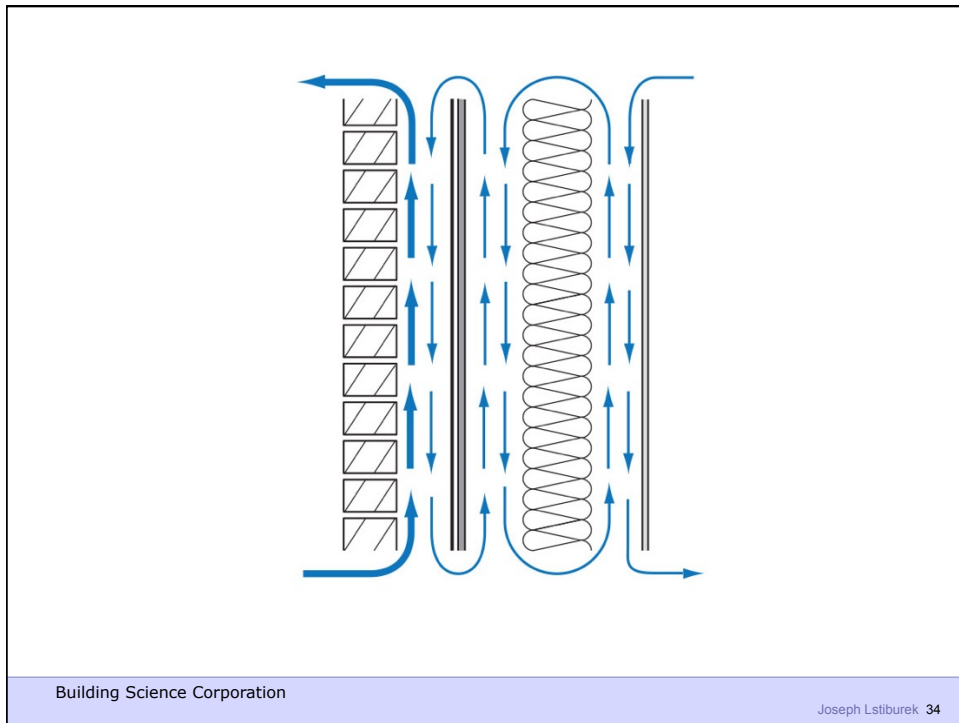
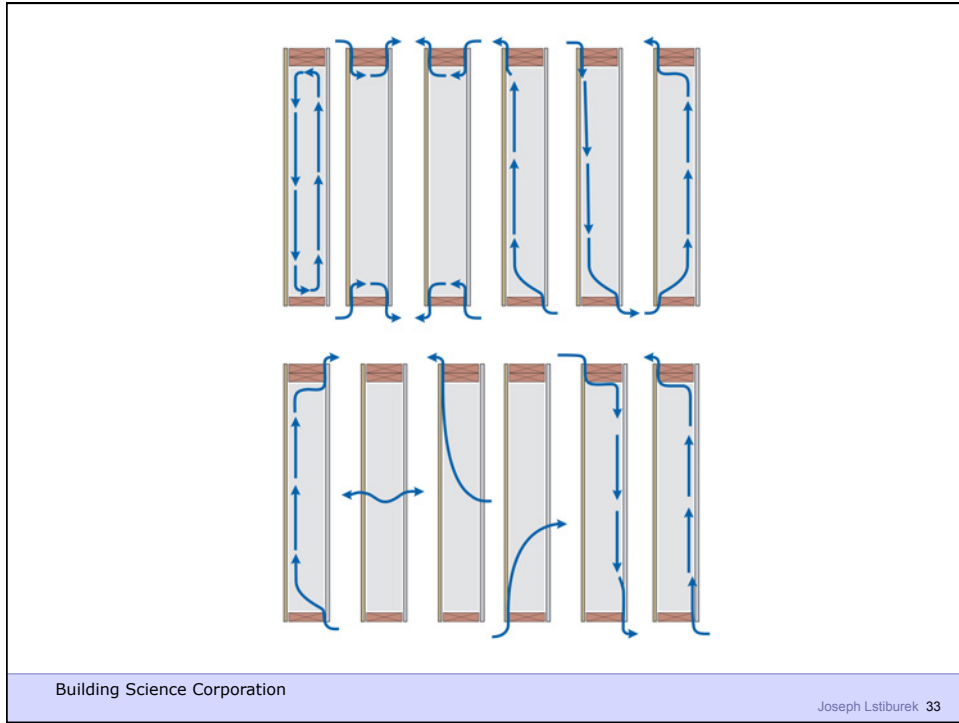
We further assume that 1% of the 1% gets past the water control layer into the sheathing.

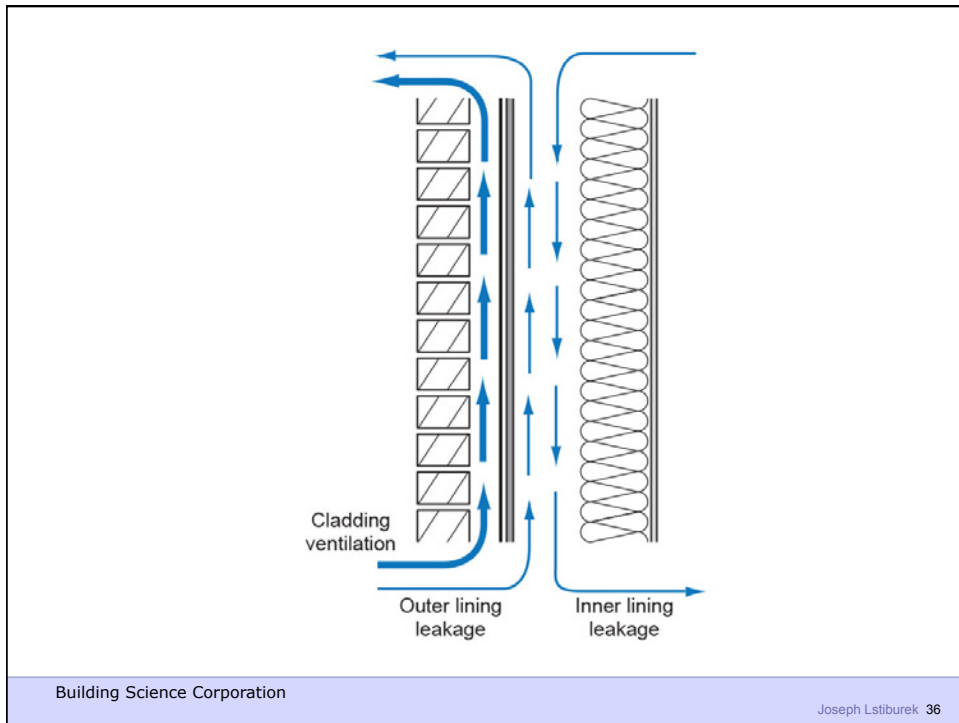
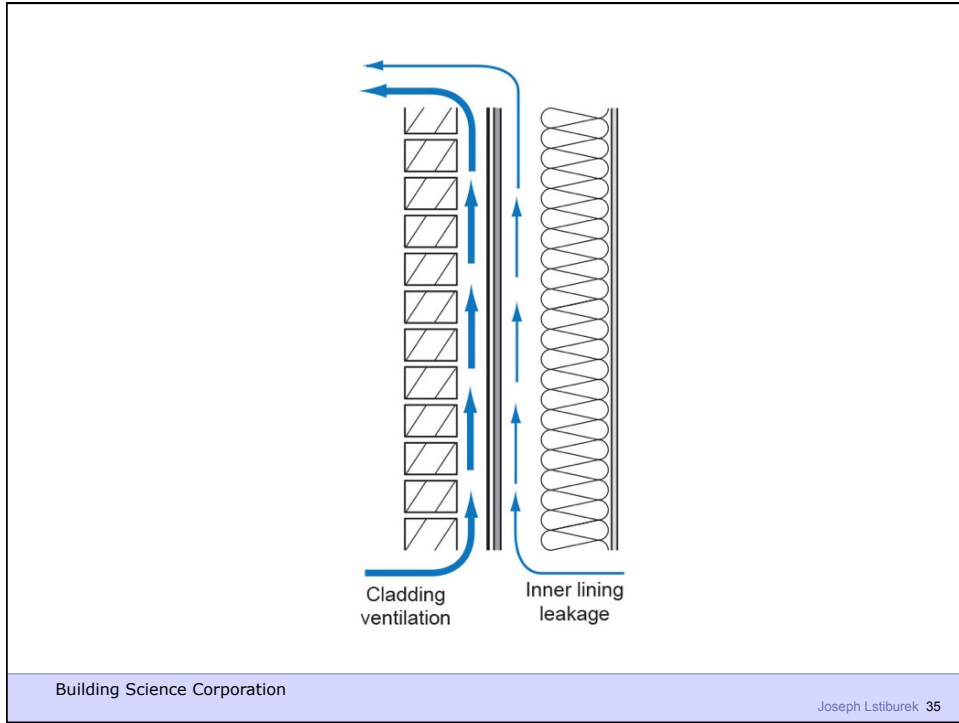


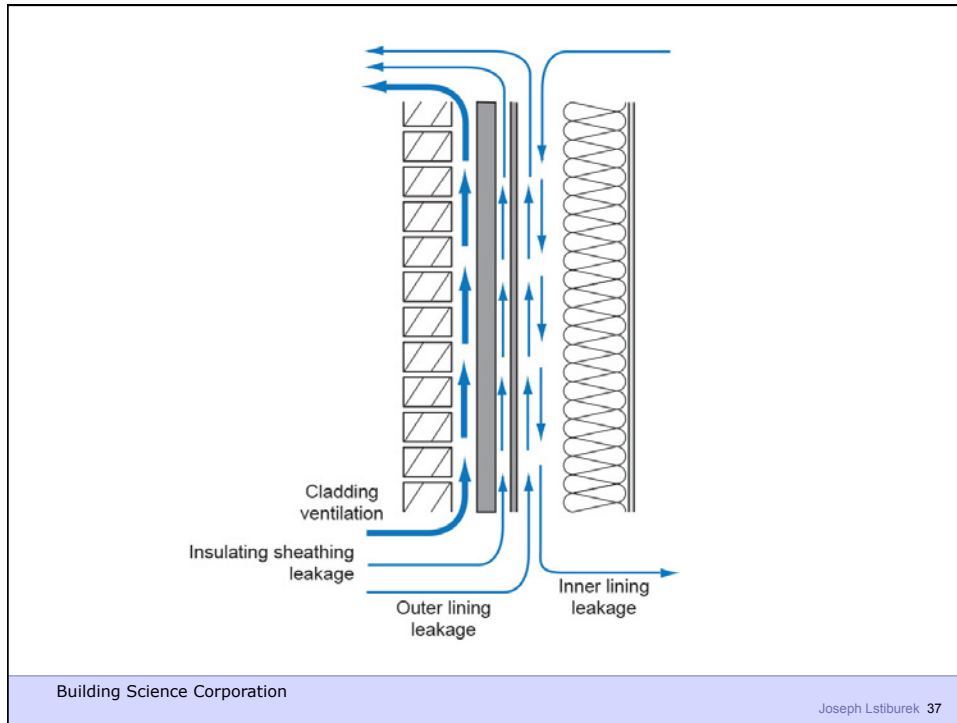


## Revisiting Convective Flow









### Cladding Ventilation/ Sheathing Ventilation

	Flow Rate	Gap	ACH
<b>Wood Siding</b>	0.1 cfm/sf	3/16"	20
<b>Vinyl Siding</b>	0.5 cfm/sf	3/16"	200
<b>Brick Veneer</b>	0.15 cfm/sf	1"	10
<b>Stucco (vented)</b>	0.1 cfm/sf	3/8"	10
<b>Stucco (direct applied)</b>	none	none	0
<b>Sheathing flanking flow</b>	0.05 cfm/sf	3/16"	10

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