

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

Tulsa PSO

Building Science

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Life is Tough Enough As it Is...

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Life is Tough Enough As it Is...
It's Harder When You Are Stupid

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Don't Do Stupid Things

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80 percent of construction defects involve water
40 percent of homeowners claim to have suffered from water damage
Water damage is the second most frequently filed claim

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80 percent of construction defects involve water
40 percent of homeowners claim to have suffered from water damage
Water damage is the second most frequently filed claim

So what has this got to do with energy?

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Buildings Get Wet From The Outside
Buildings Get Wet From The Inside
Buildings Start Out Wet
Wet Happens

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Buildings Must Be Designed To Dry

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Buildings Can Dry To The Outside
Buildings Can Dry To The Inside
Buildings Can Dry To Both Sides

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2nd Law of Thermodynamics

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Heat Flow Is From Warm To Cold
Moisture Flow Is From Warm To Cold
Moisture Flow Is From More To Less
Air Flow Is From A Higher Pressure to a
Lower Pressure
Gravity Acts Down

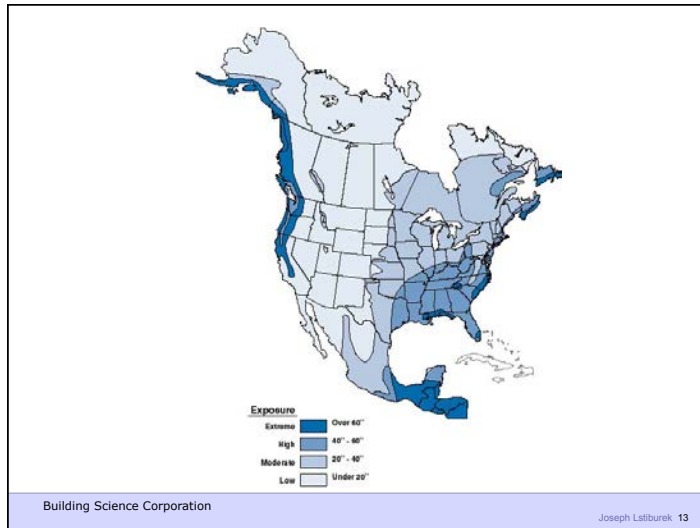
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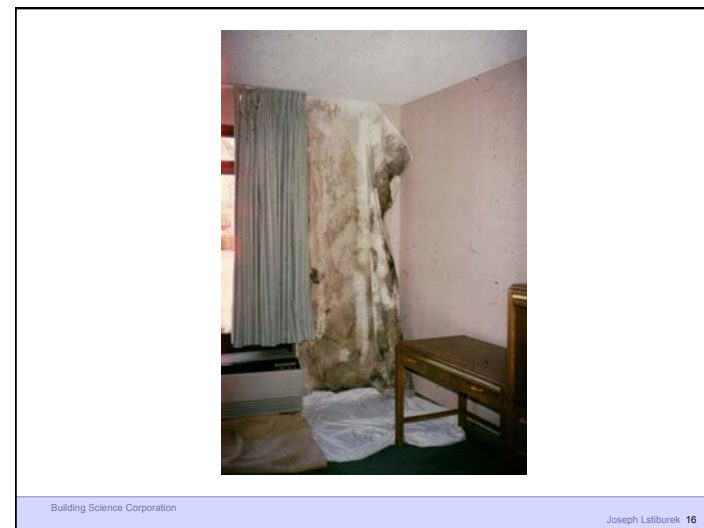
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Don't Do Stupid Things
Vapor Barriers

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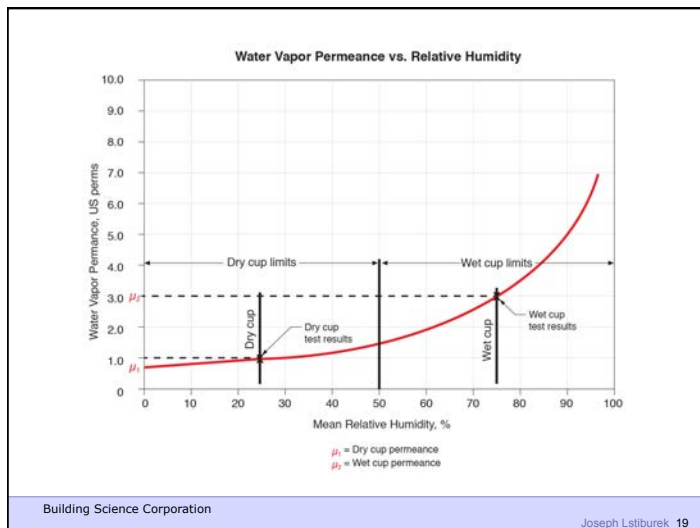
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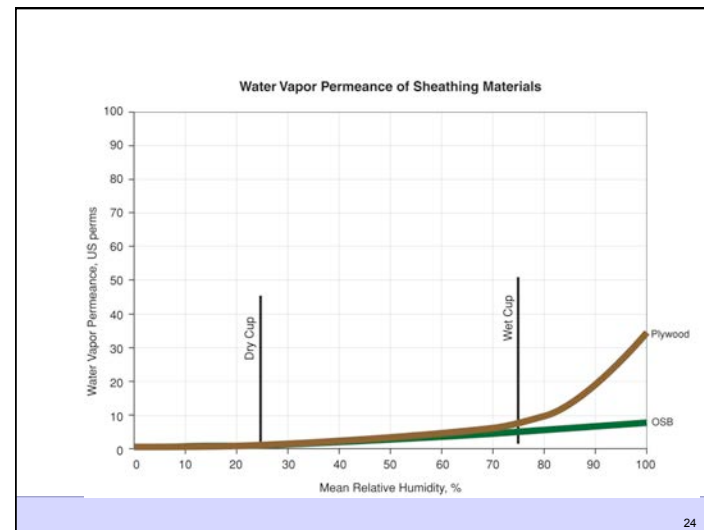
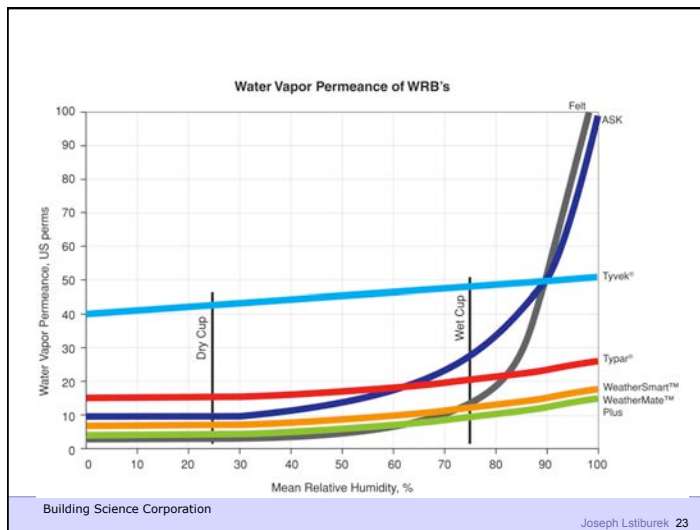
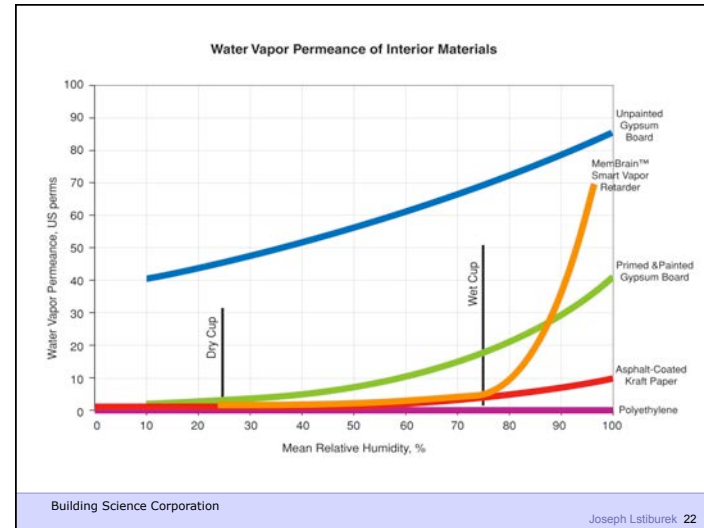
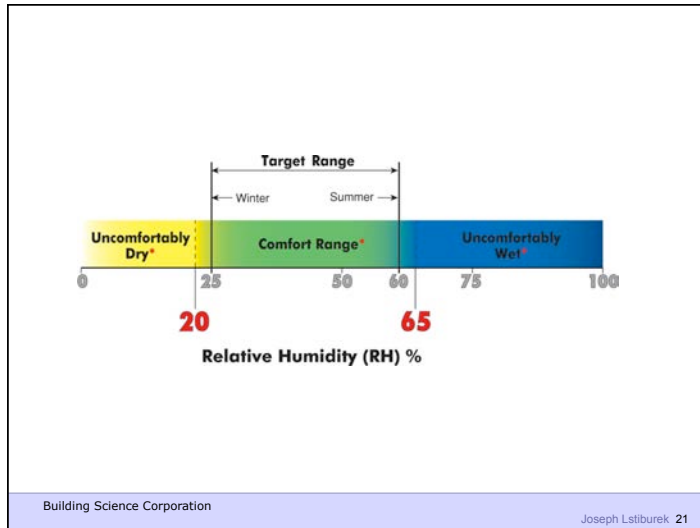
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Crawl Spaces

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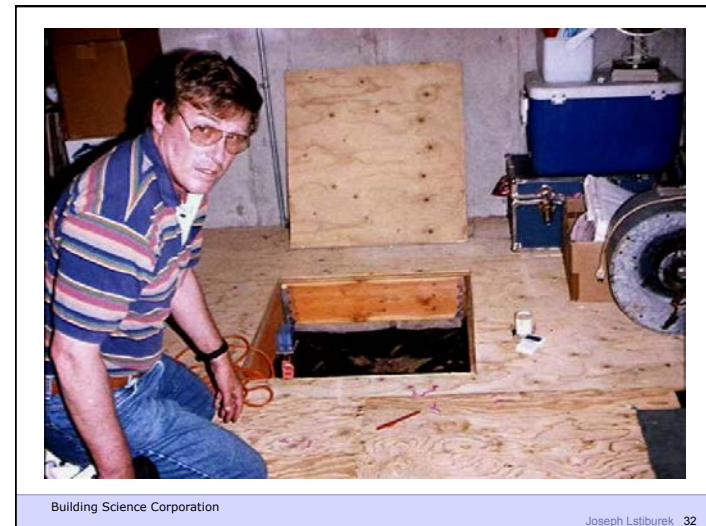
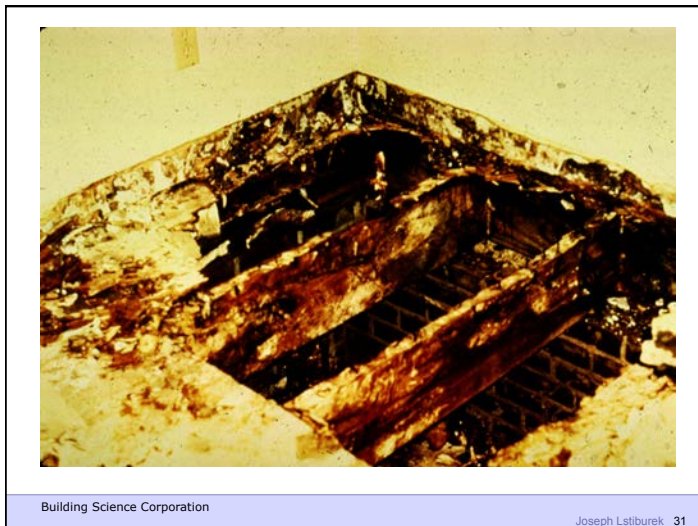
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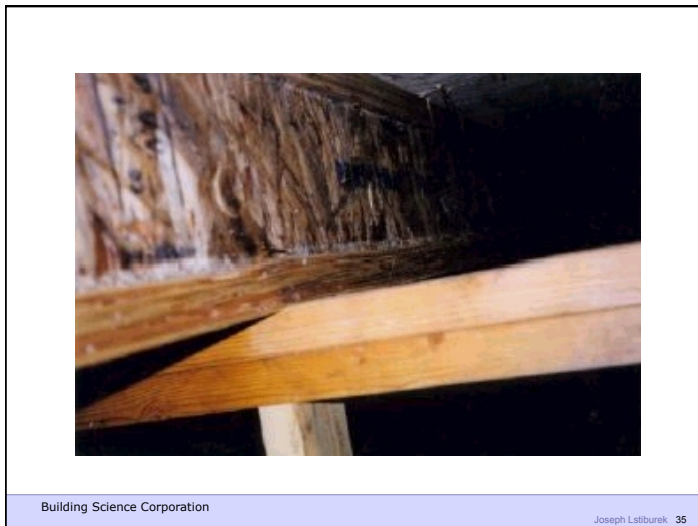


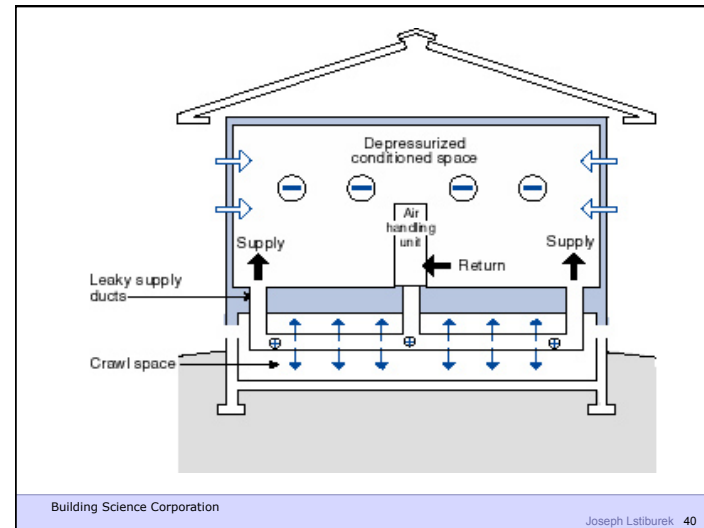
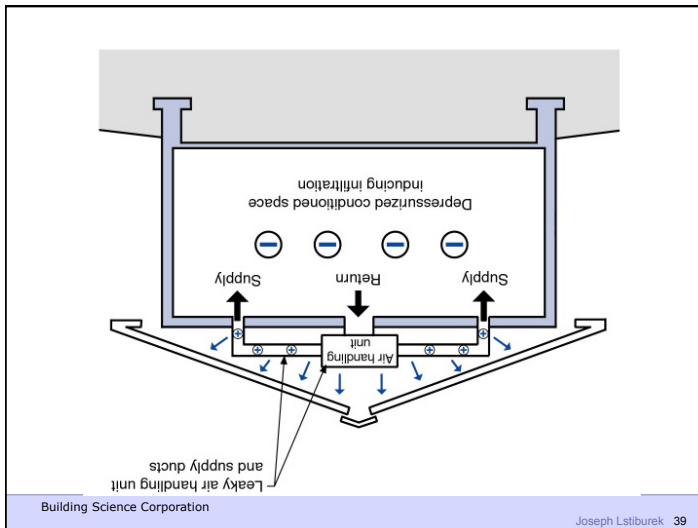
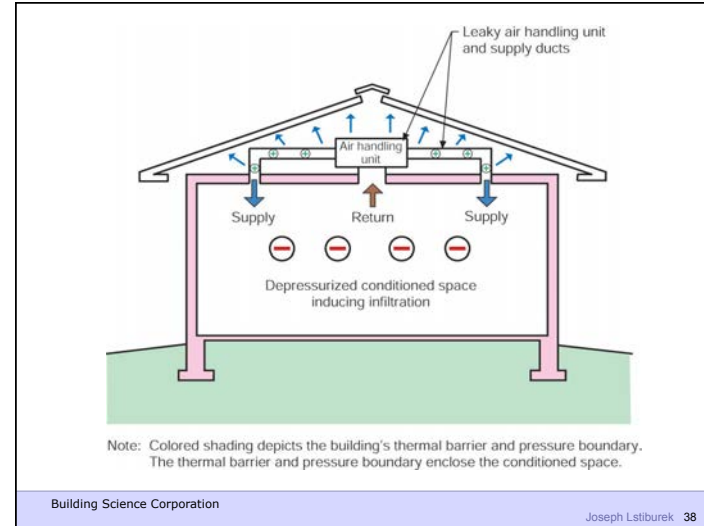
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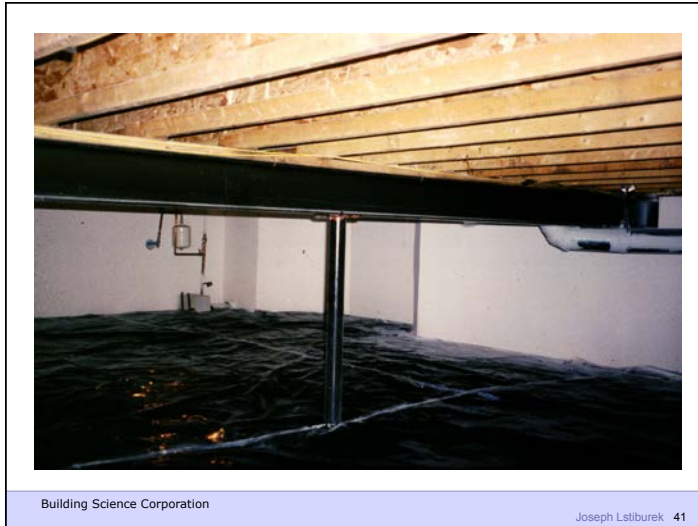


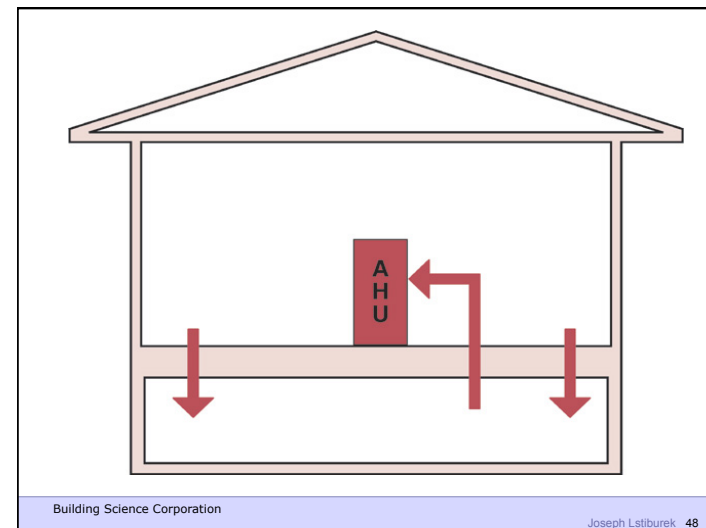
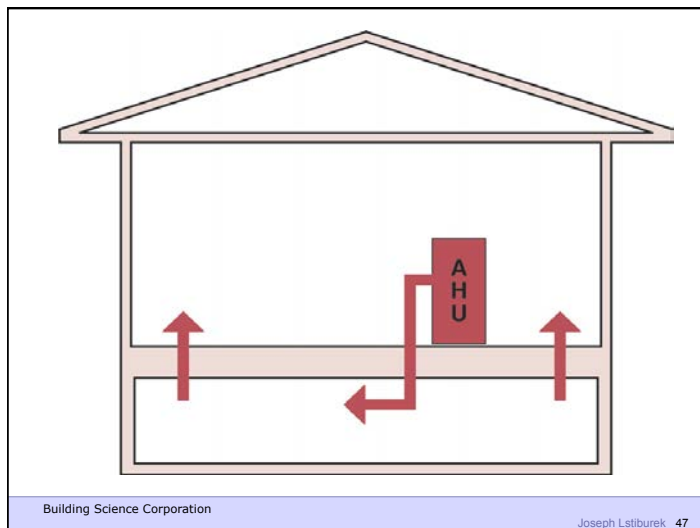
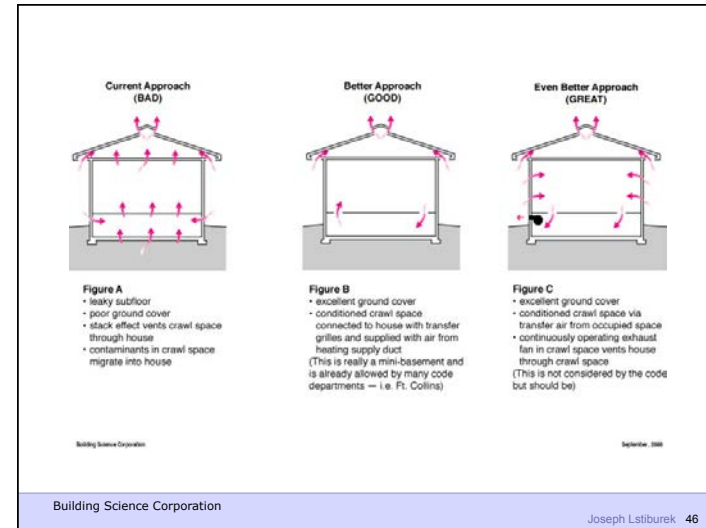
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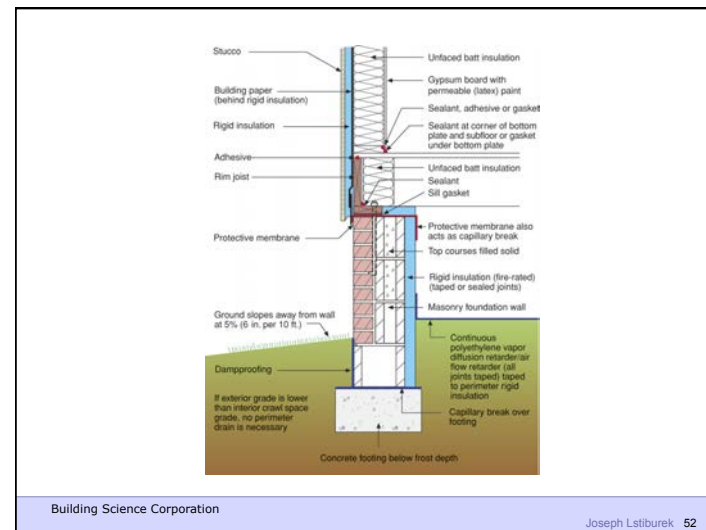
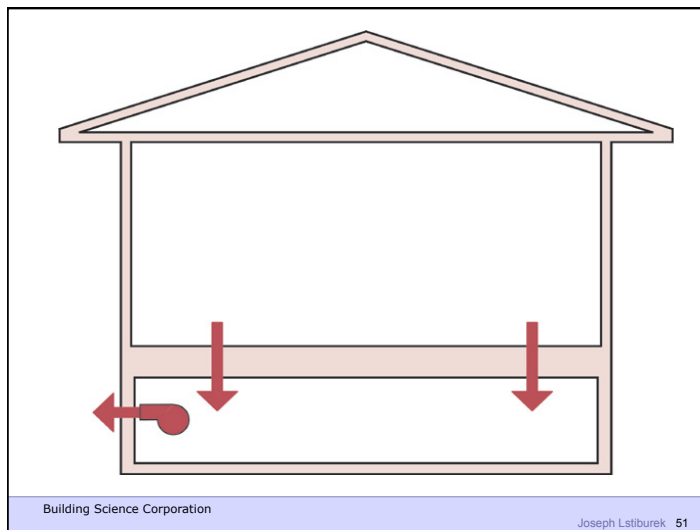
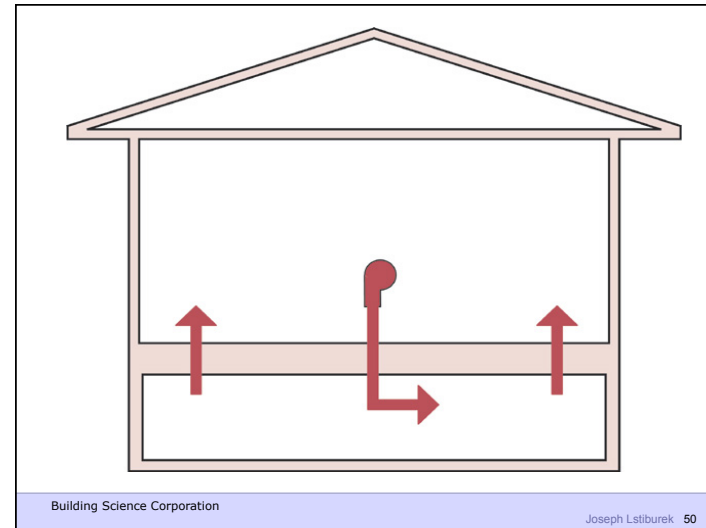
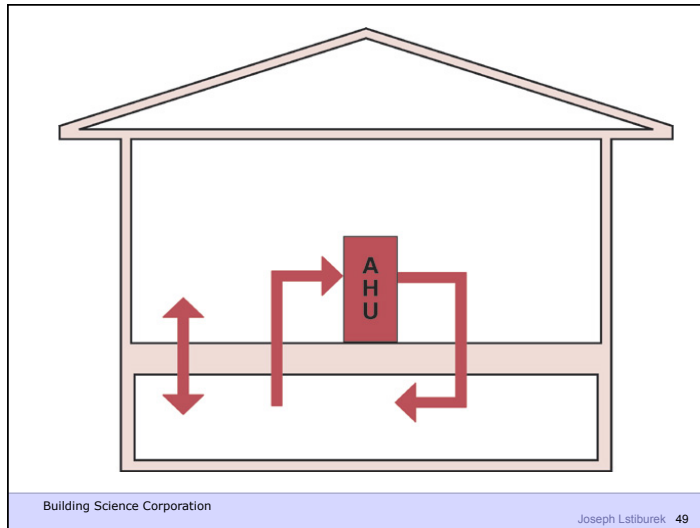


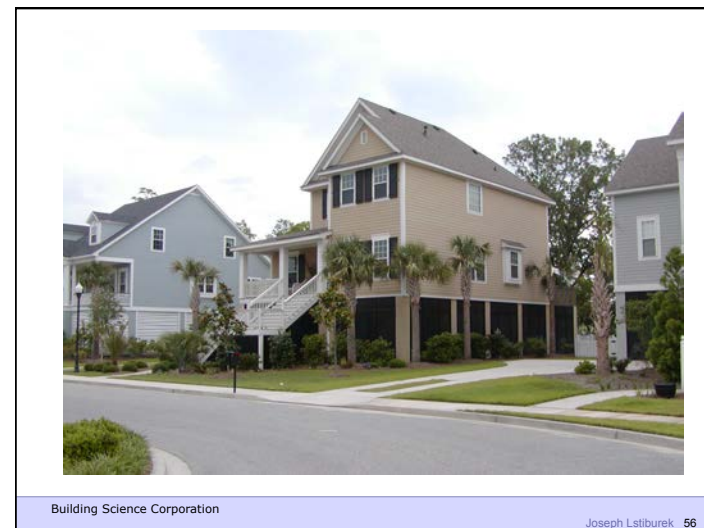
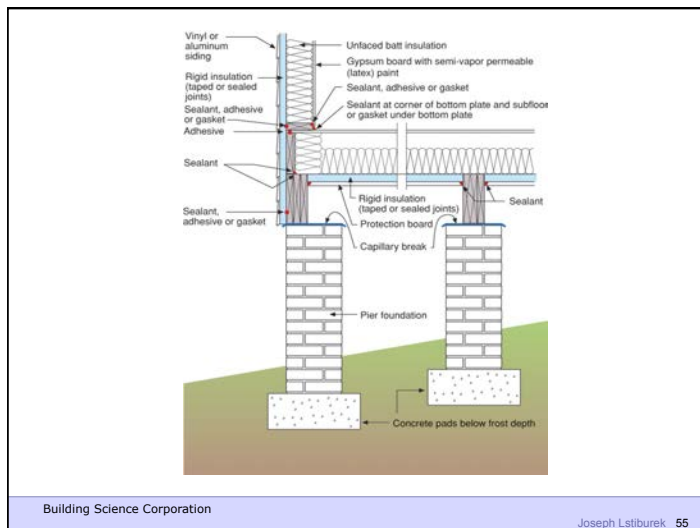
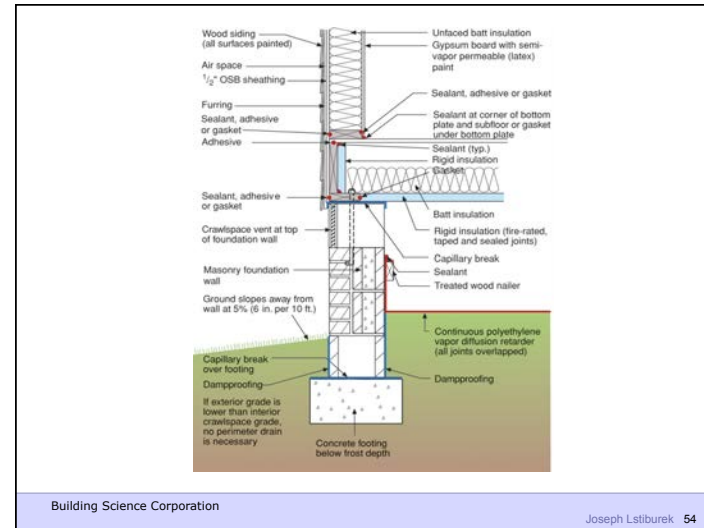
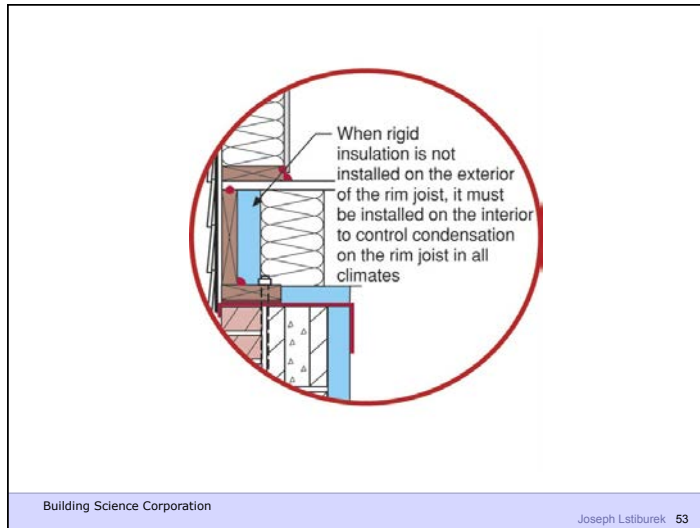


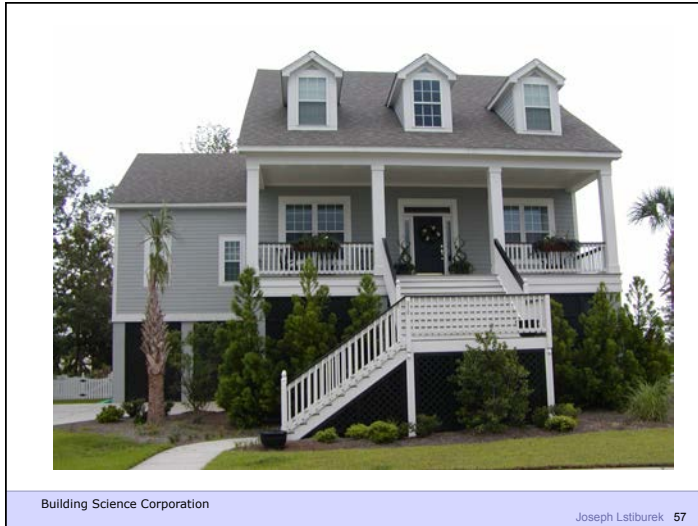


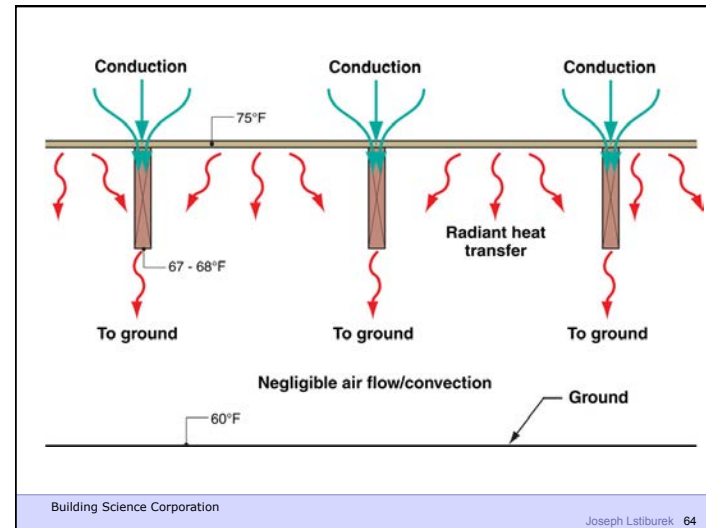
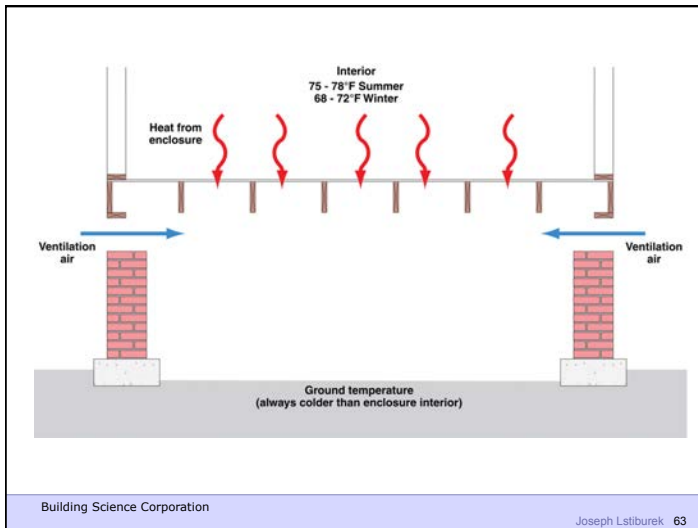
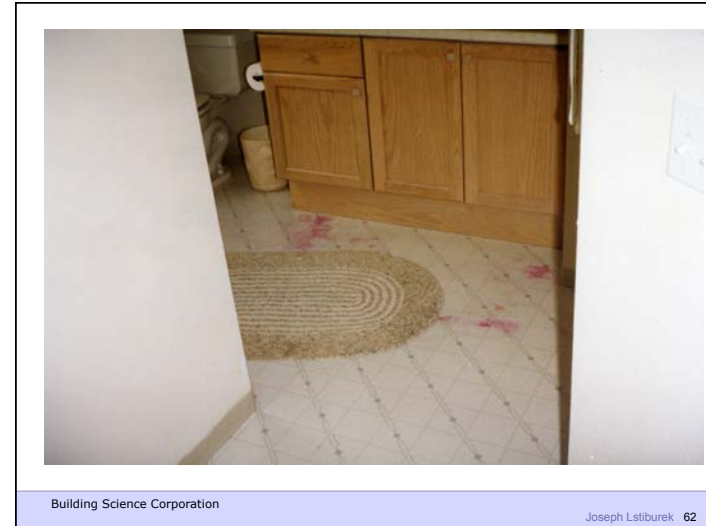


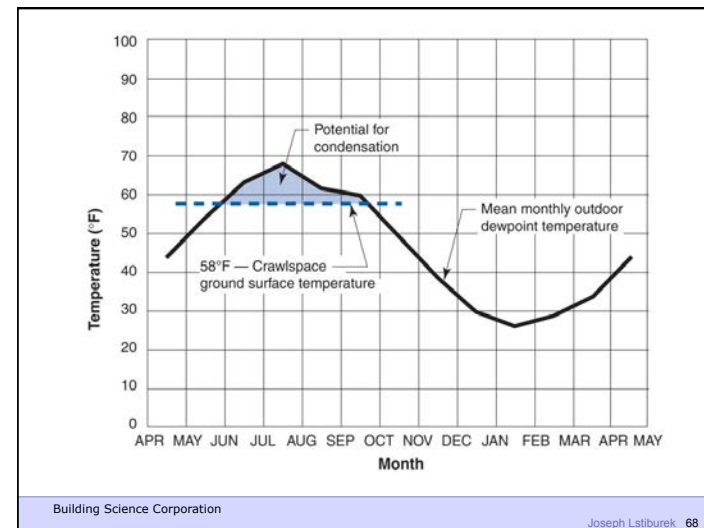
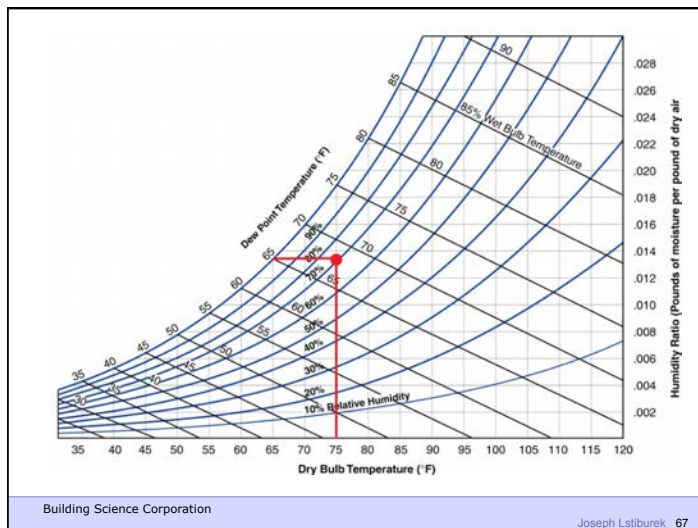
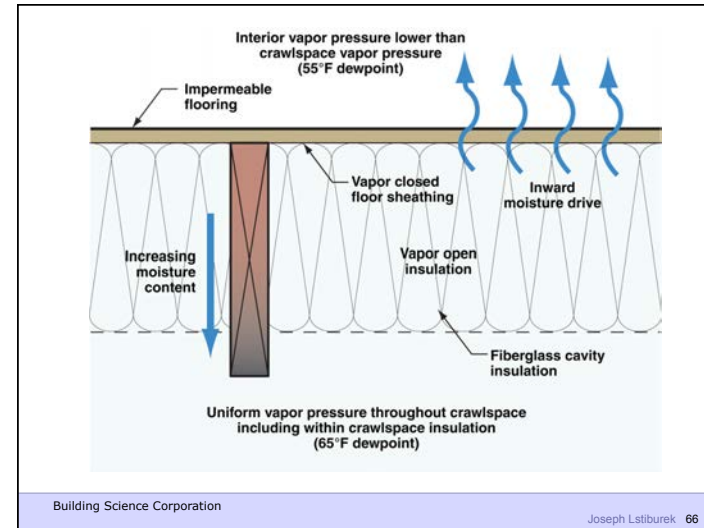
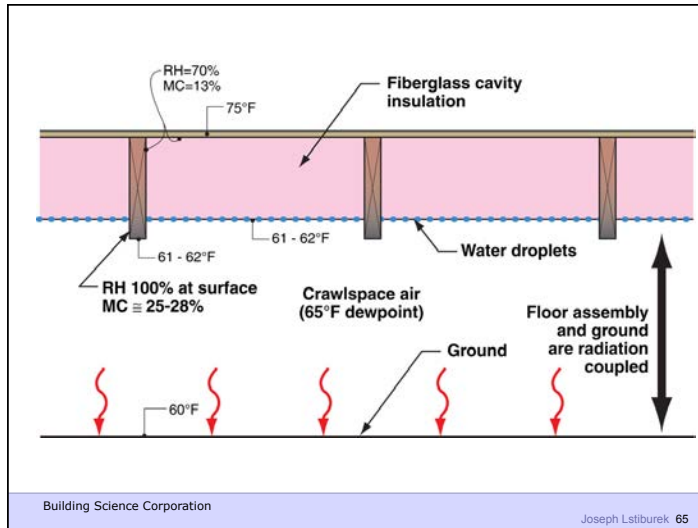


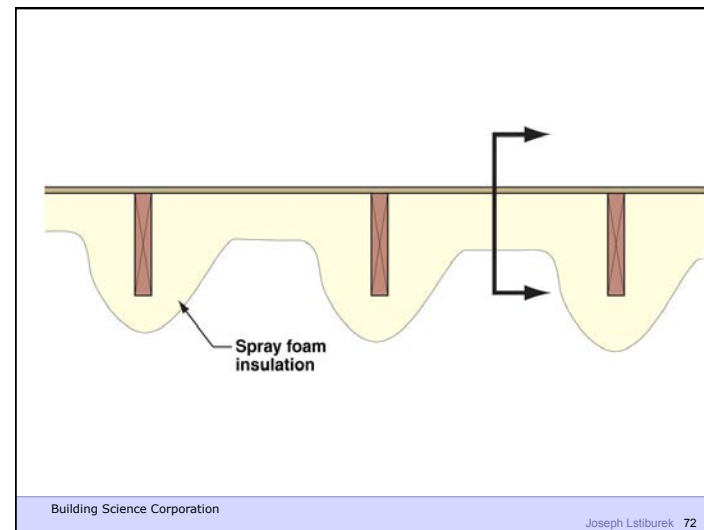
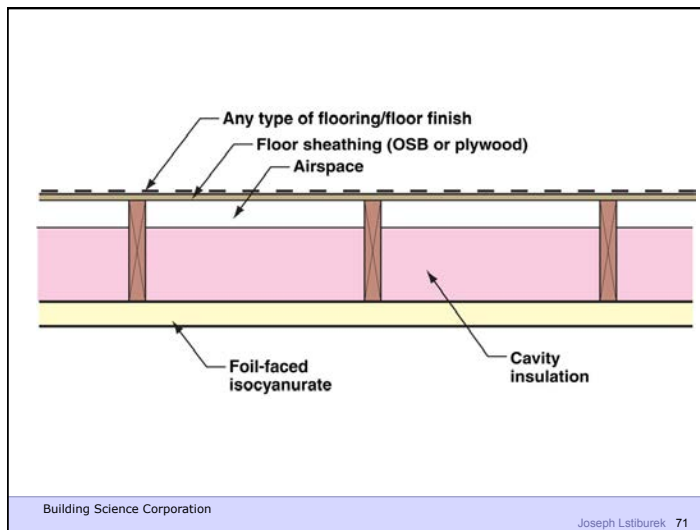
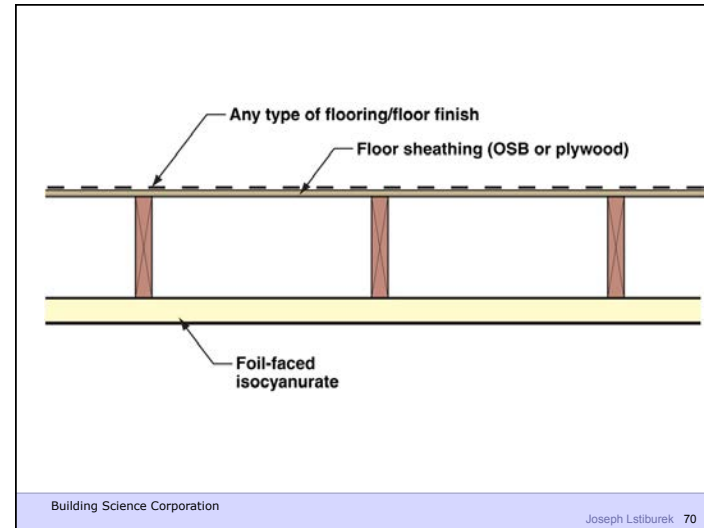
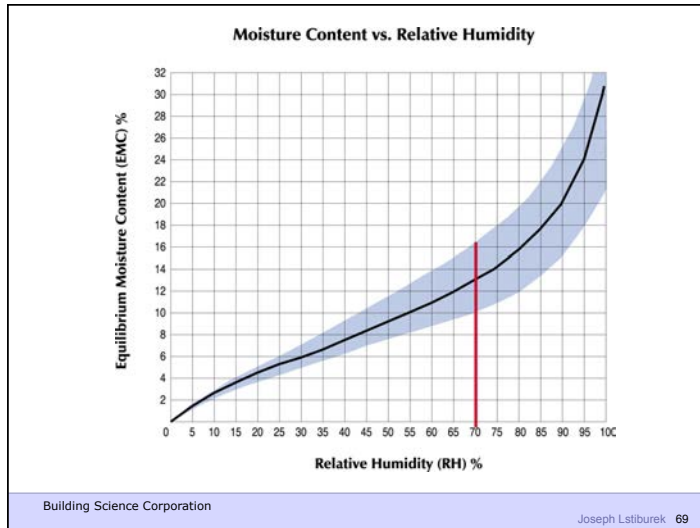


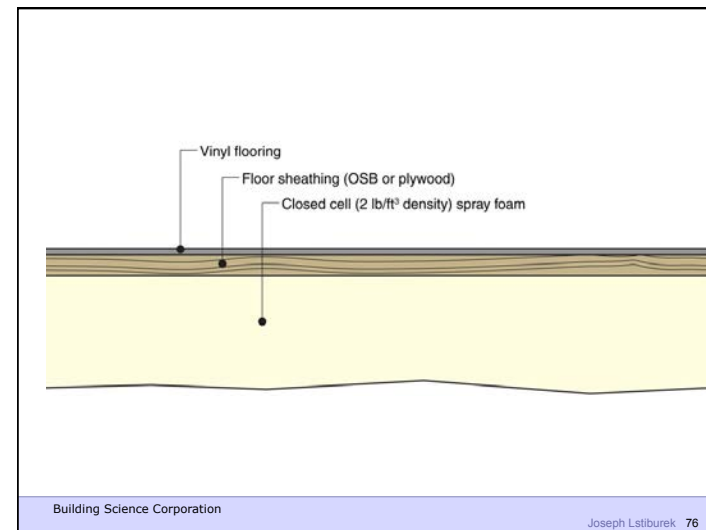
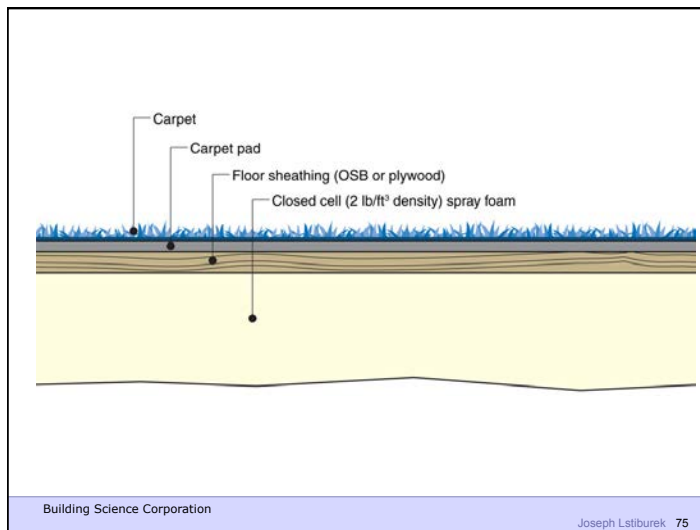
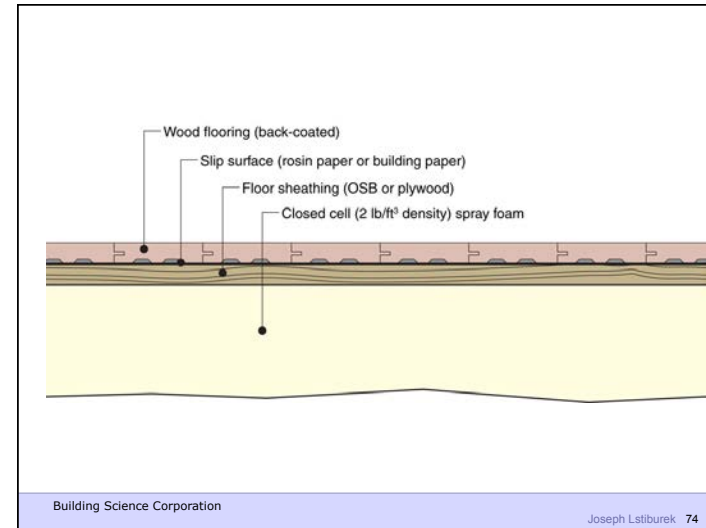
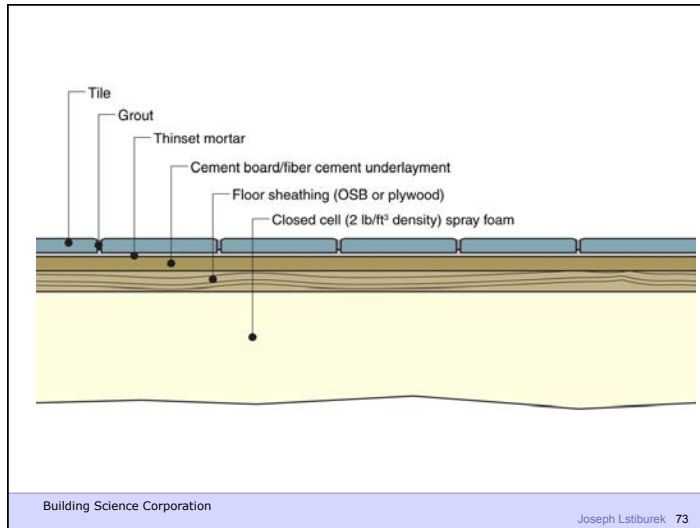












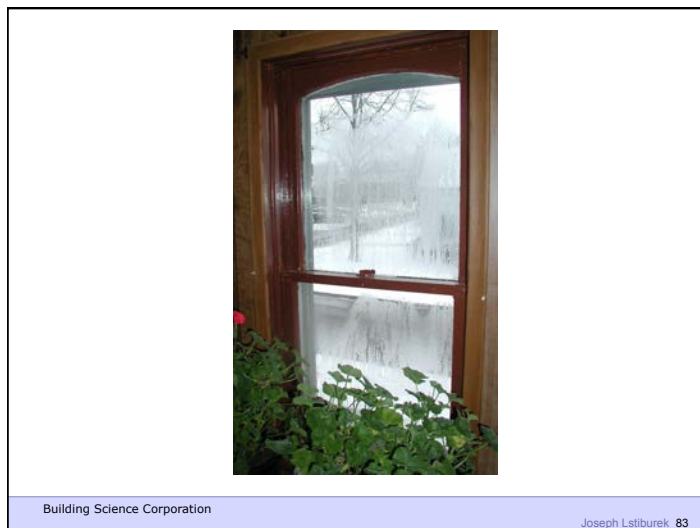
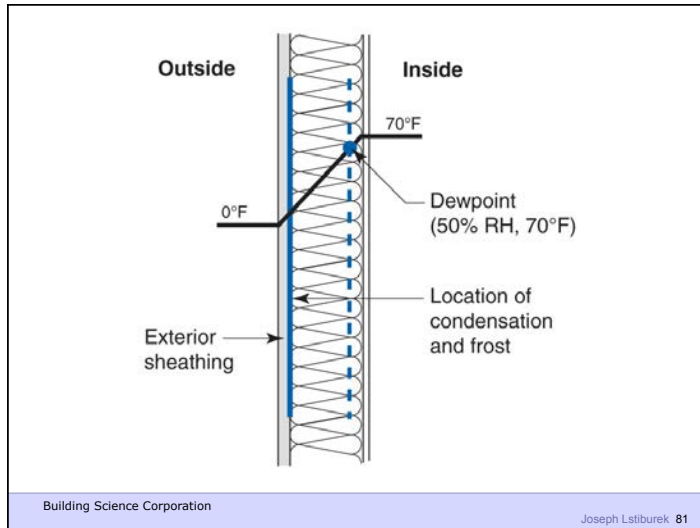
Don't Do Stupid Things Humidifiers

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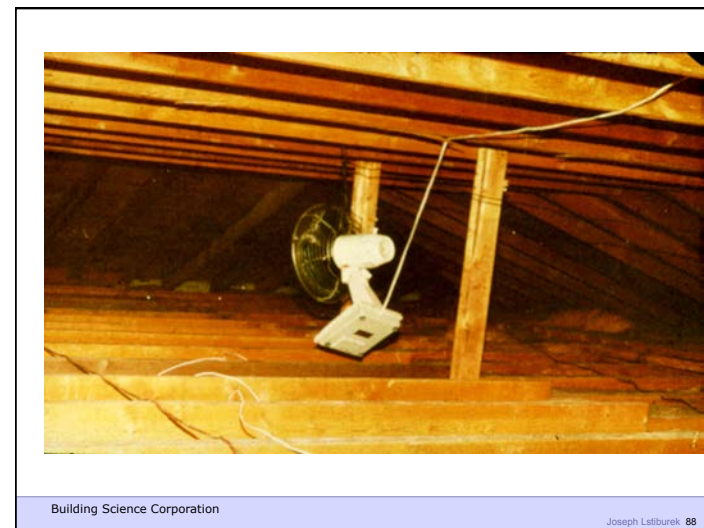
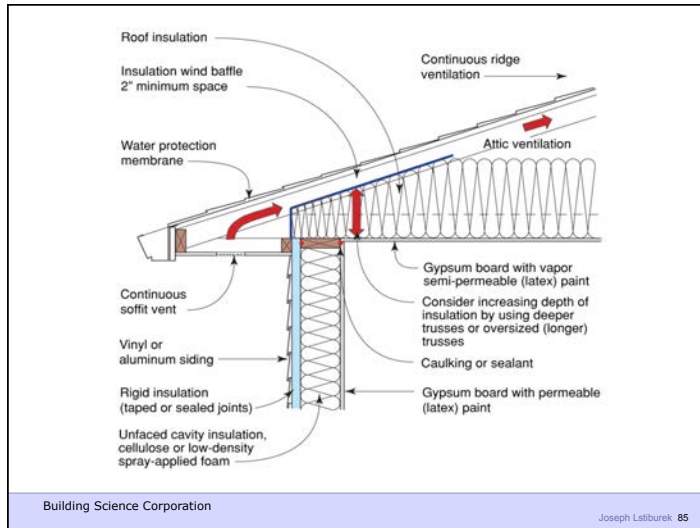
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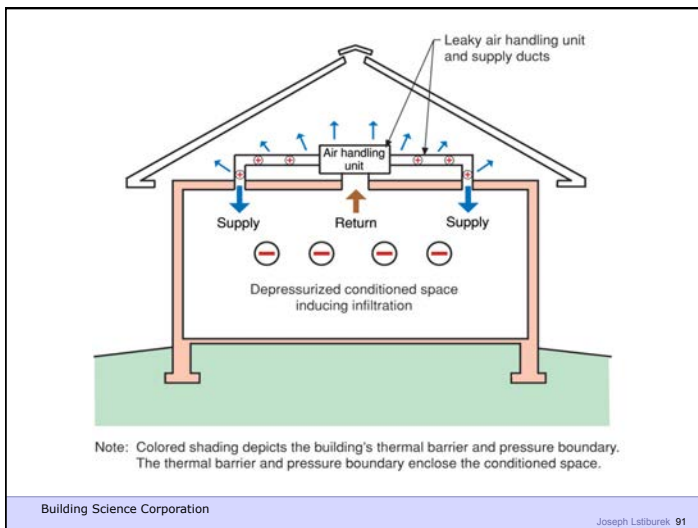
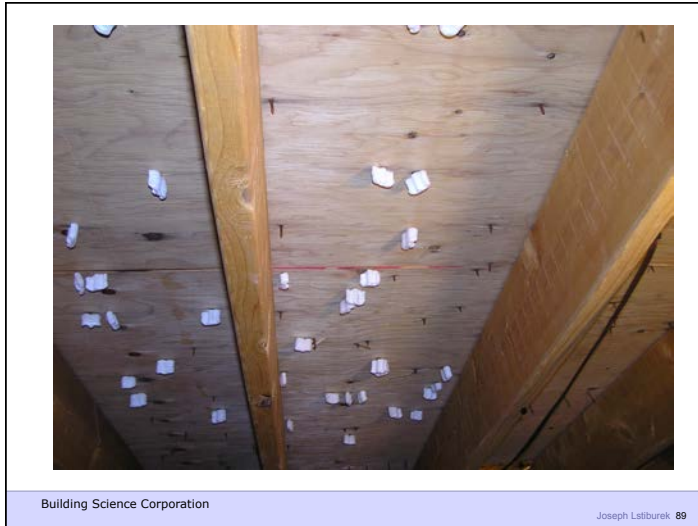
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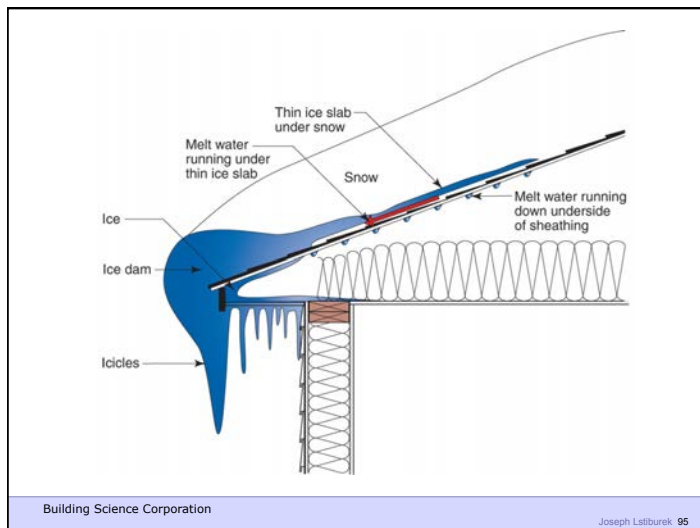
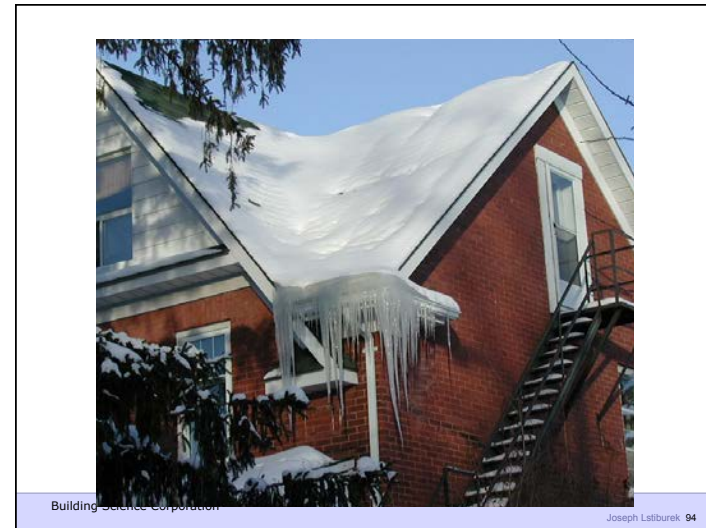


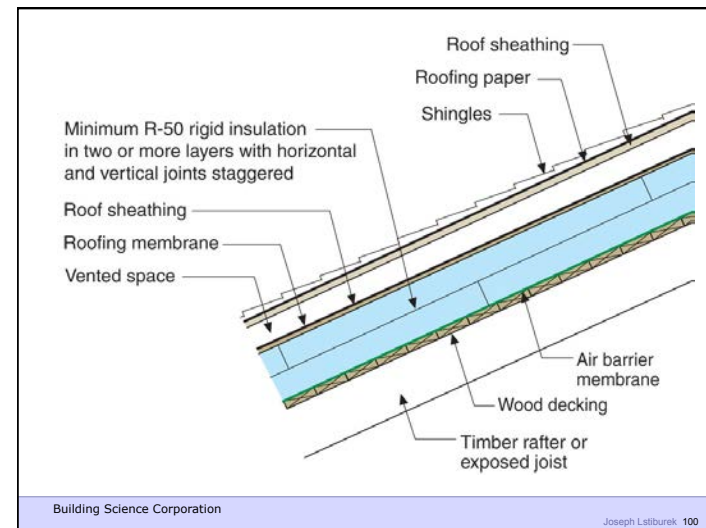
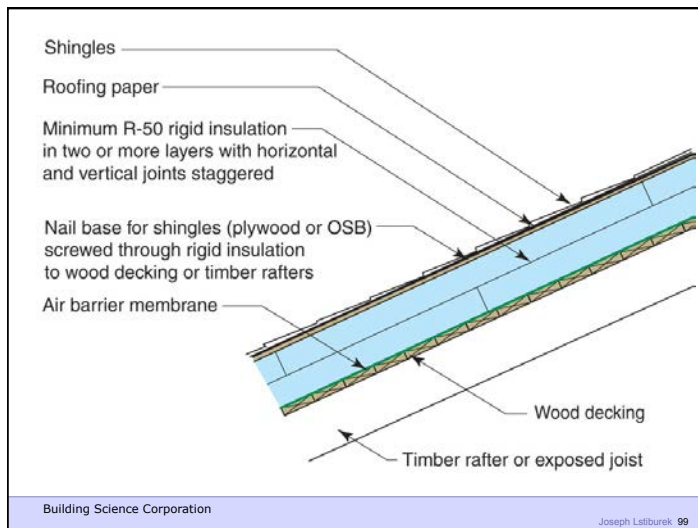
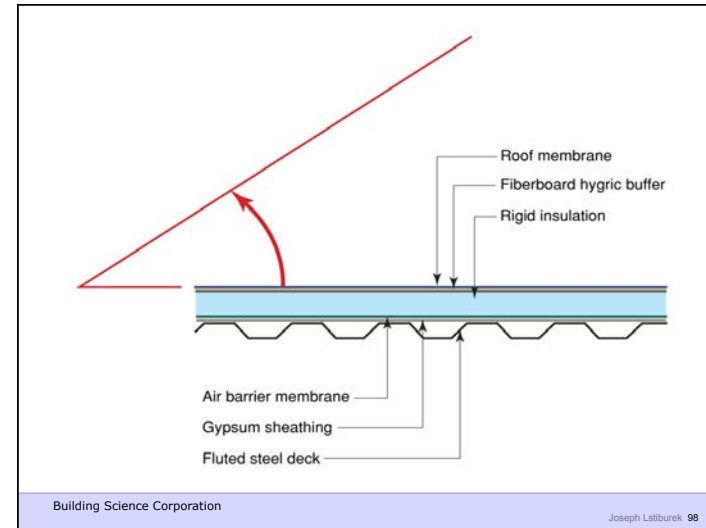
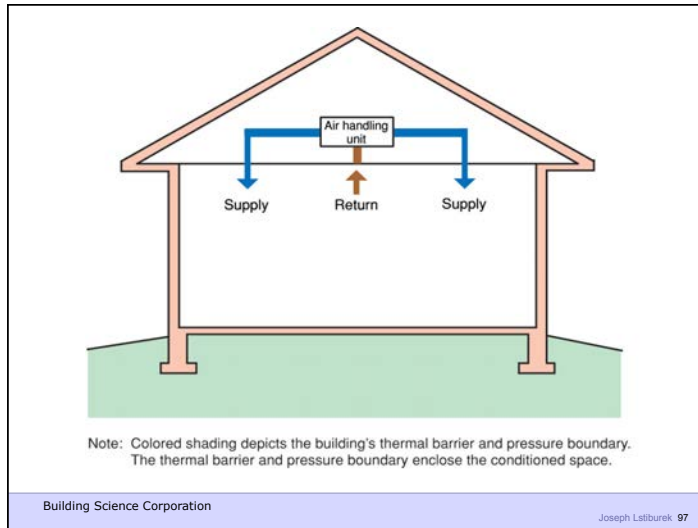
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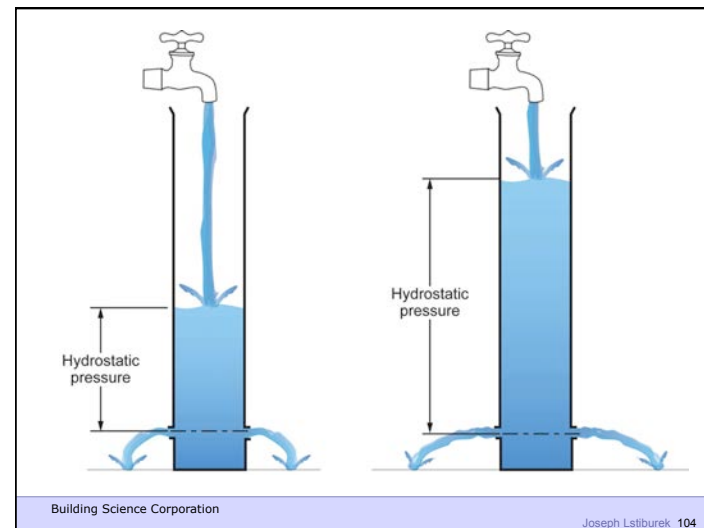
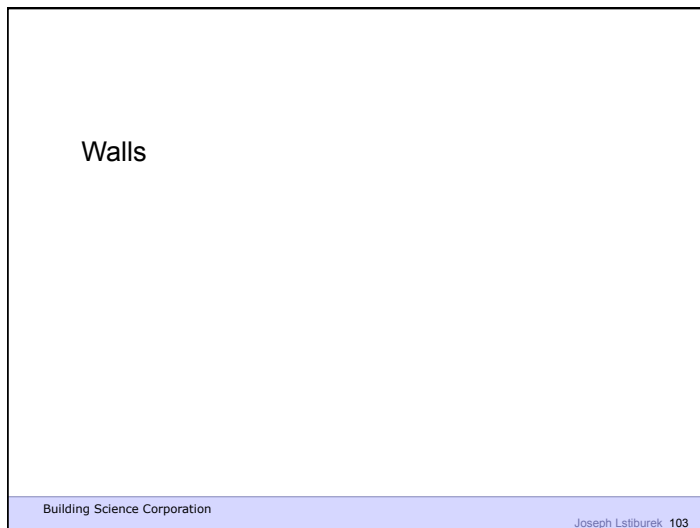
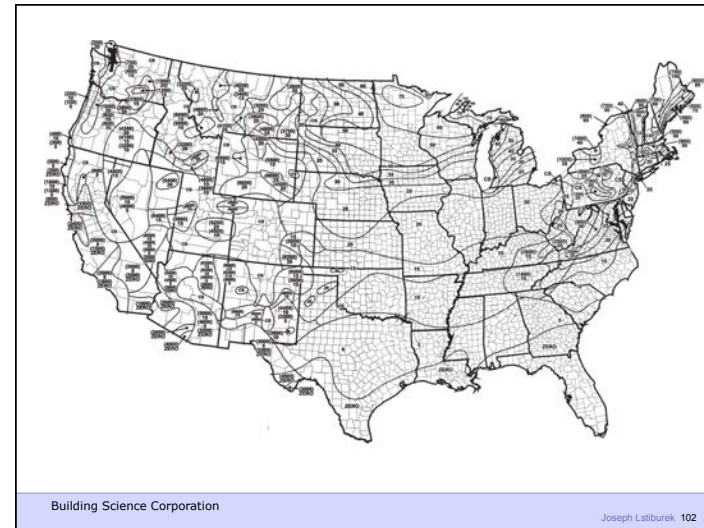
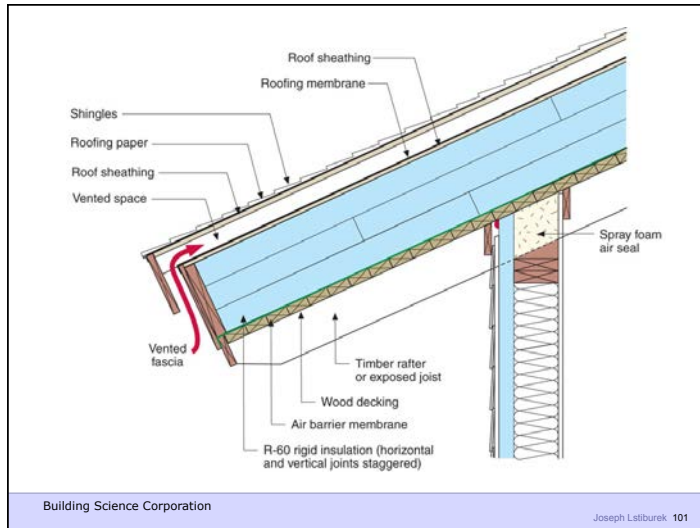
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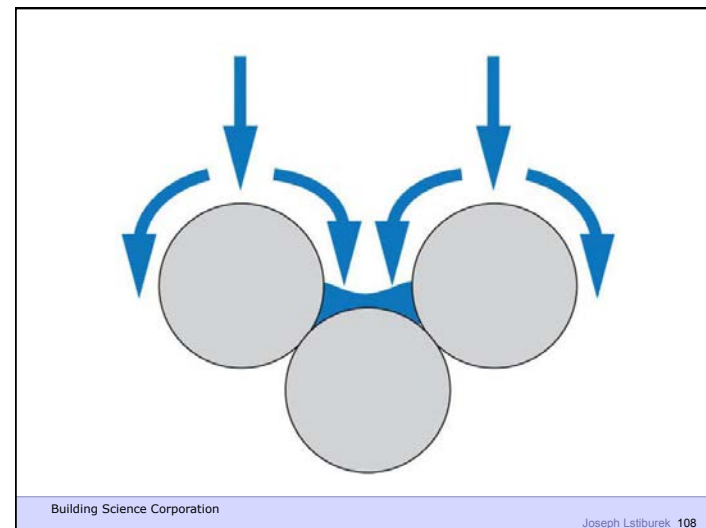
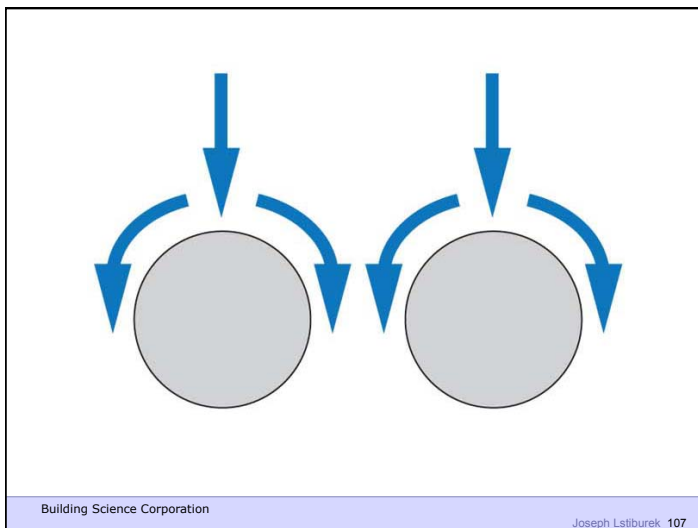
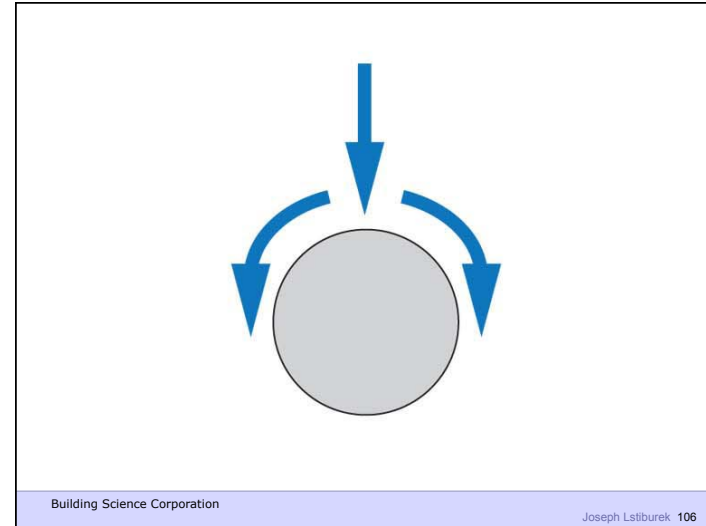
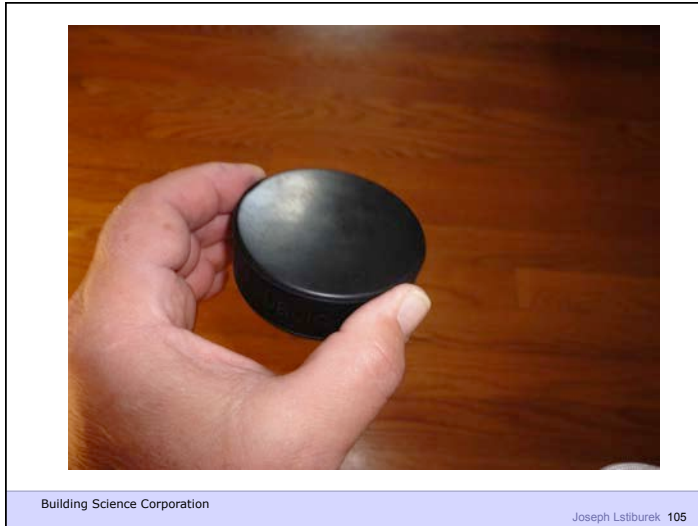


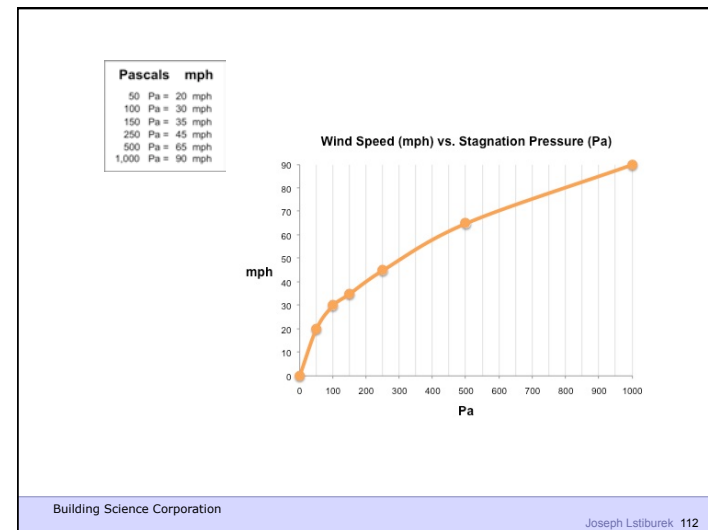
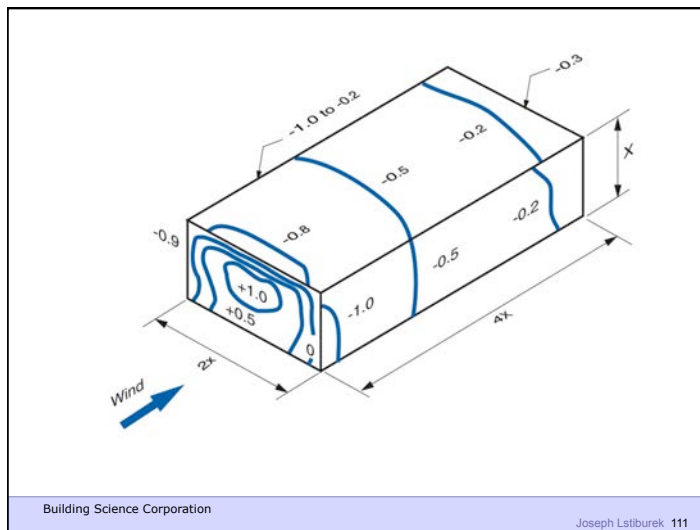
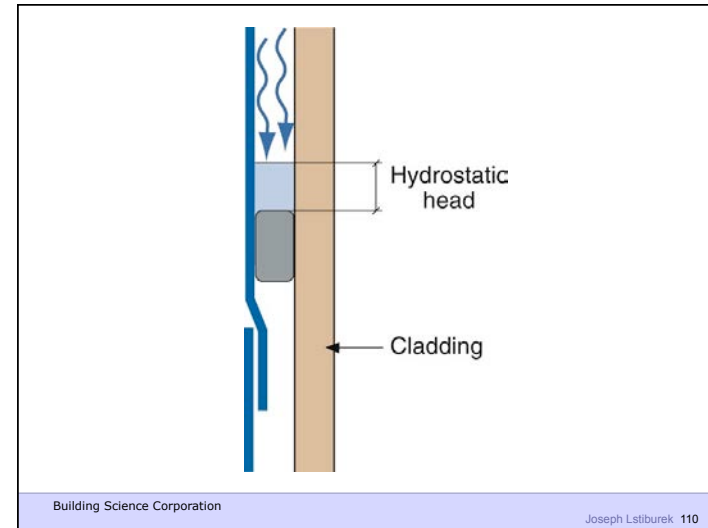
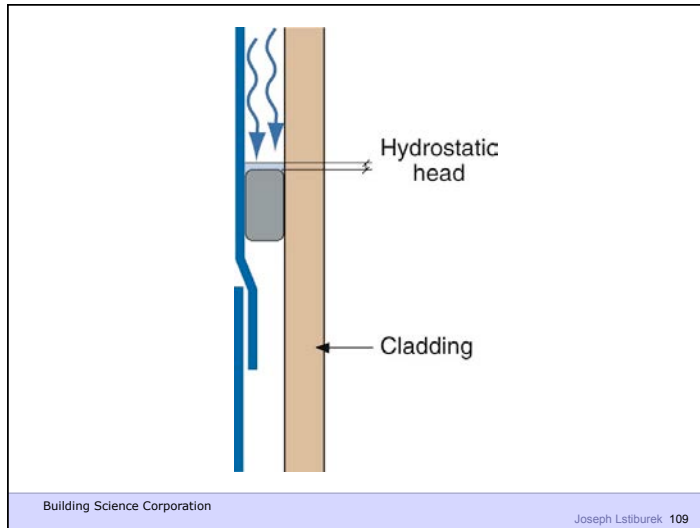


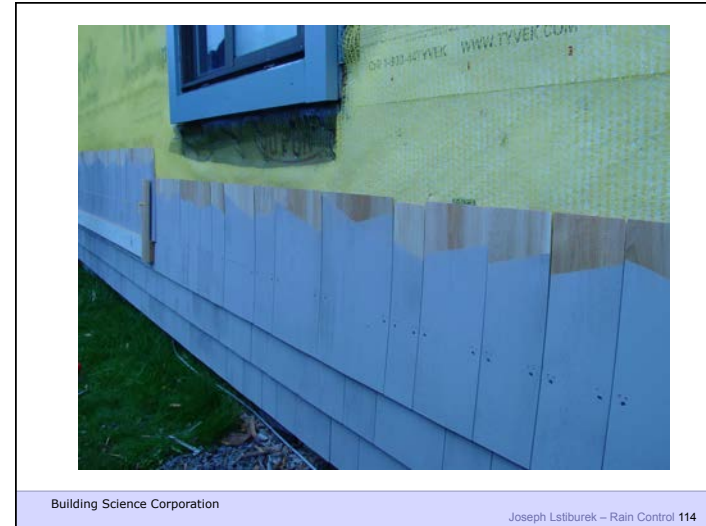


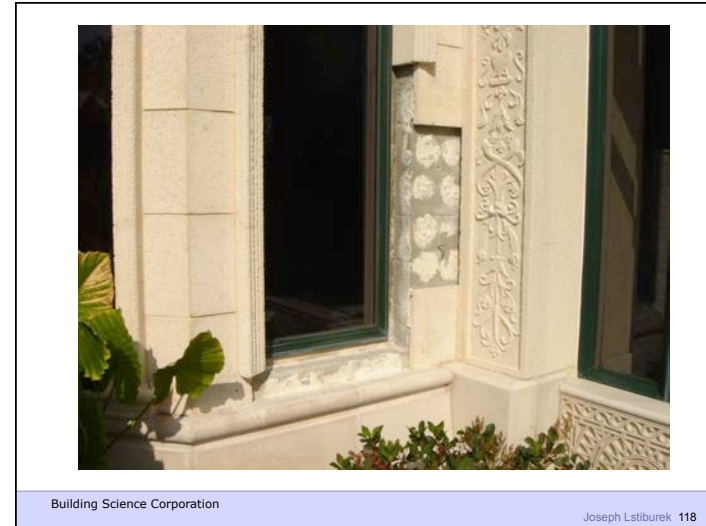
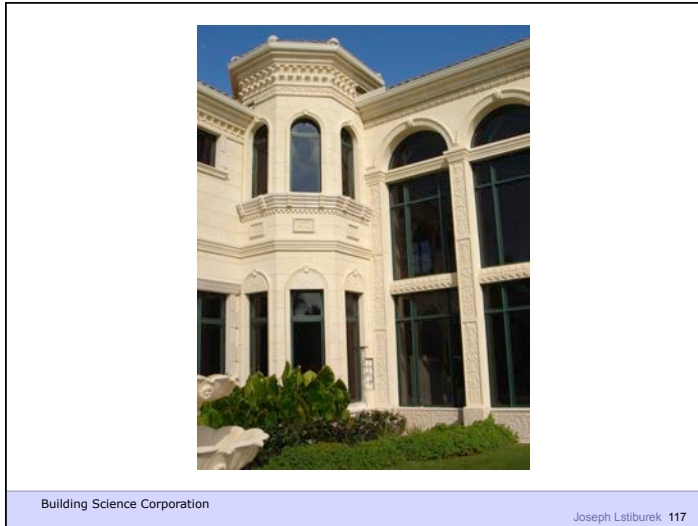


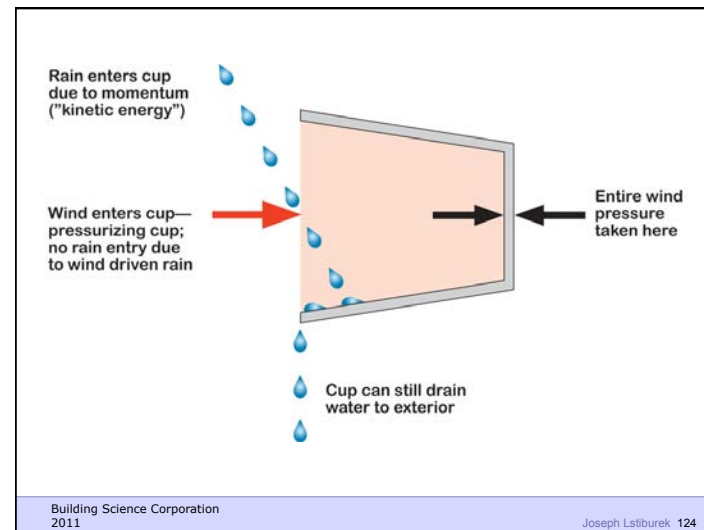
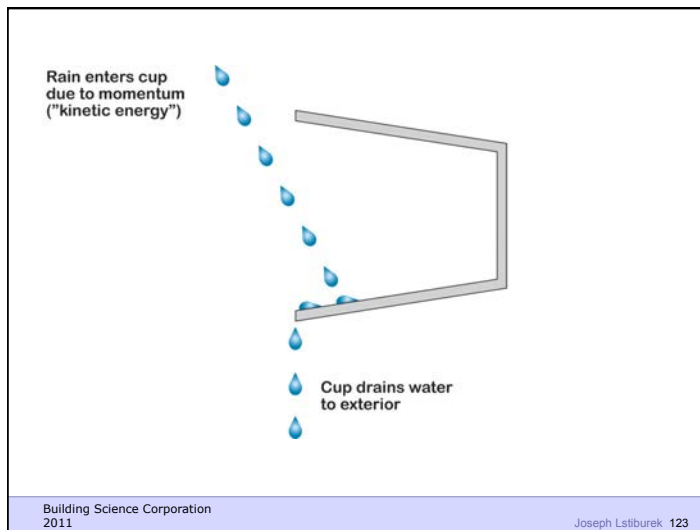
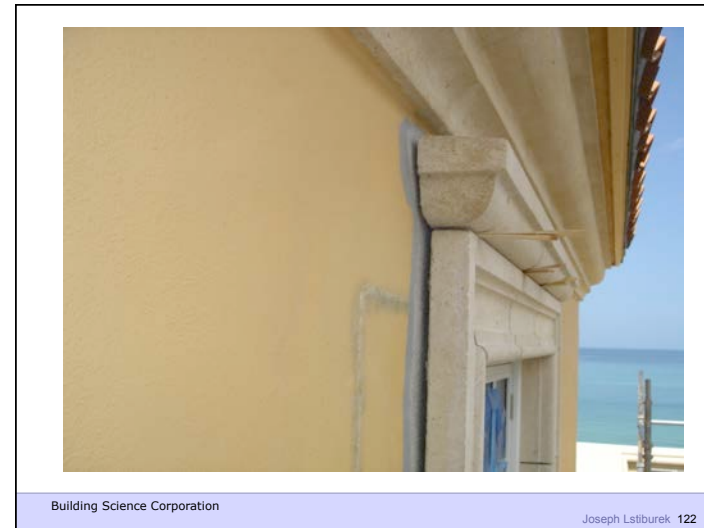
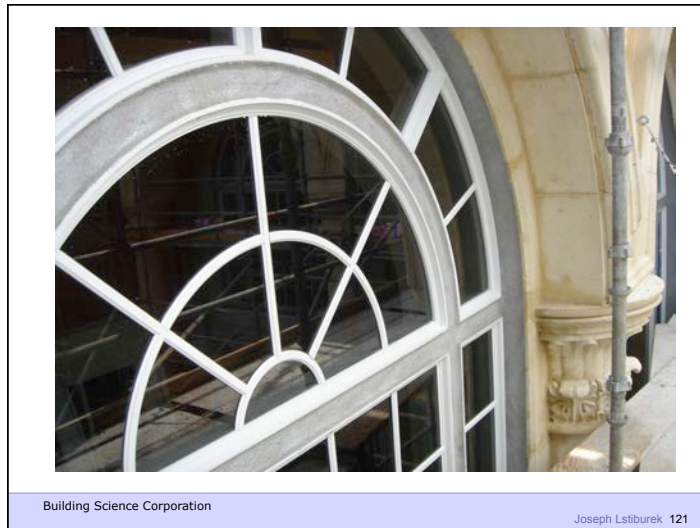


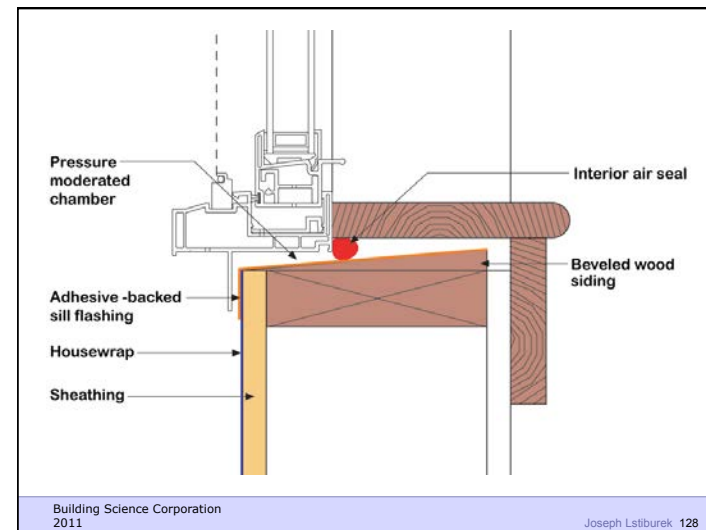
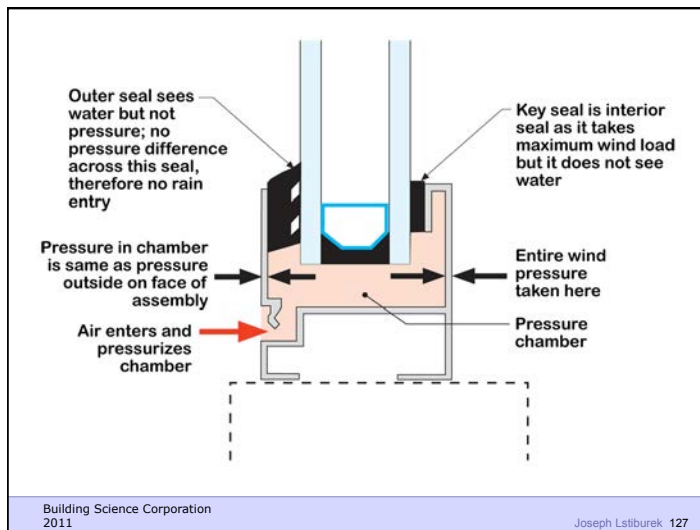
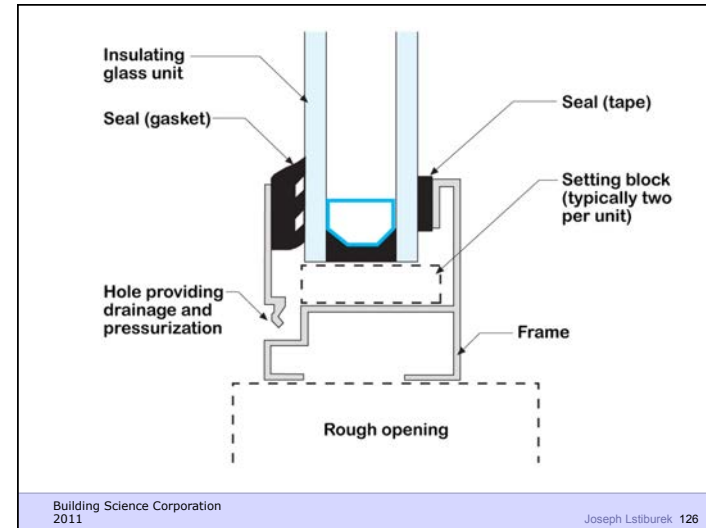
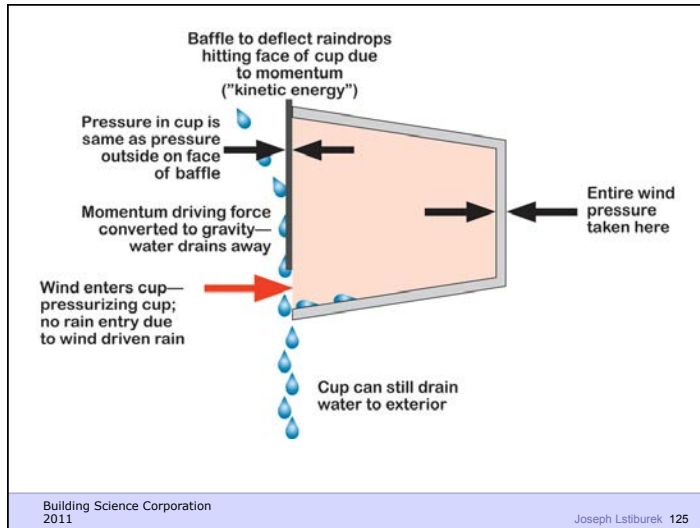


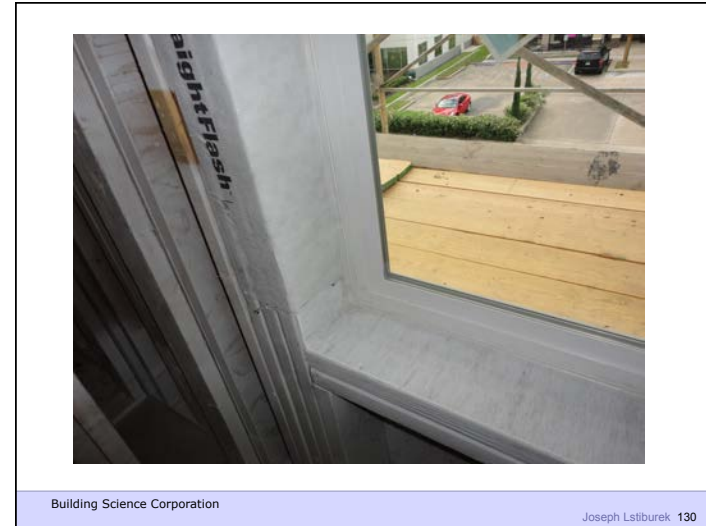


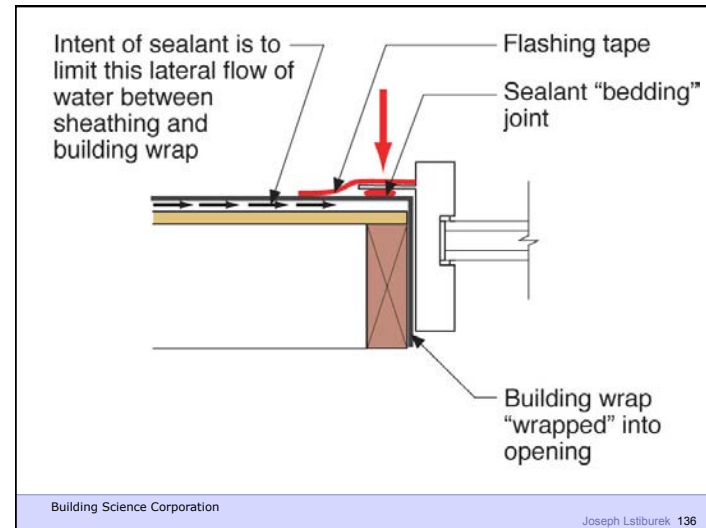


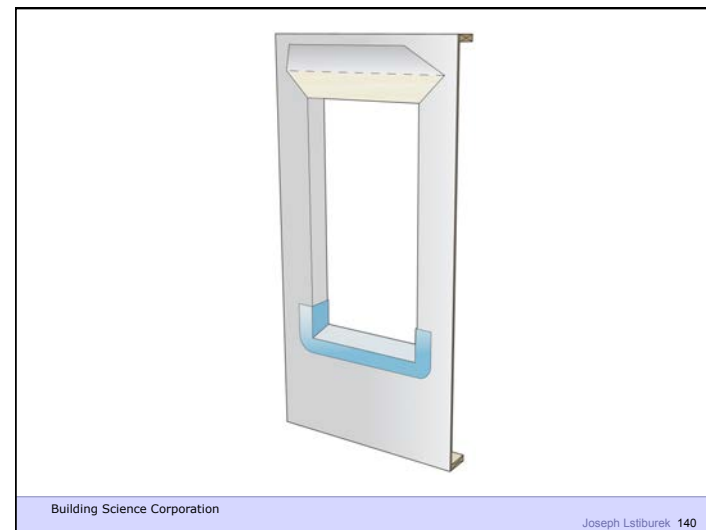
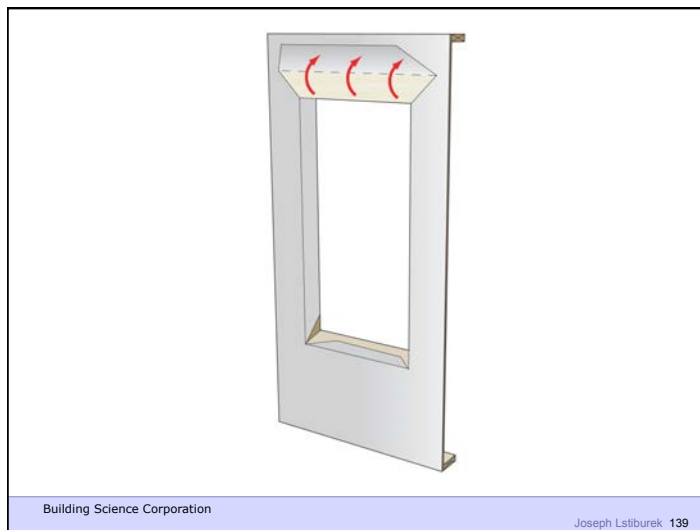
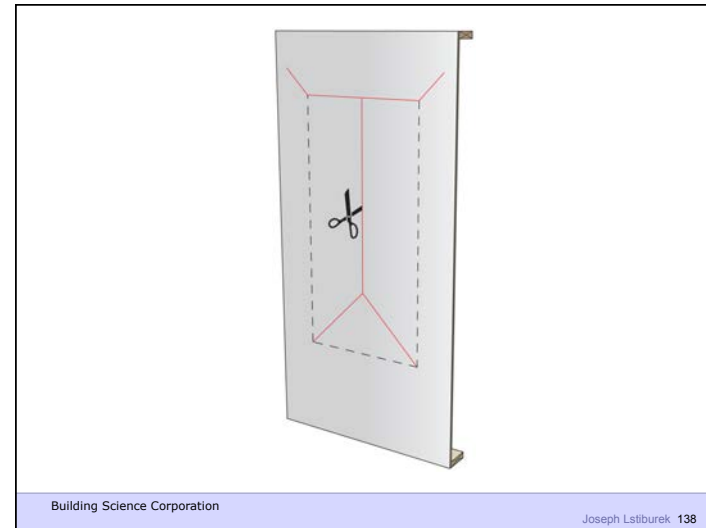
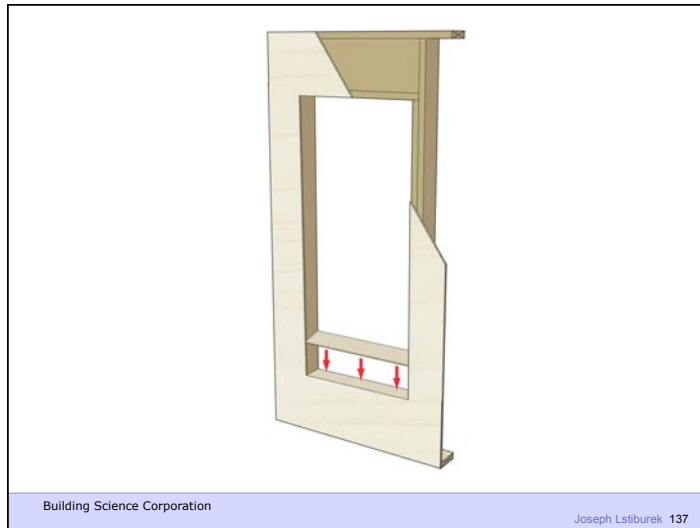


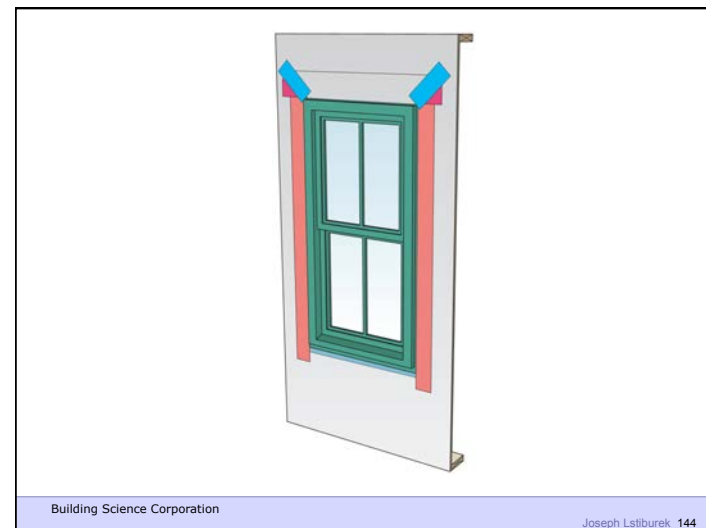
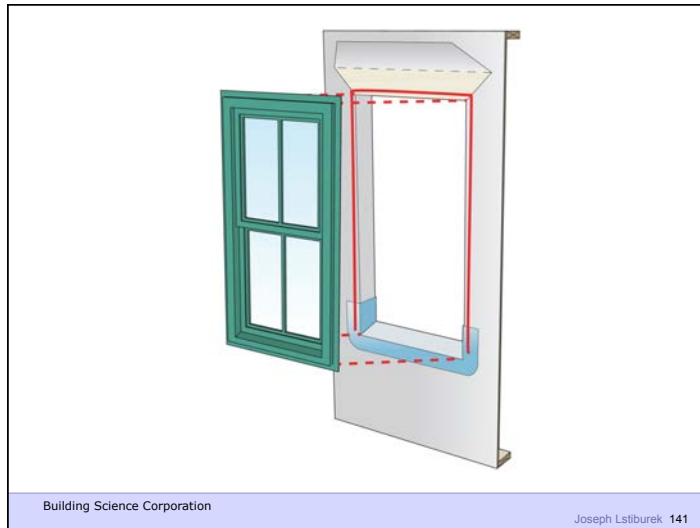




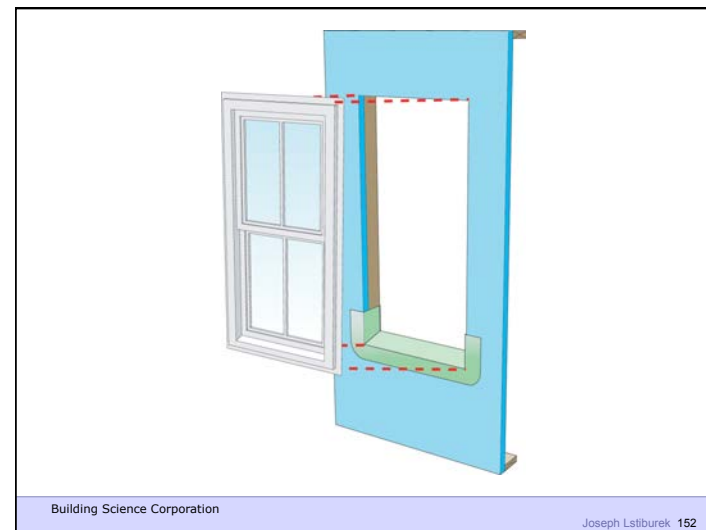
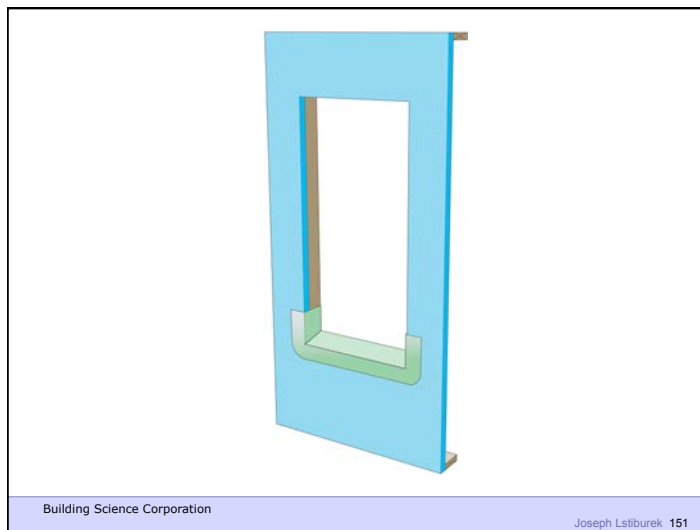
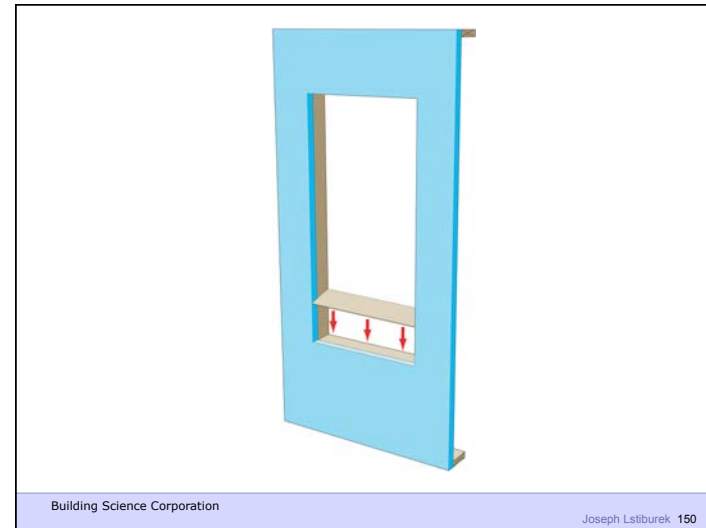
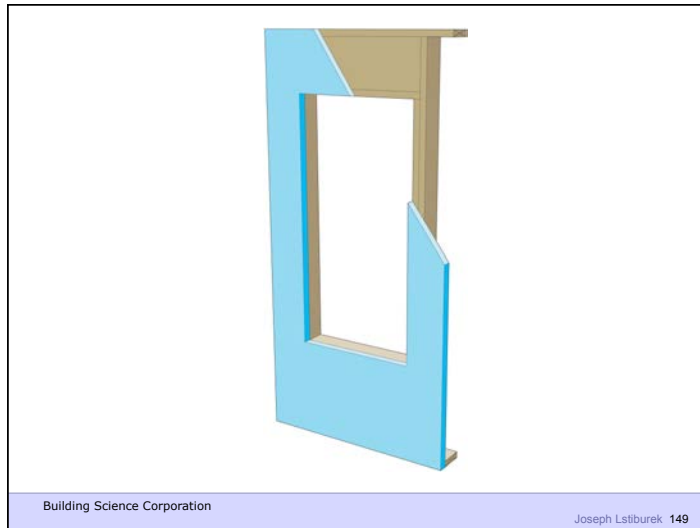






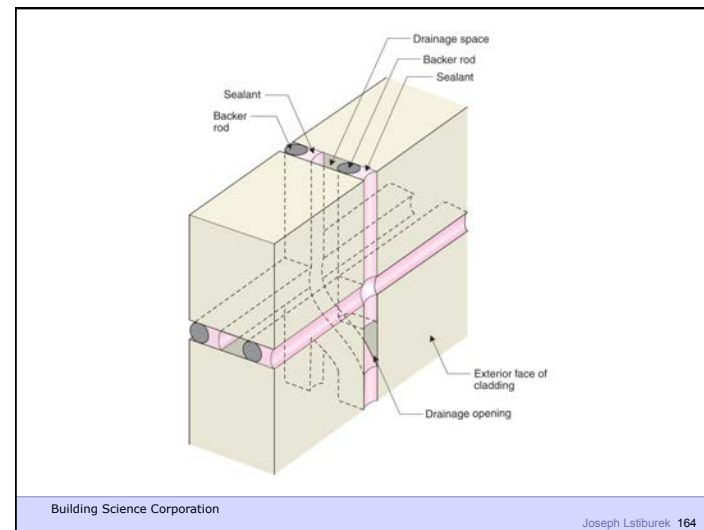
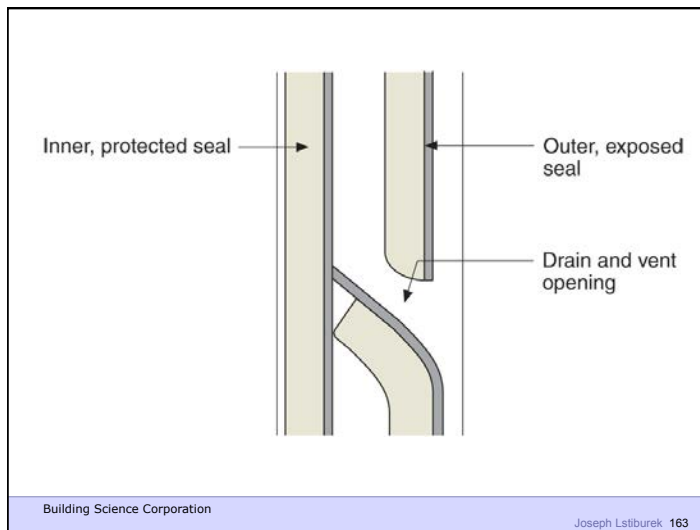
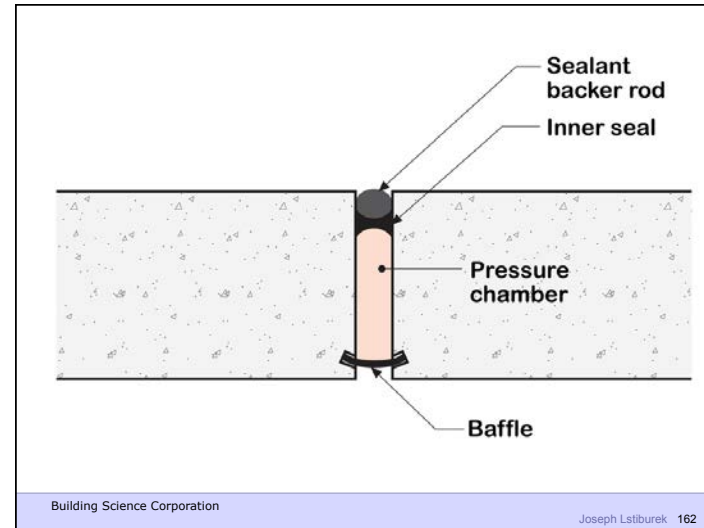
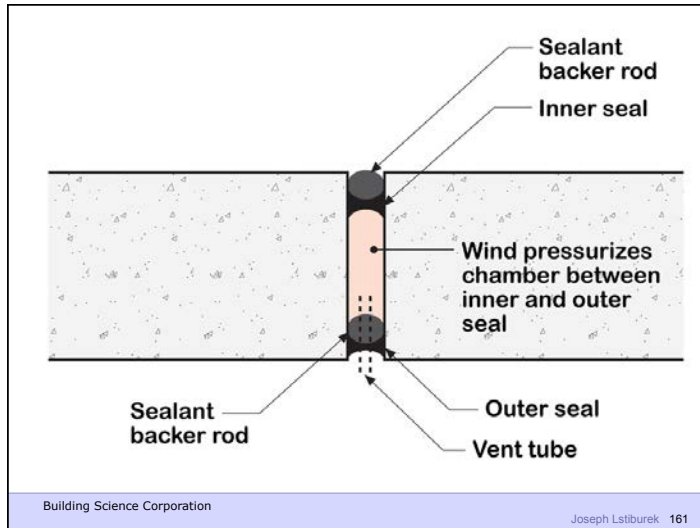


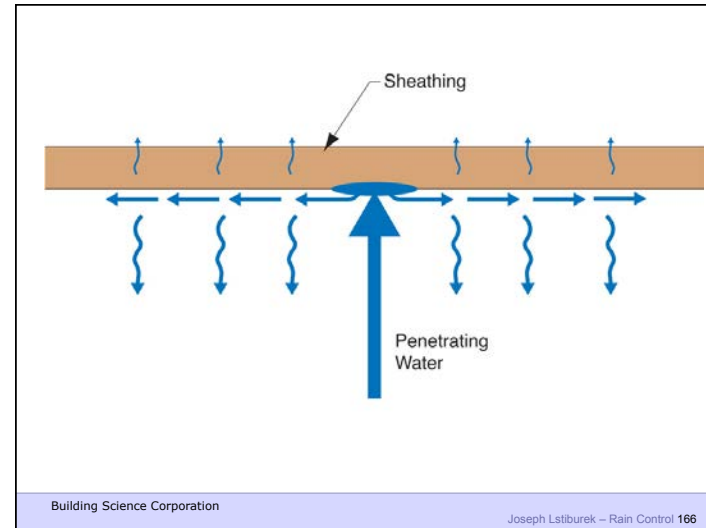
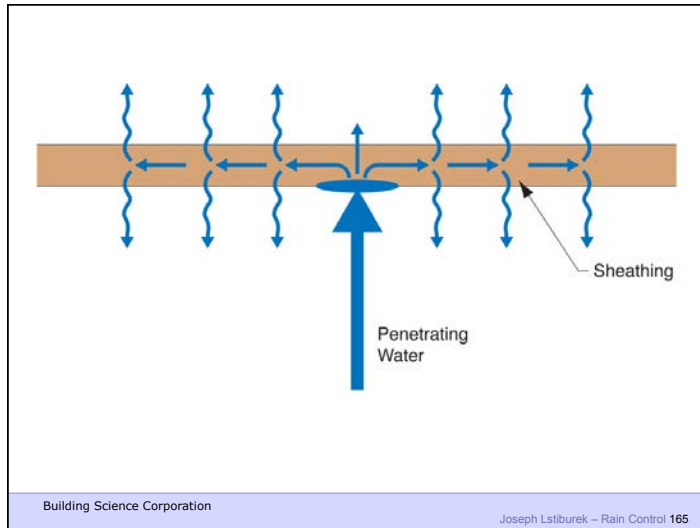


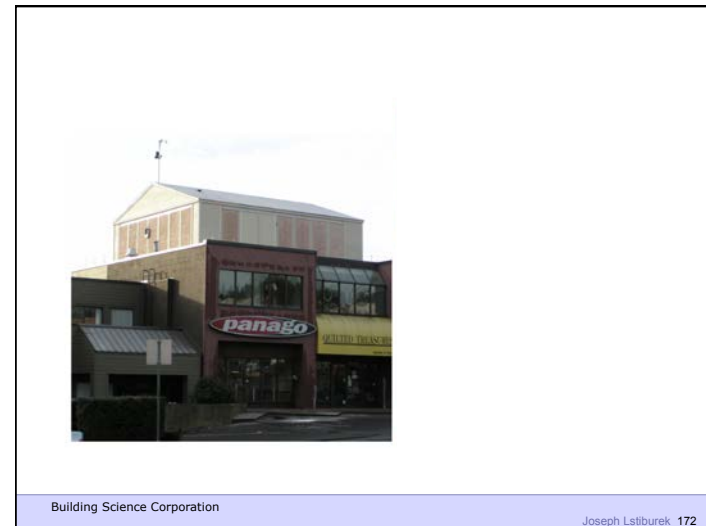
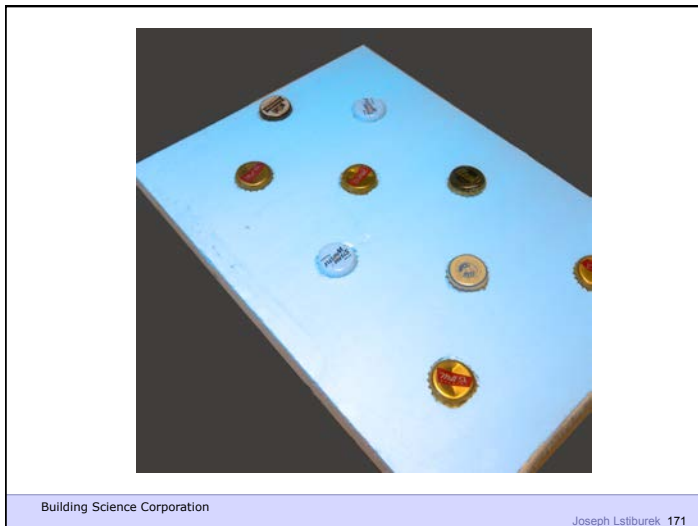
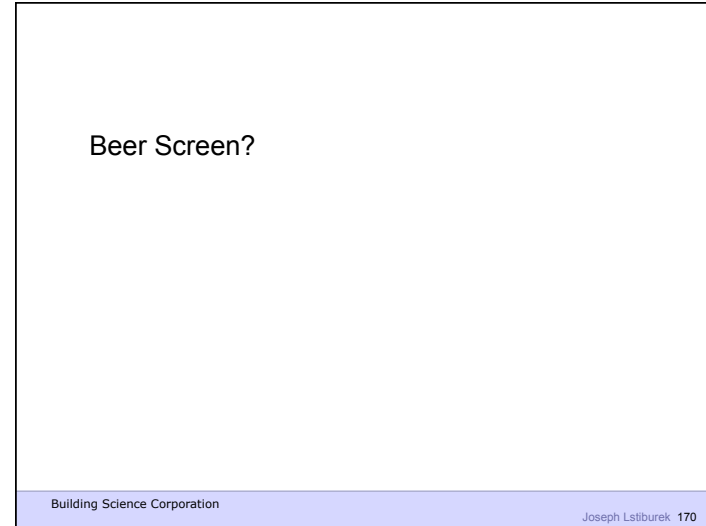


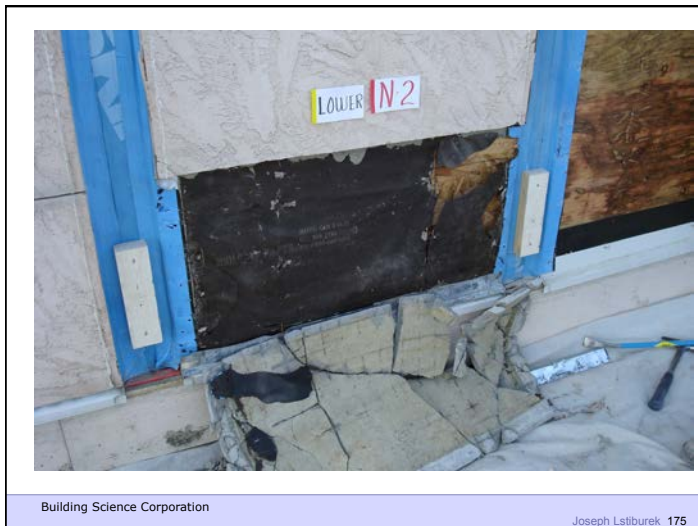
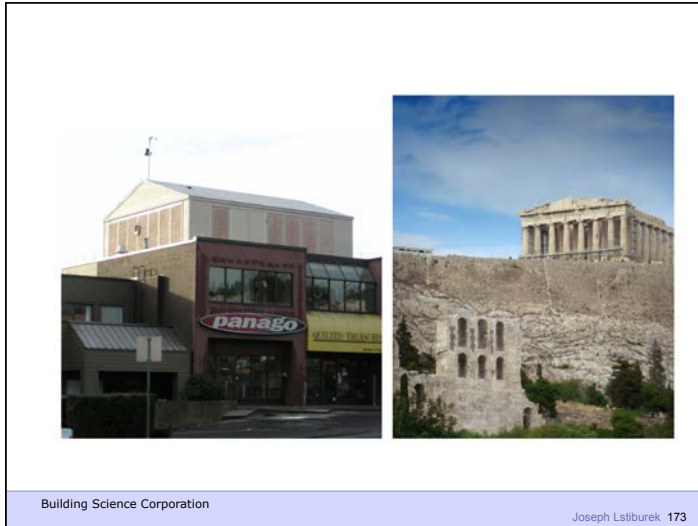






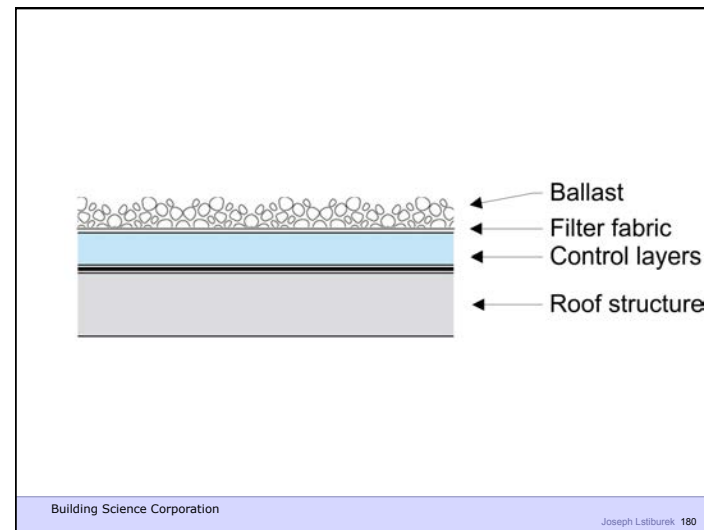
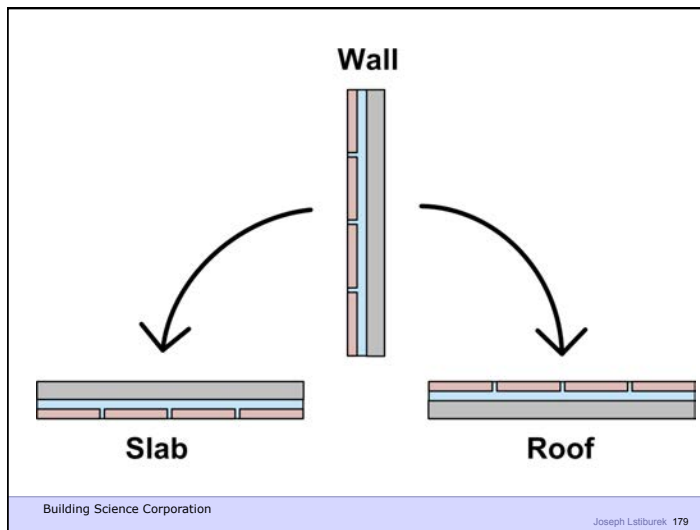
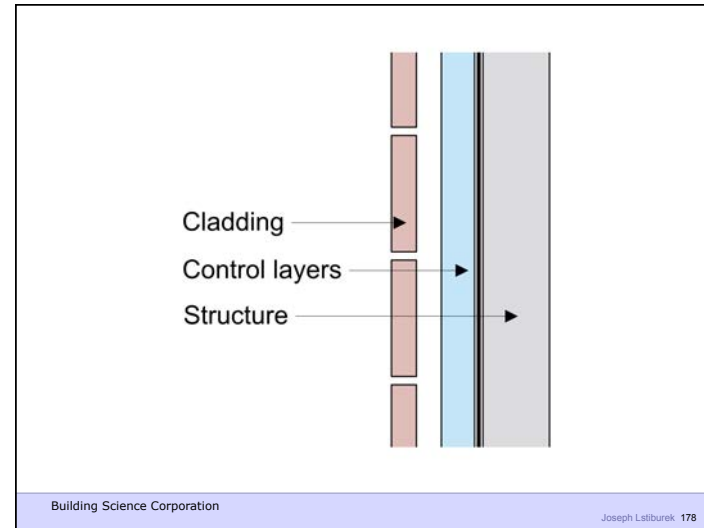


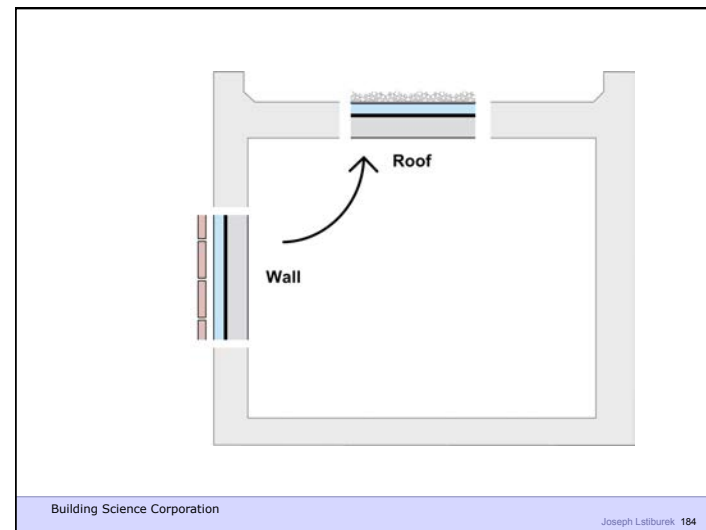
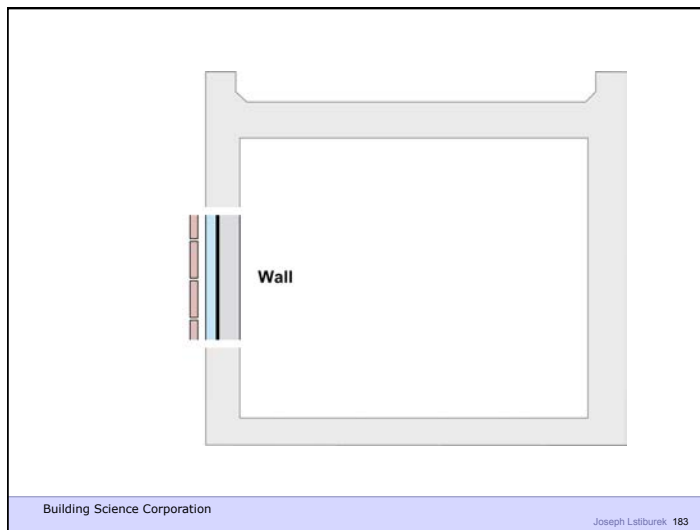
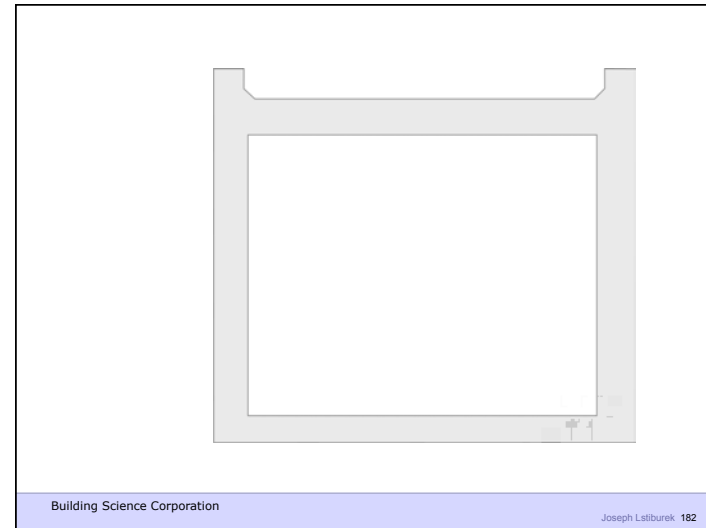
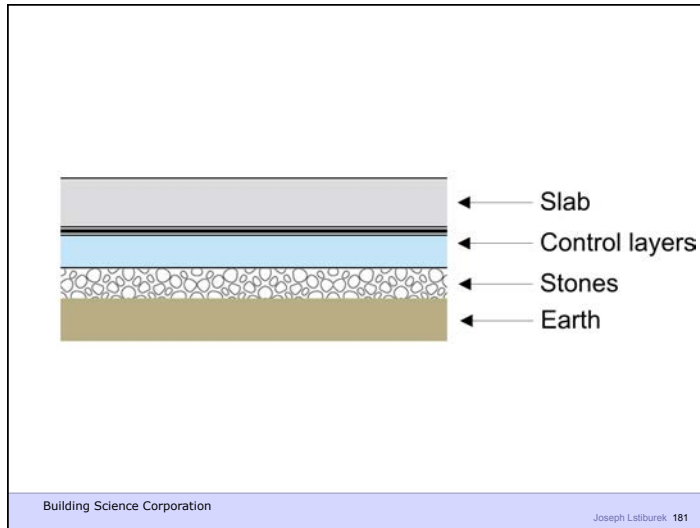


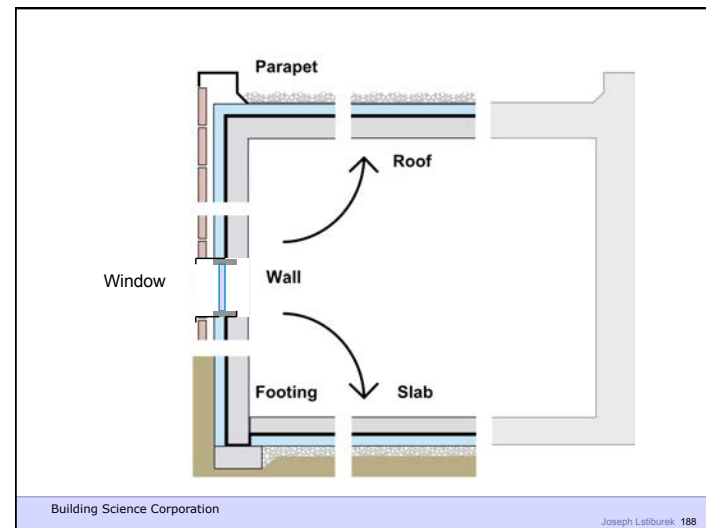
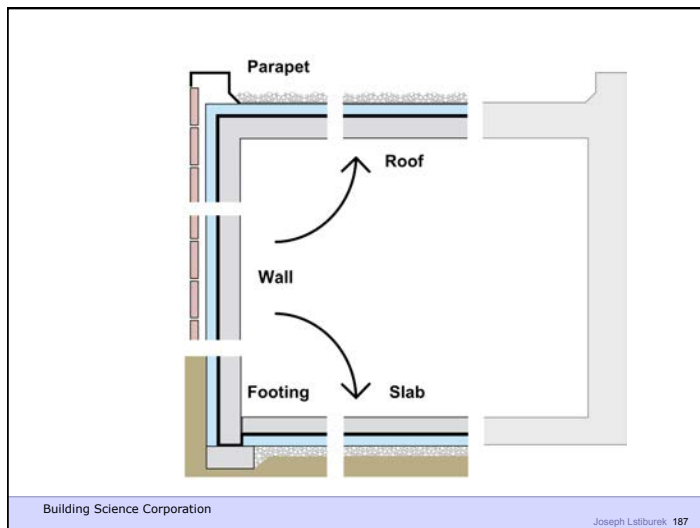
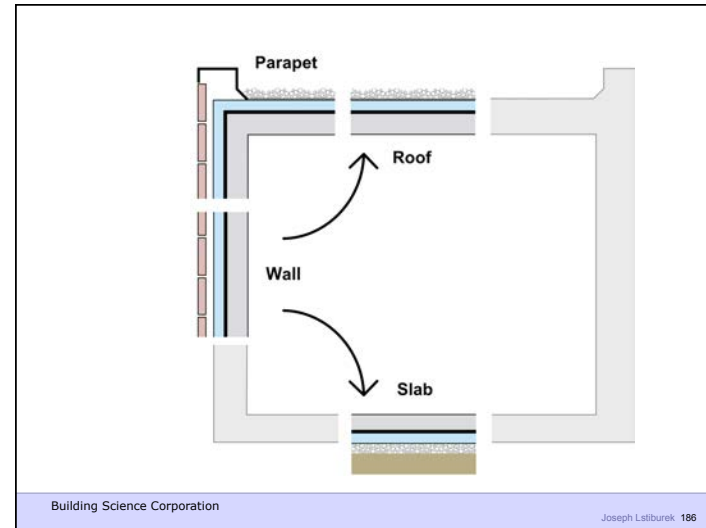
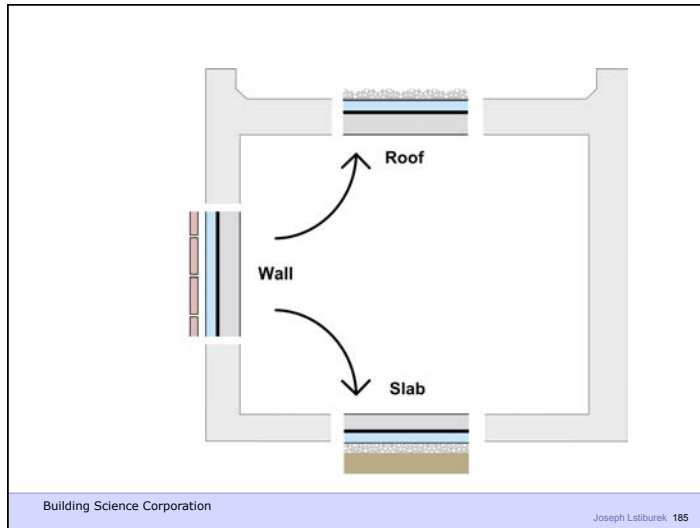


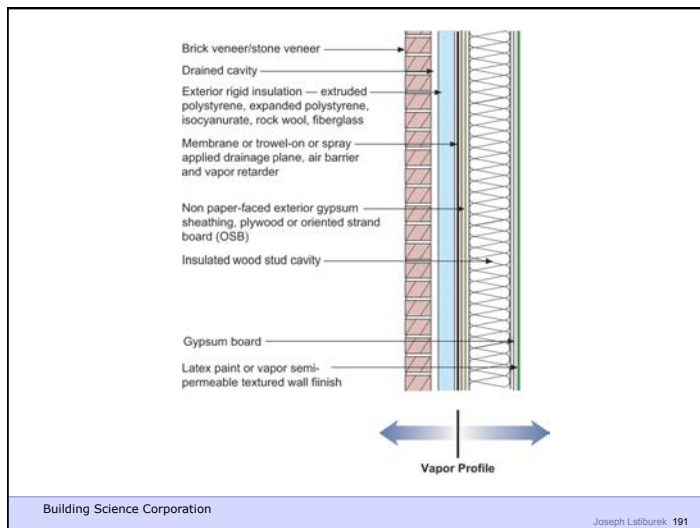
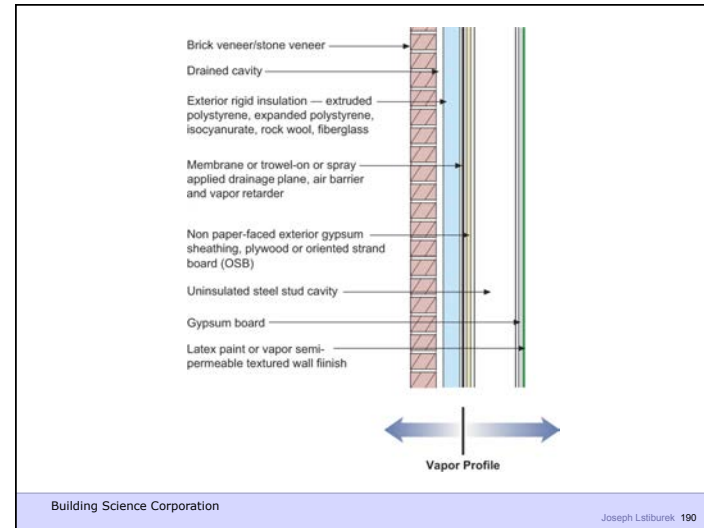
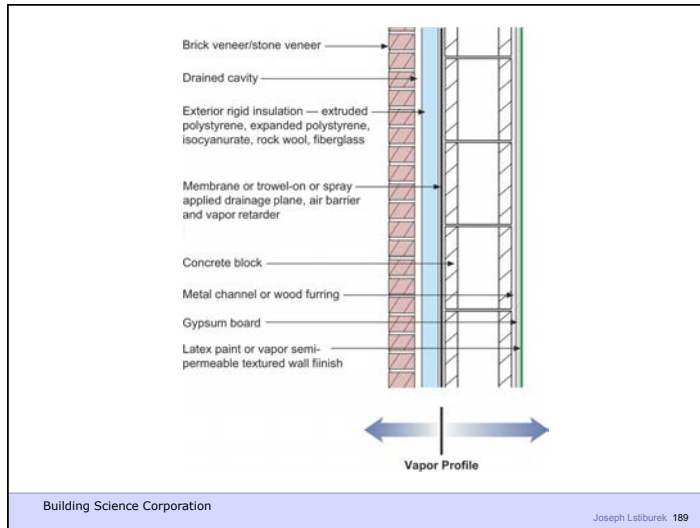
Water Control Layer
 Air Control Layer
 Vapor Control Layer
 Thermal Control Layer

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Commercial Enclosure: Simple Layers

- Structure
- Rain/Air/Vapor
- Insulation
- Finish

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