

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

# Building Science

## Adventures In Building Science

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"It isn't what we don't know that gives us trouble, it's what we know that ain't so"

Will Rogers

"There are known knowns. These are things we know. There are known unknowns. There are things that we know we don't know. But there are also unknown unknowns. There are things we don't know we don't know.

Donald Rumsfeld

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# What is a Building?

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# A Building is an Environmental Separator

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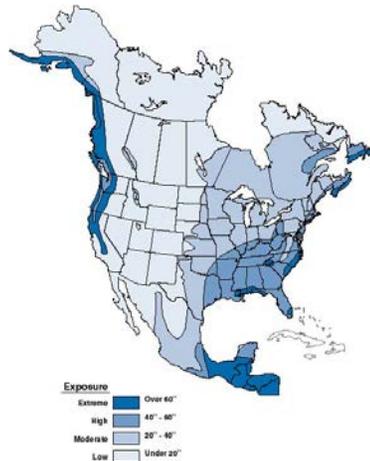
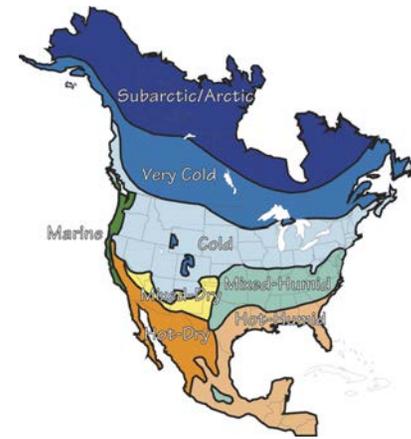
Buildings Can Dry To The Outside  
Buildings Can Dry To The Inside  
Buildings Can Dry To Both Sides

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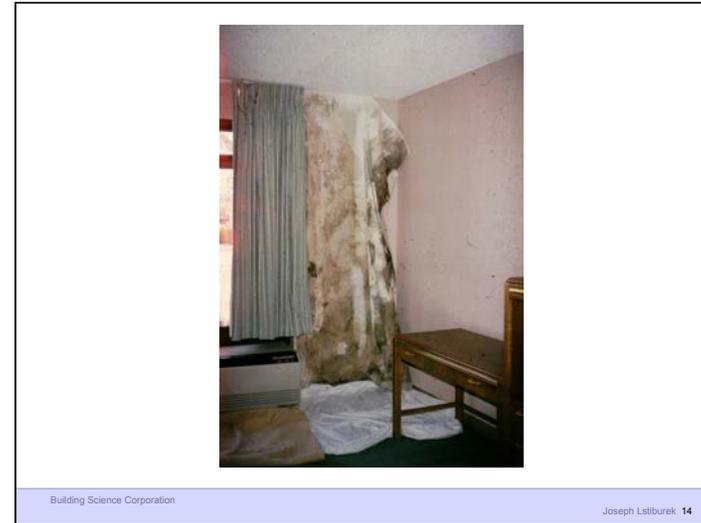
2<sup>nd</sup> Law of Thermodynamics

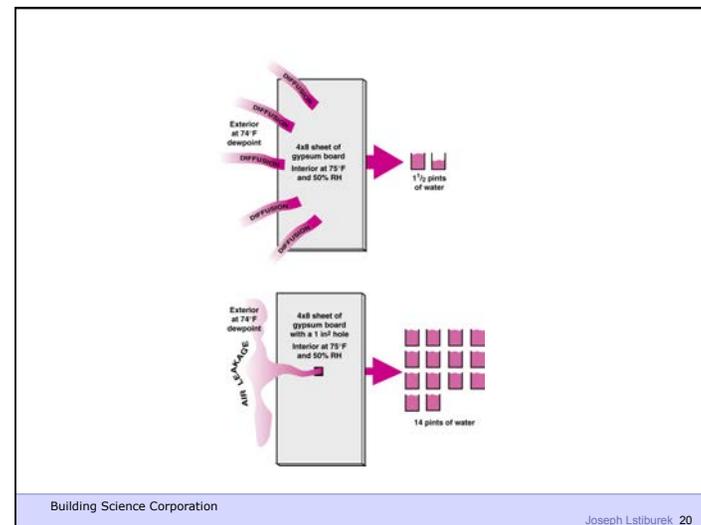
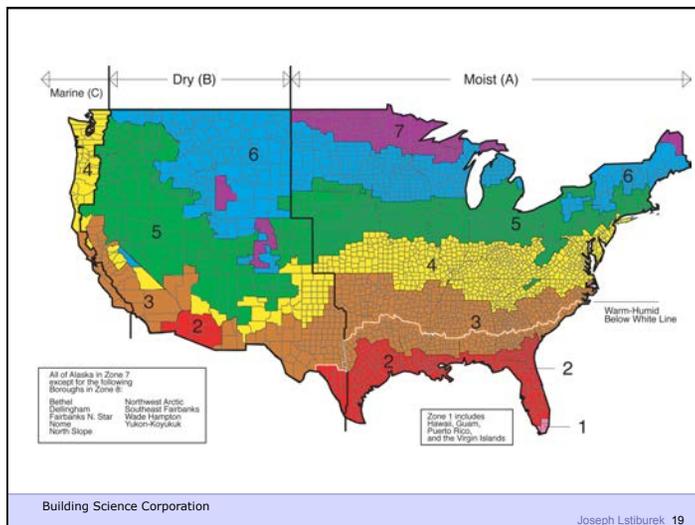
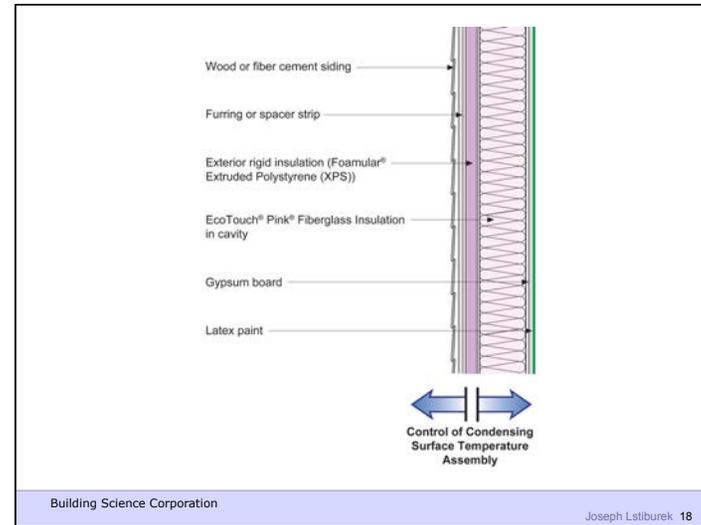
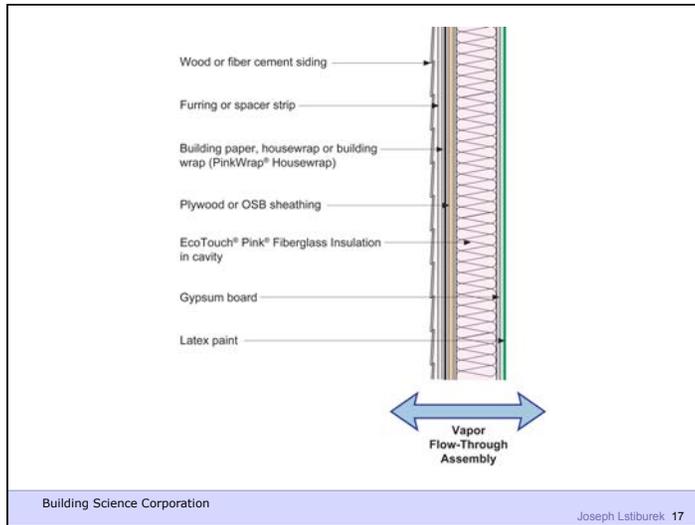
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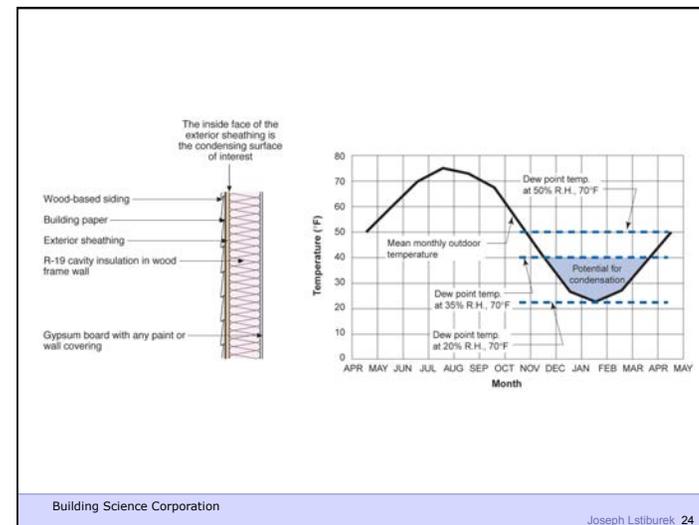
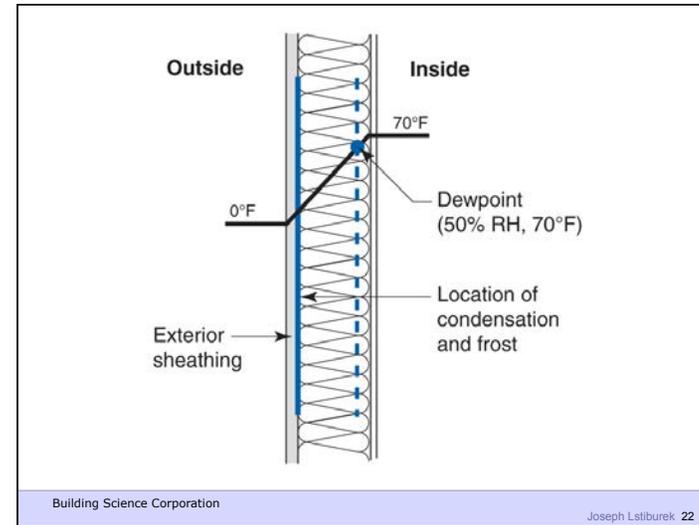
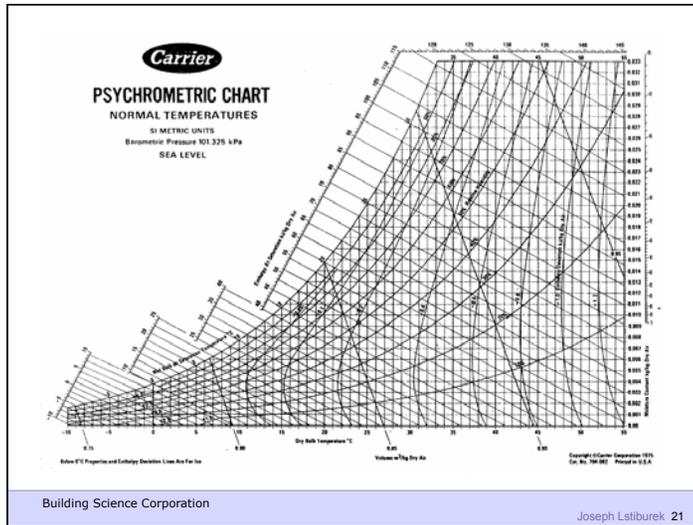
Heat Flow Is From Warm To Cold  
 Moisture Flow Is From Warm To Cold  
 Moisture Flow Is From More To Less  
 Air Flow Is From A Higher Pressure to a Lower Pressure  
 Gravity Acts Down

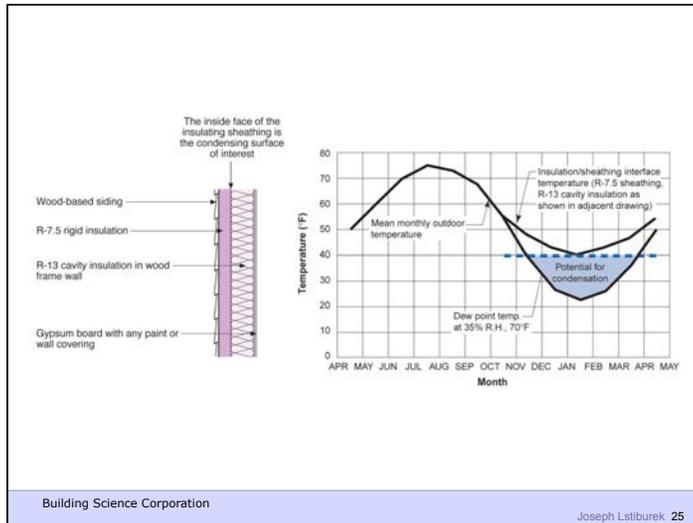


Don't Do Stupid Things









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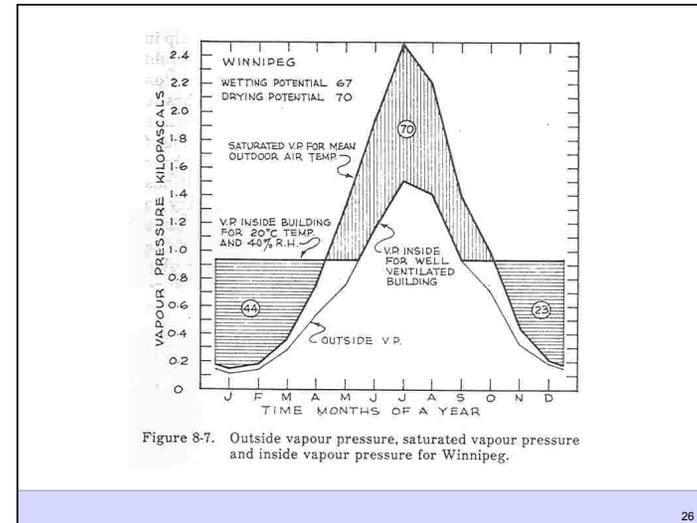
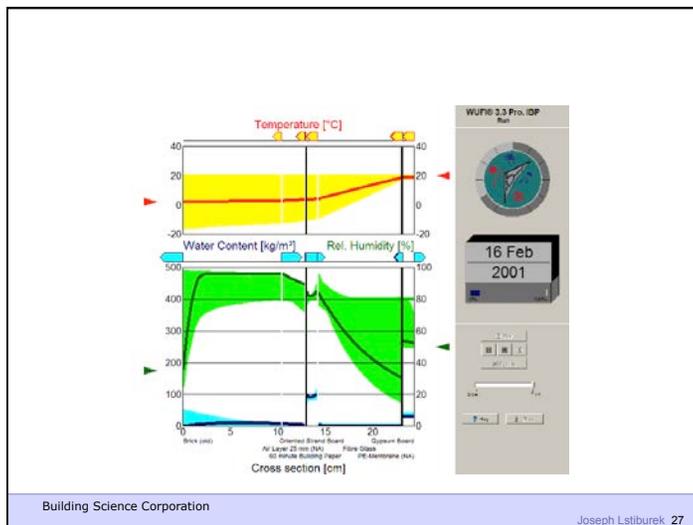


Figure 8-7. Outside vapour pressure, saturated vapour pressure and inside vapour pressure for Winnipeg.

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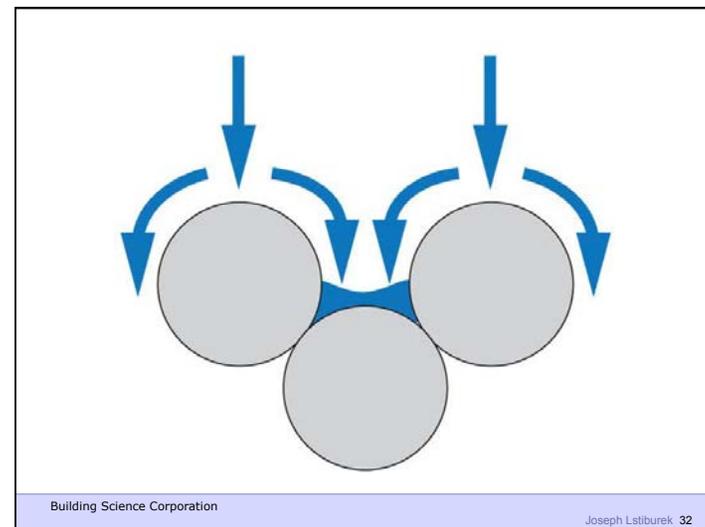
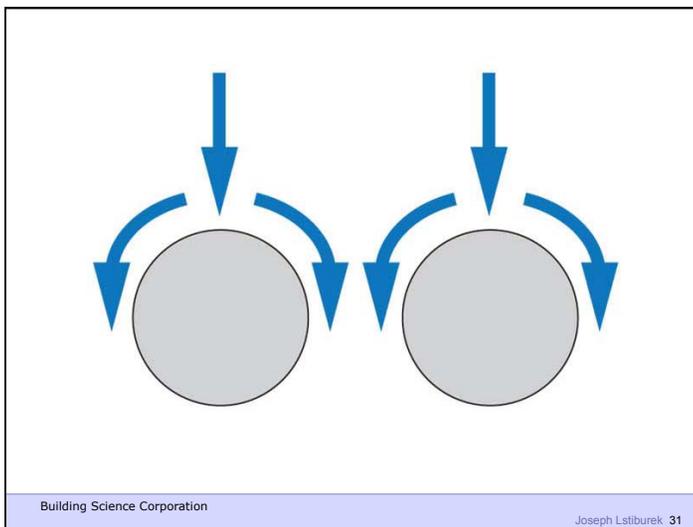
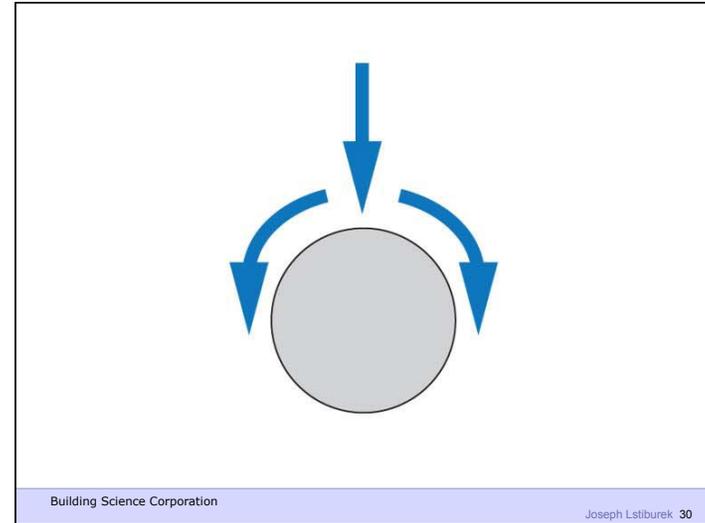
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If You Need To Run A Hygrothermal Model To Figure Out If Your Wall Works You Have The Wrong Design

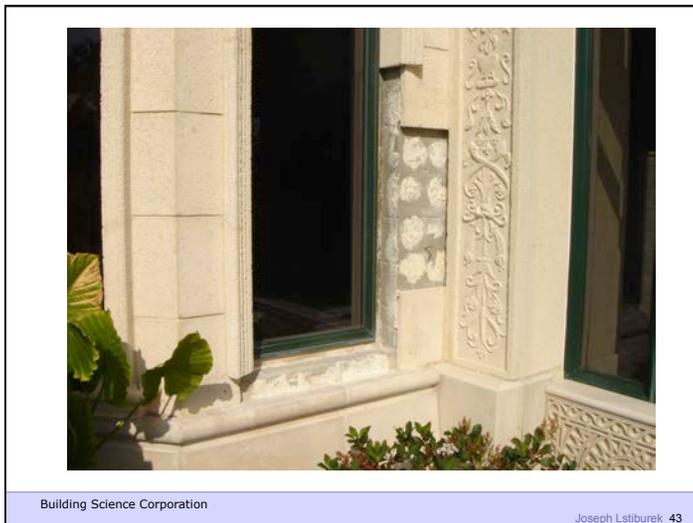
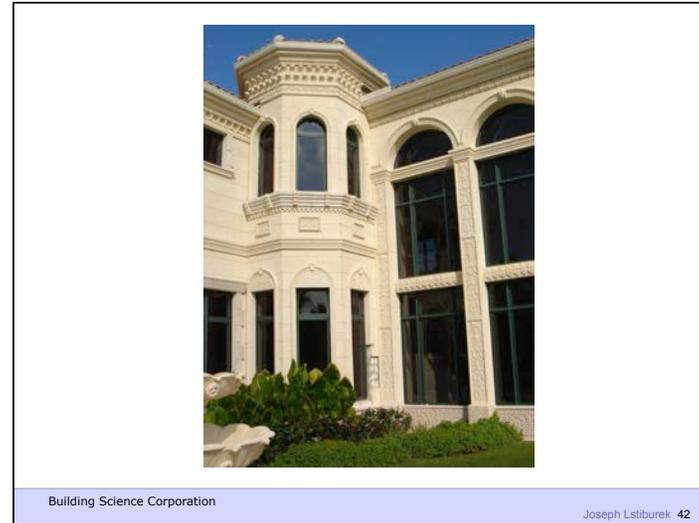
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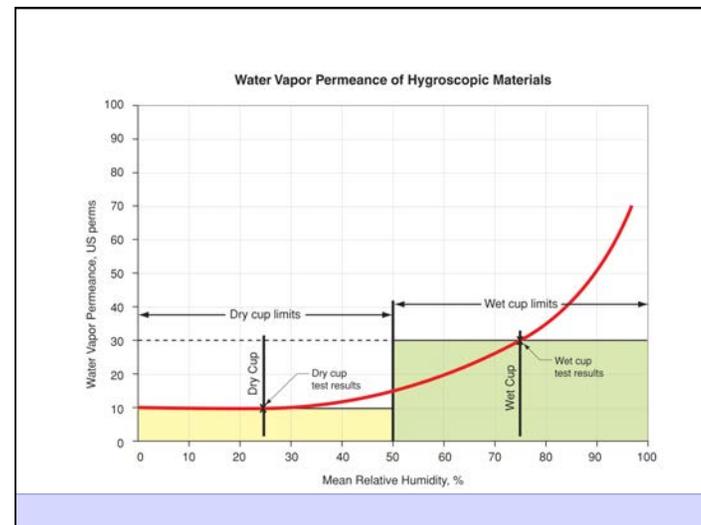
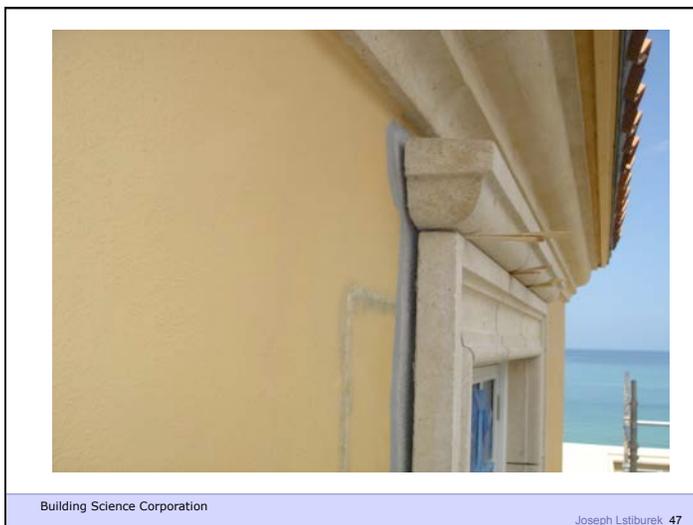
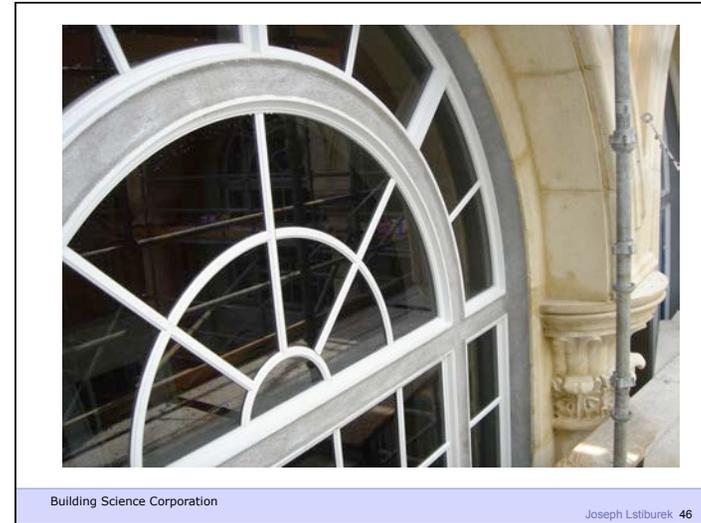
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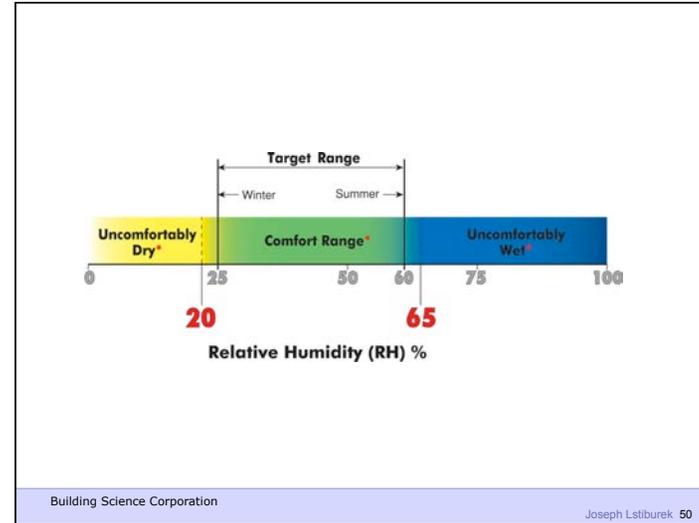






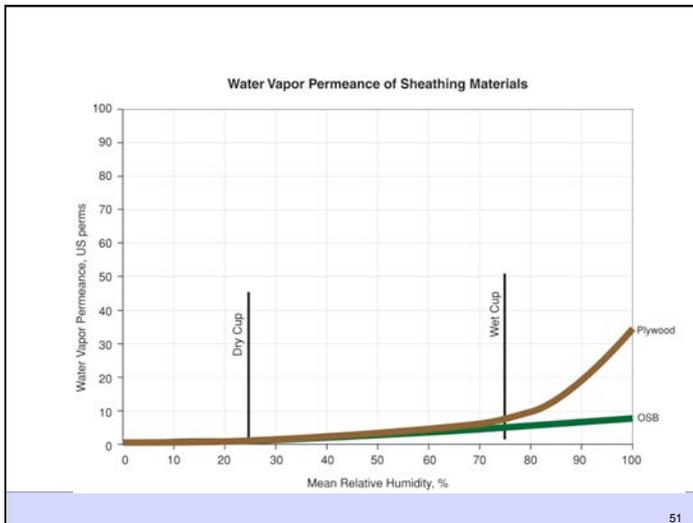




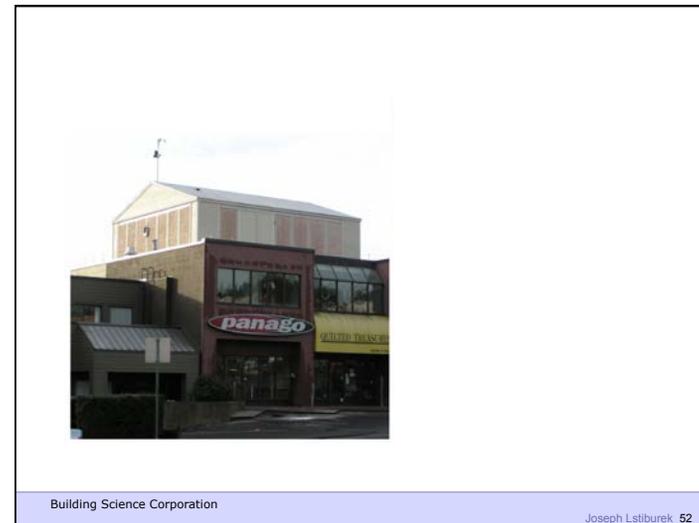


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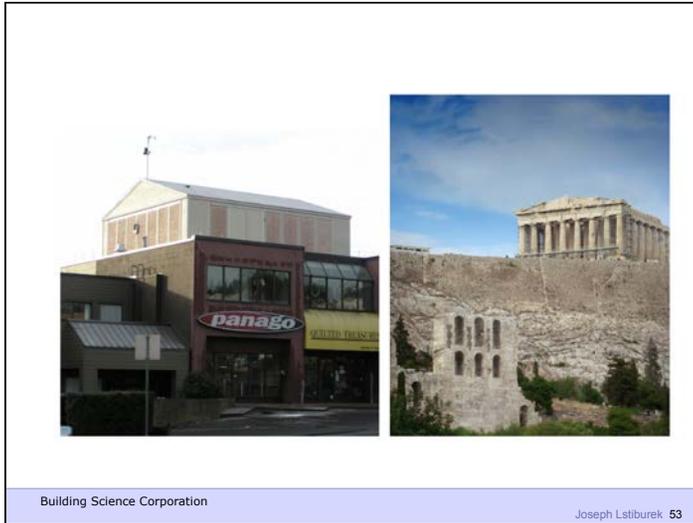


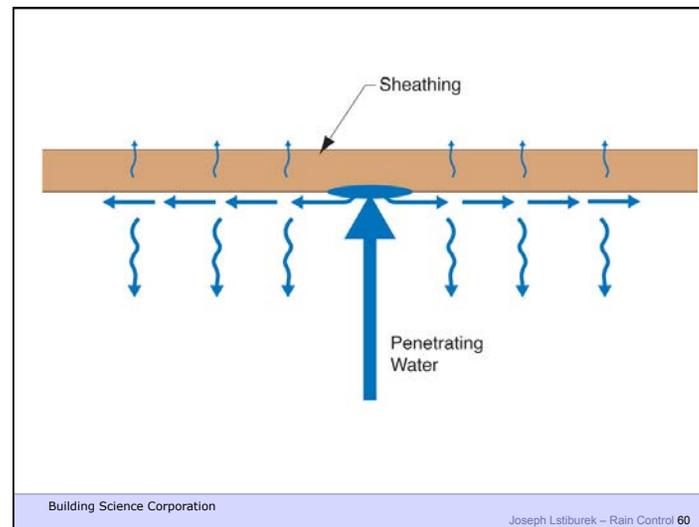
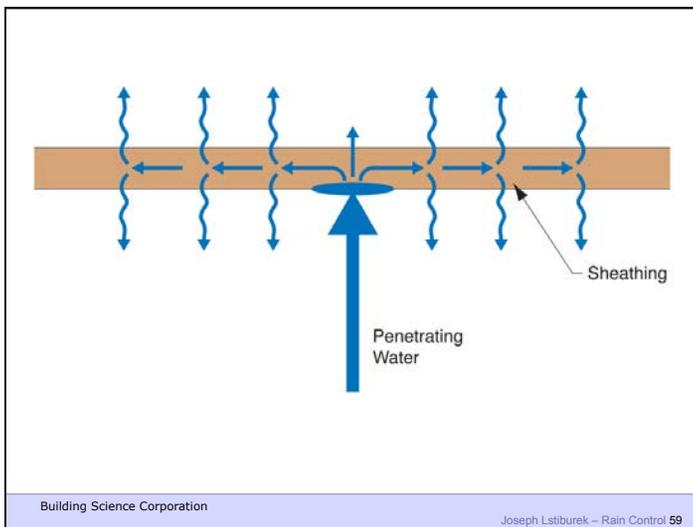
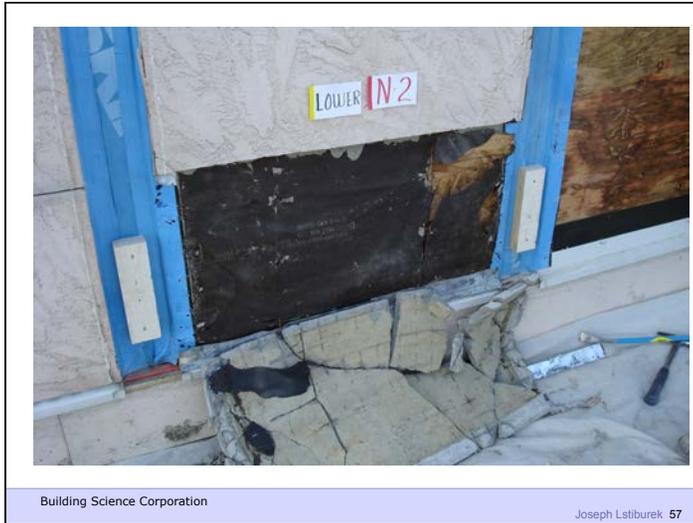
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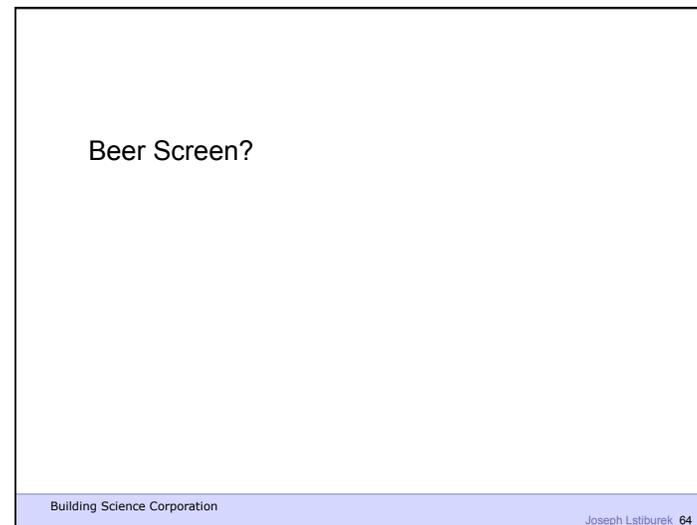
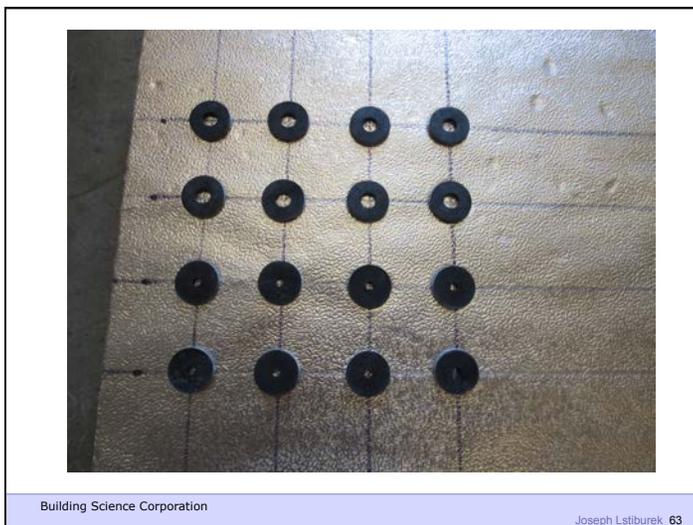
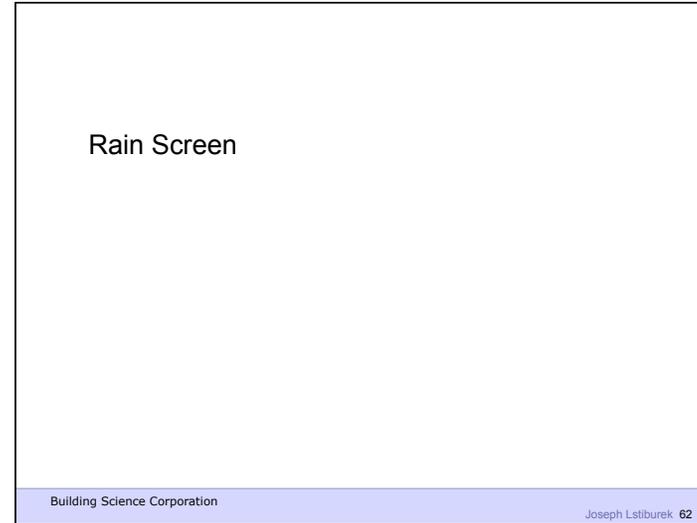


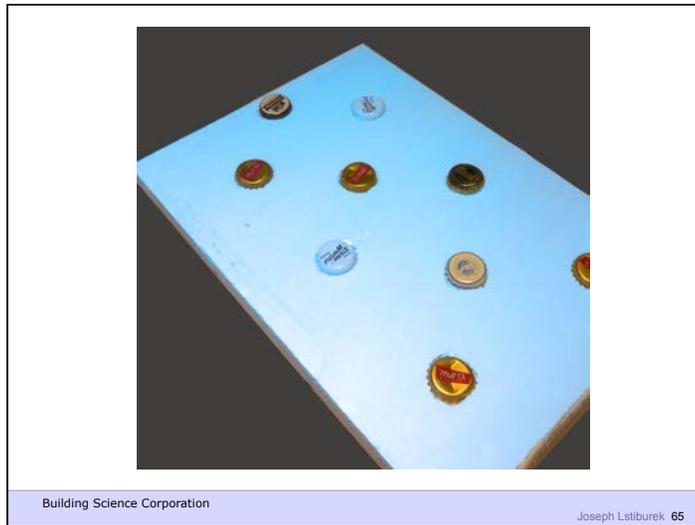
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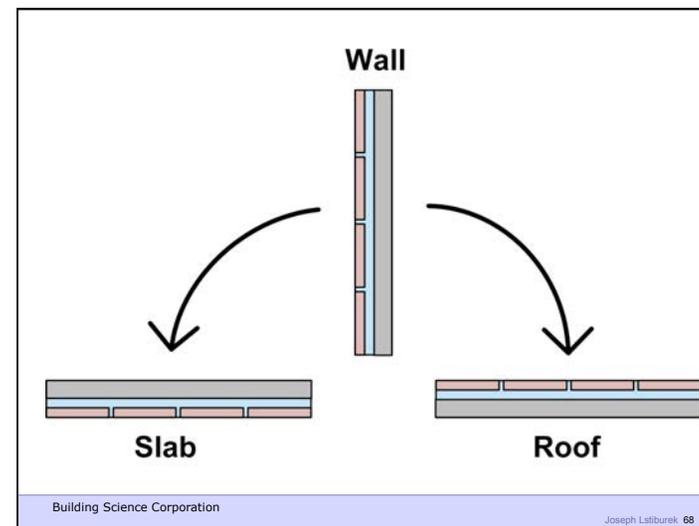
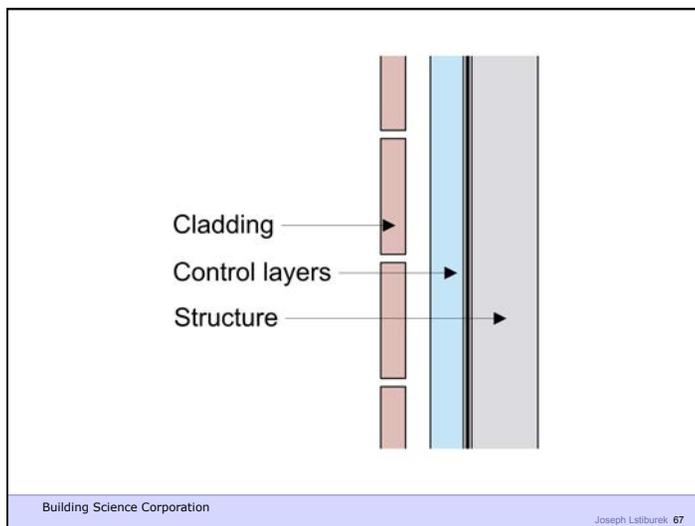


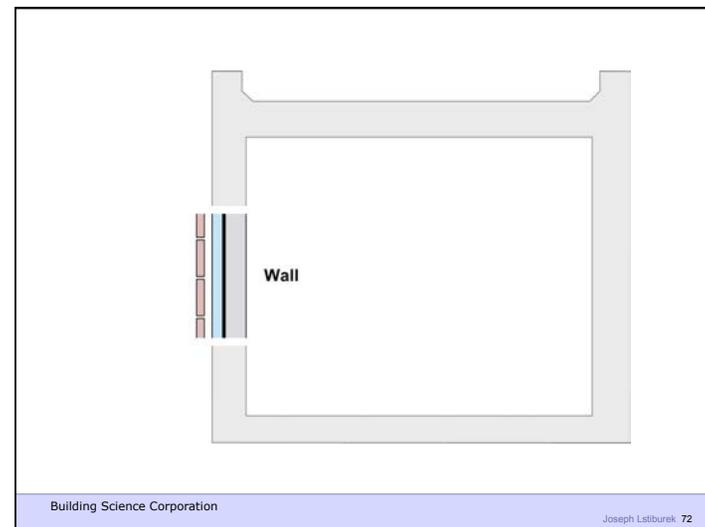
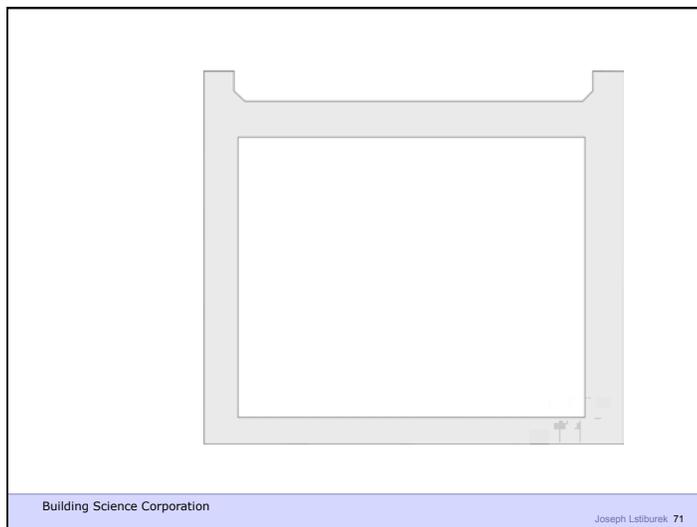
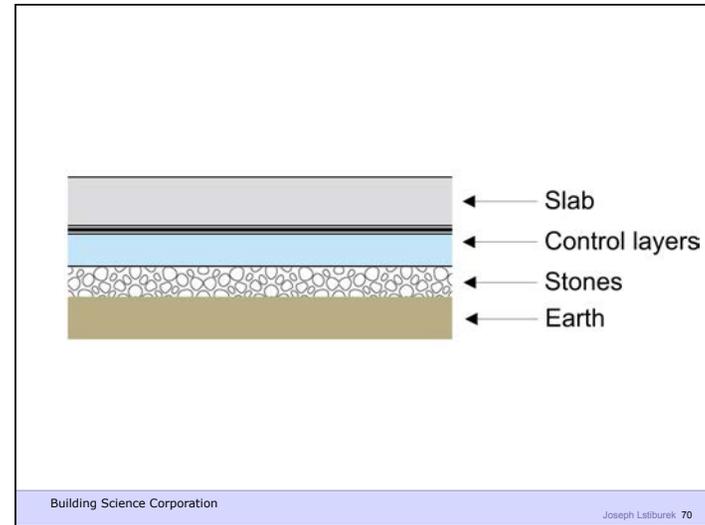
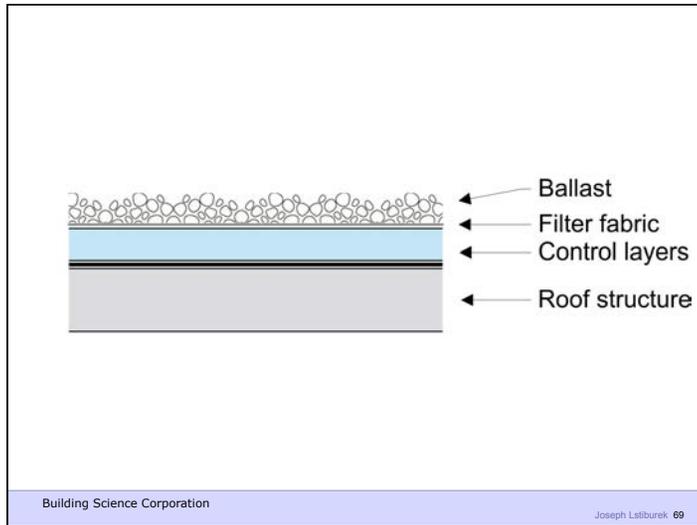


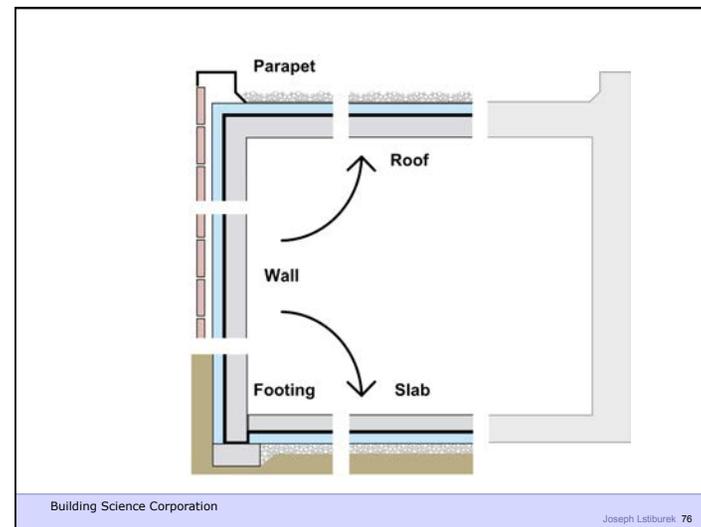
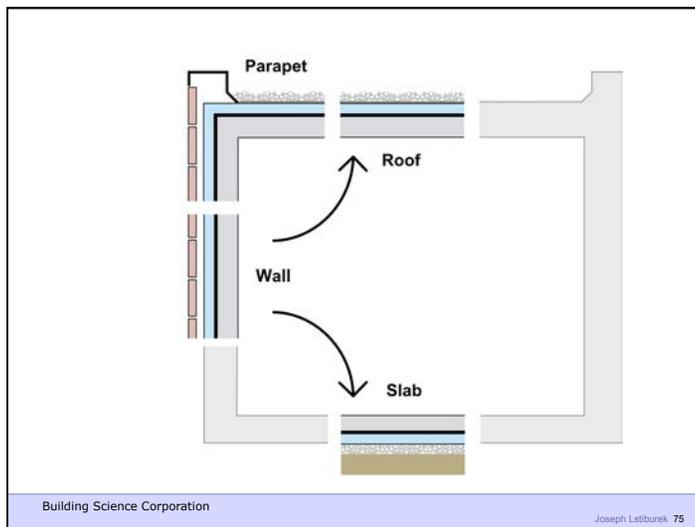
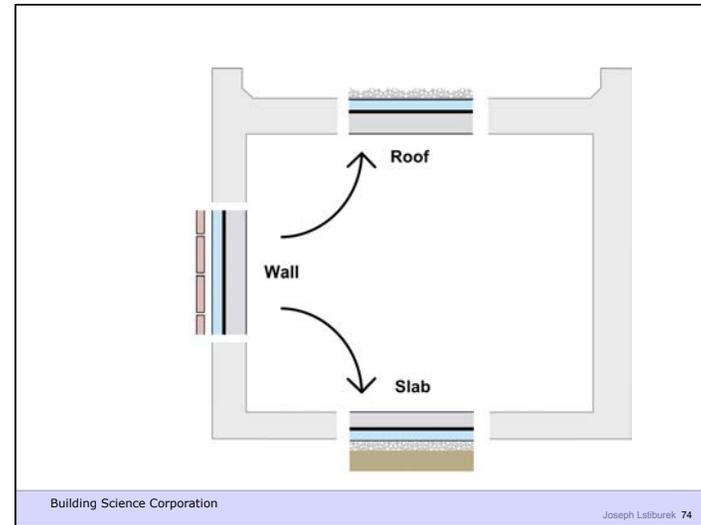
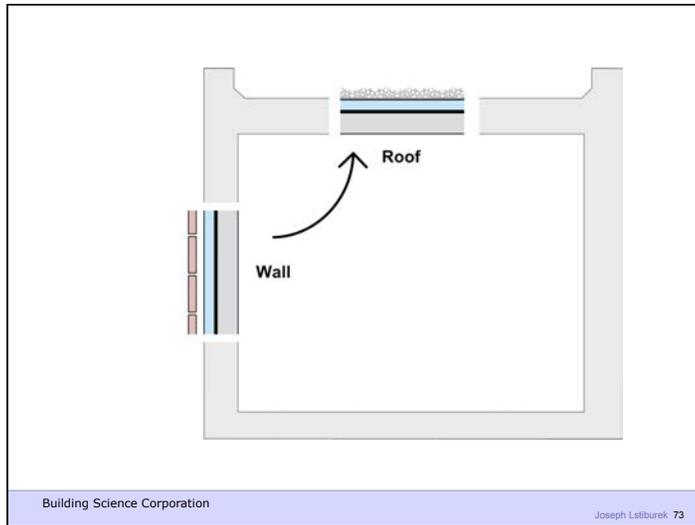


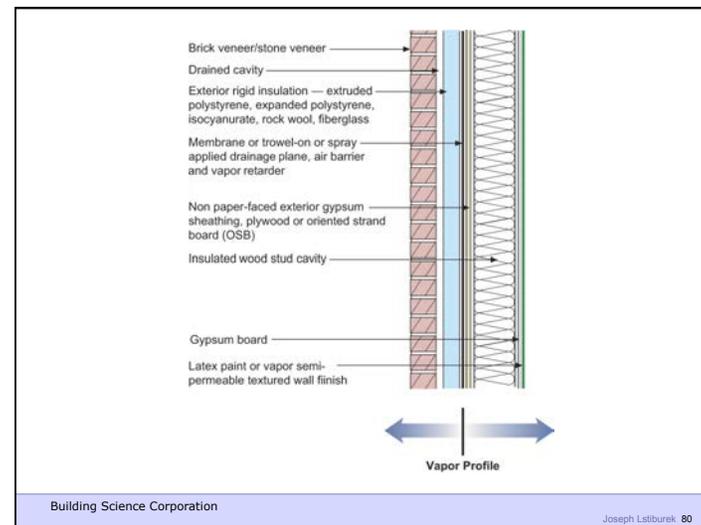
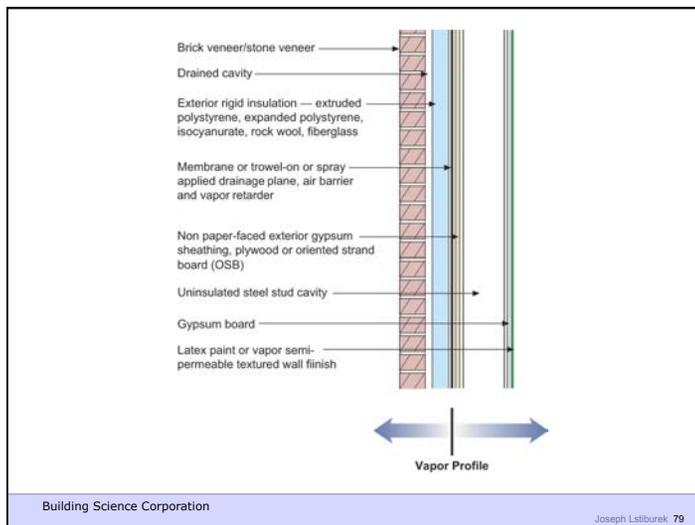
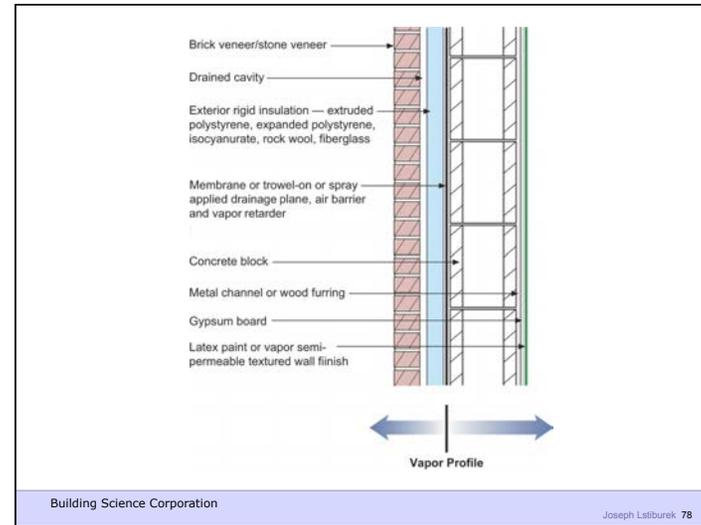
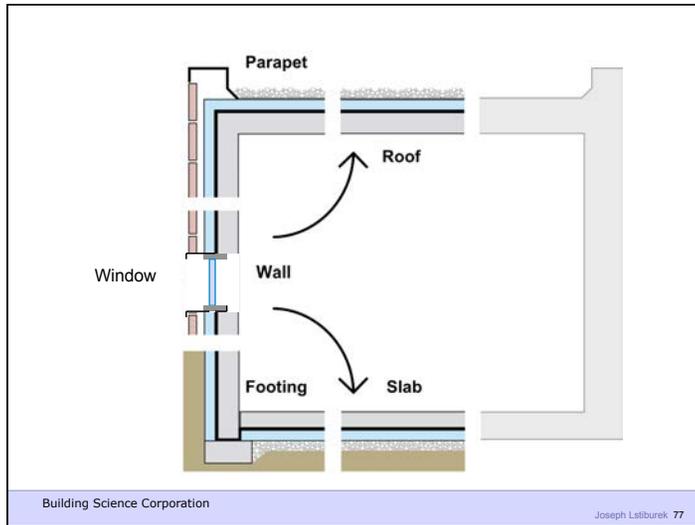
Water Control Layer  
Air Control Layer  
Vapor Control Layer  
Thermal Control Layer

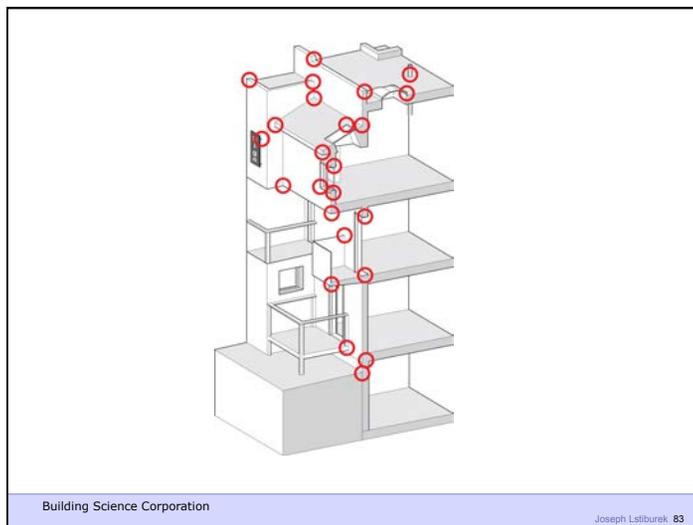
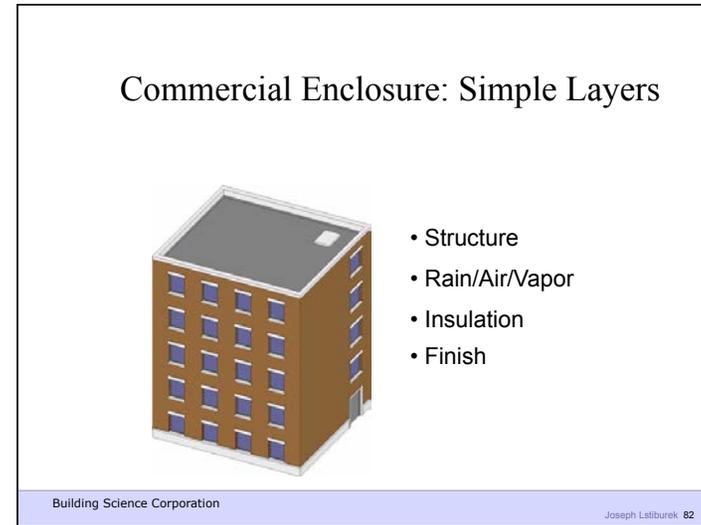
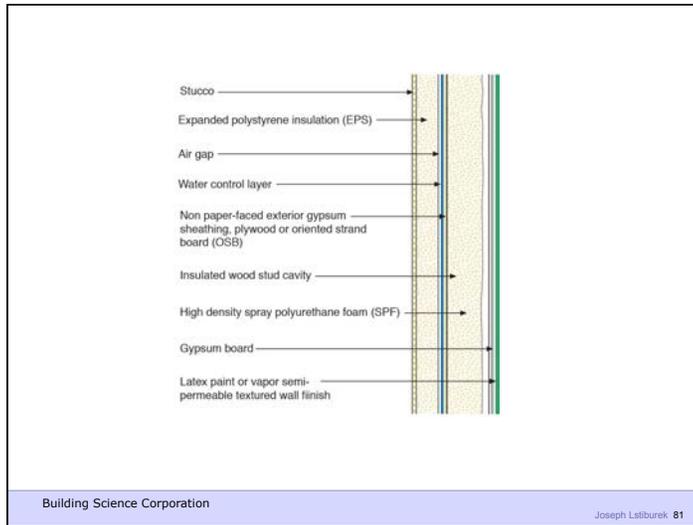
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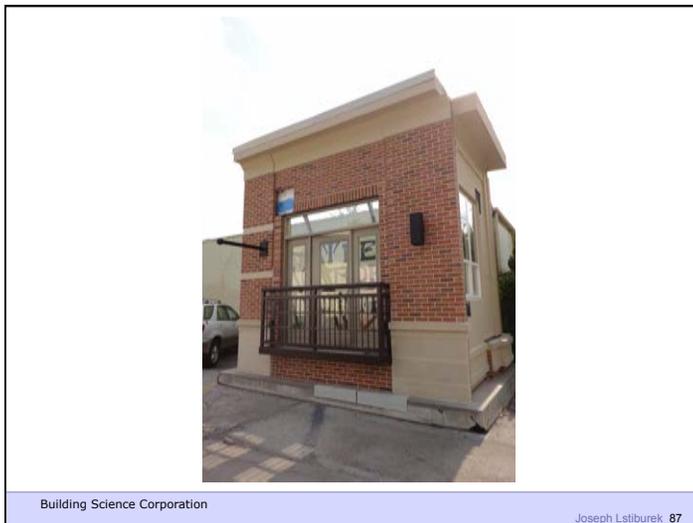


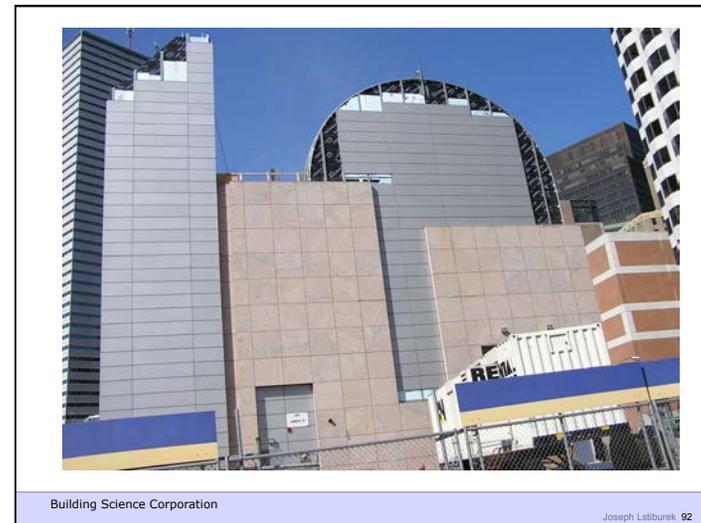
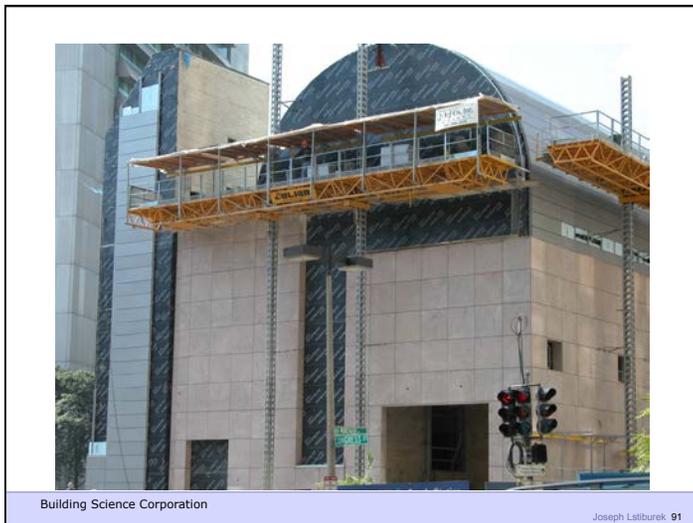




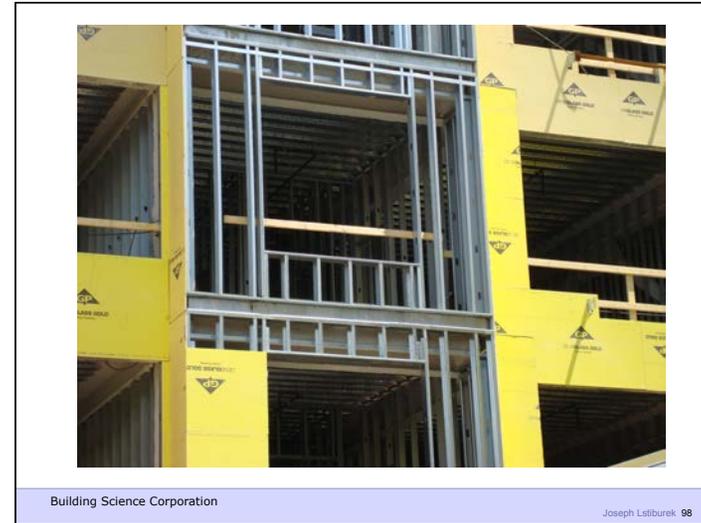


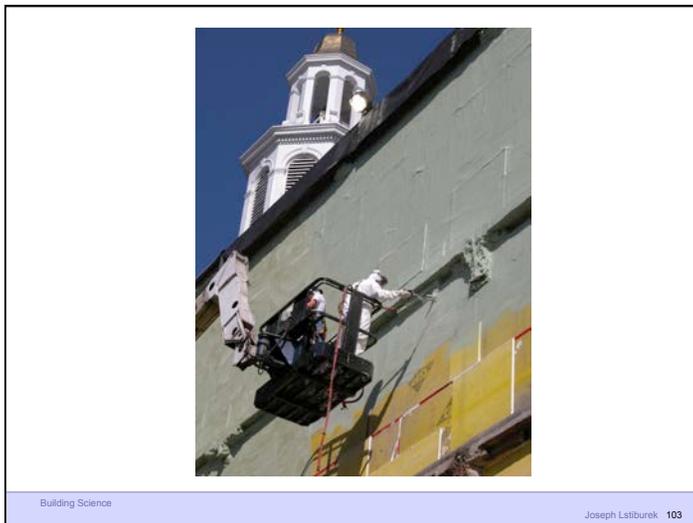
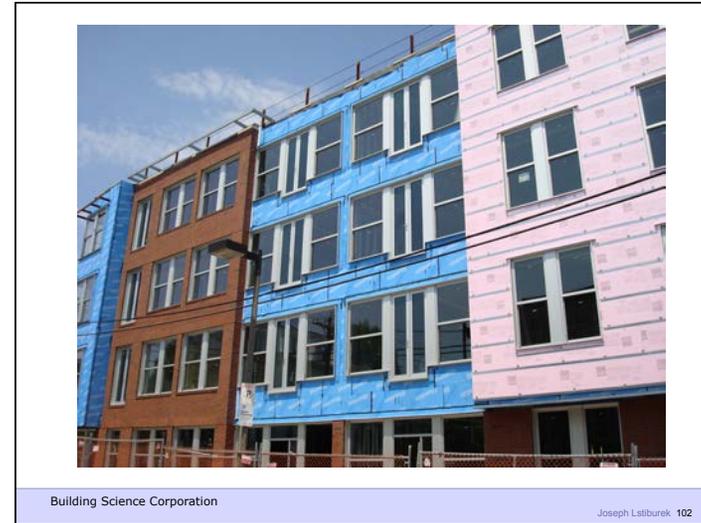
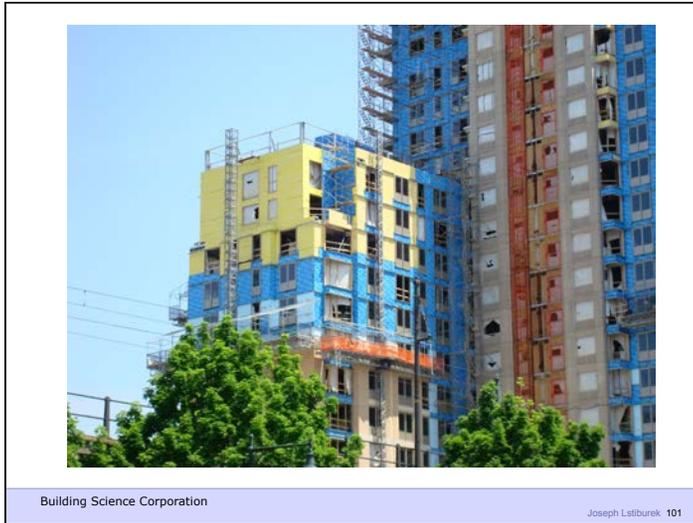








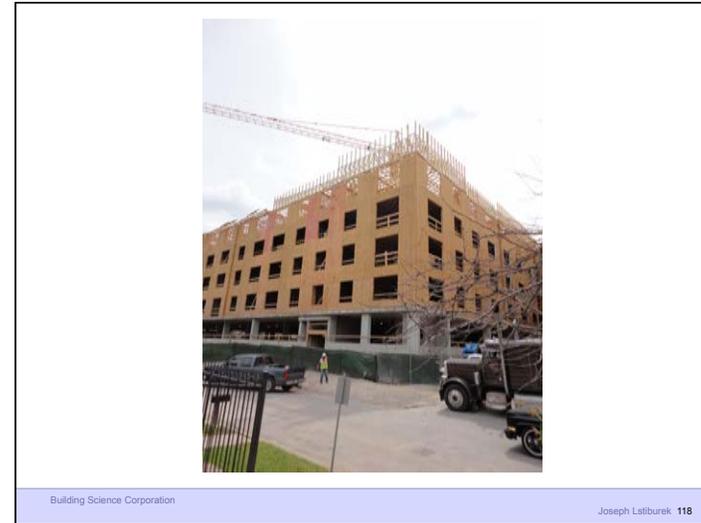


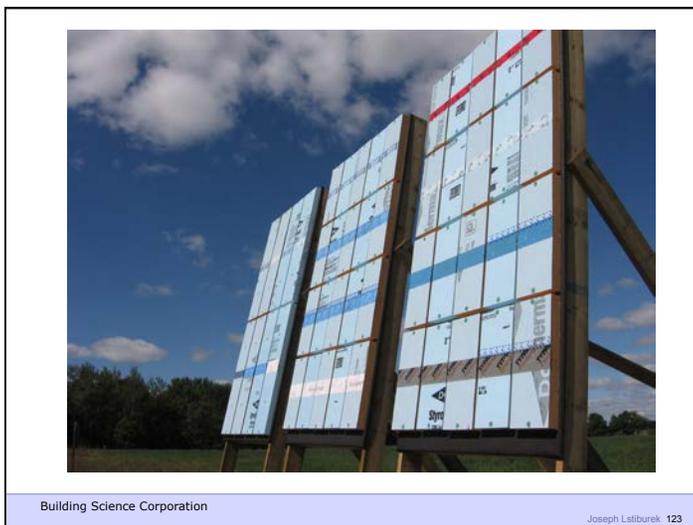
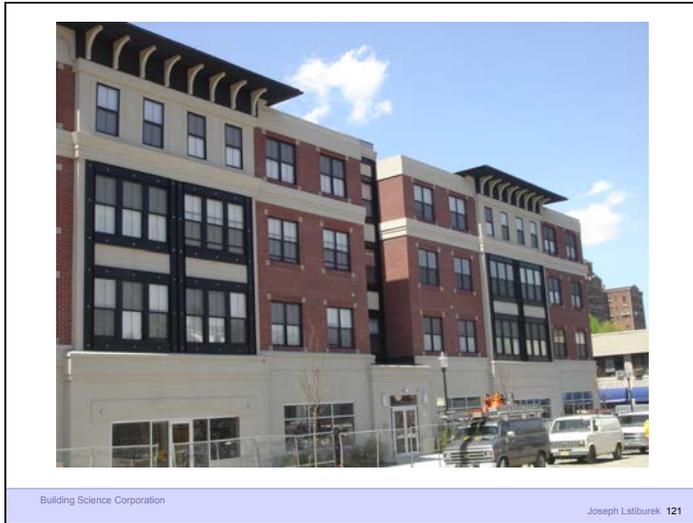


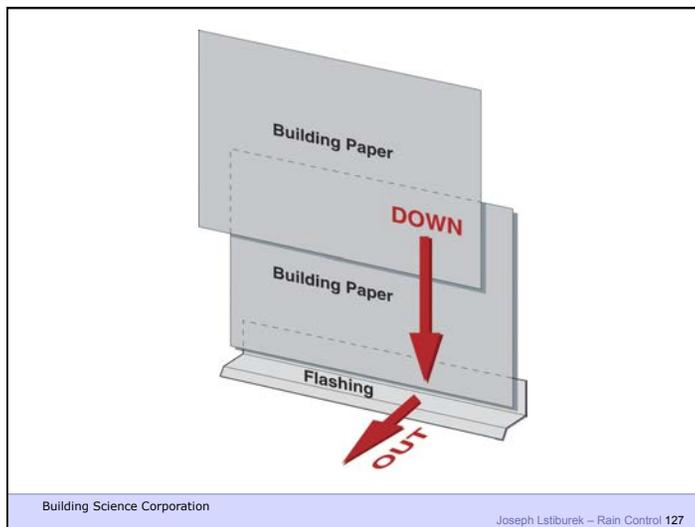
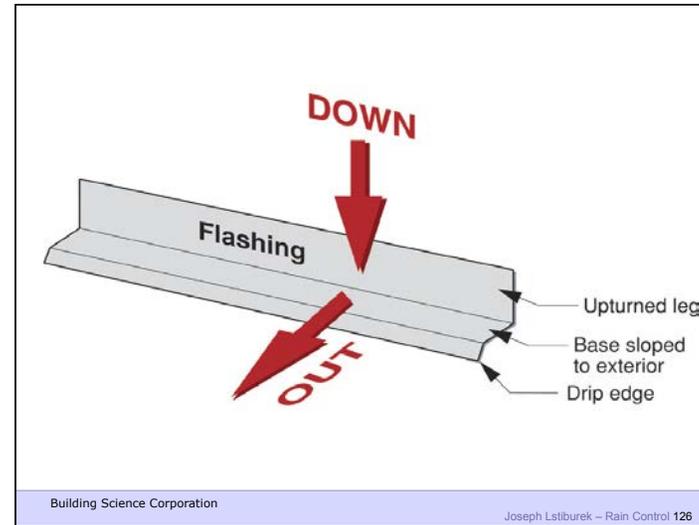
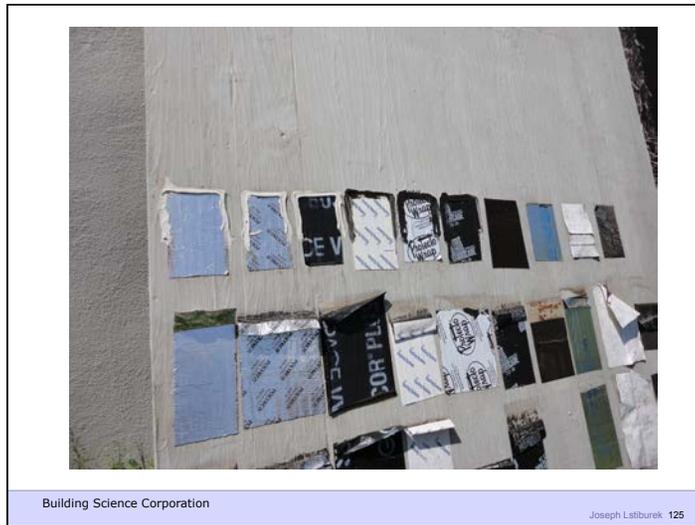








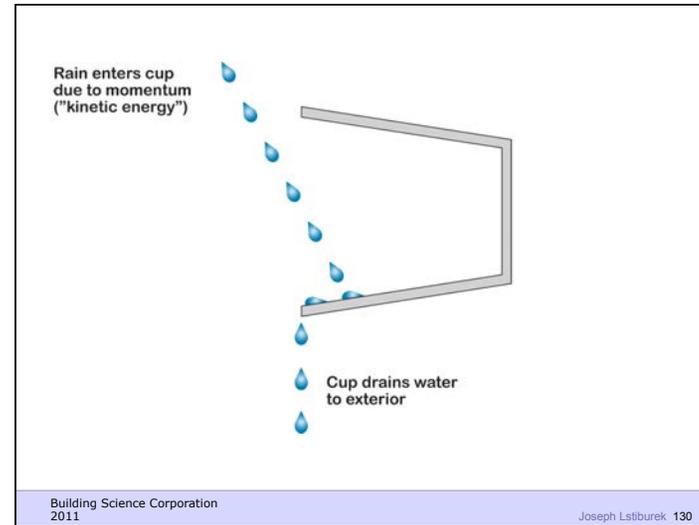






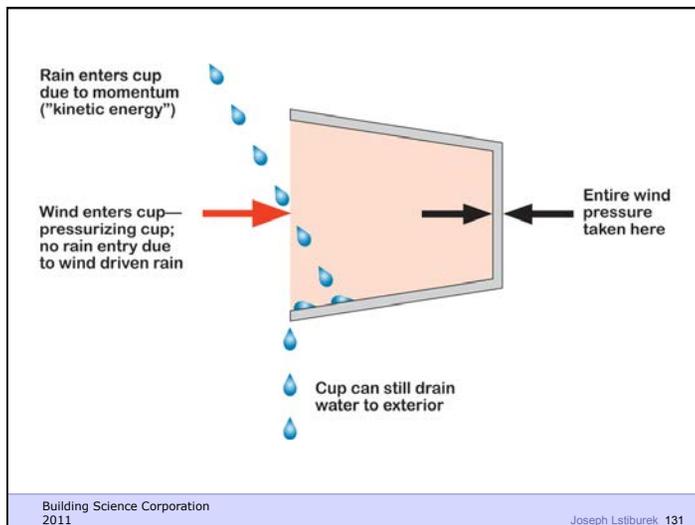
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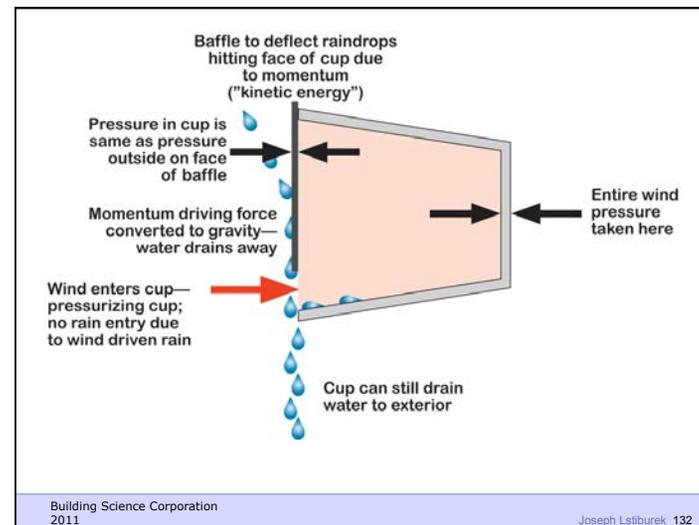
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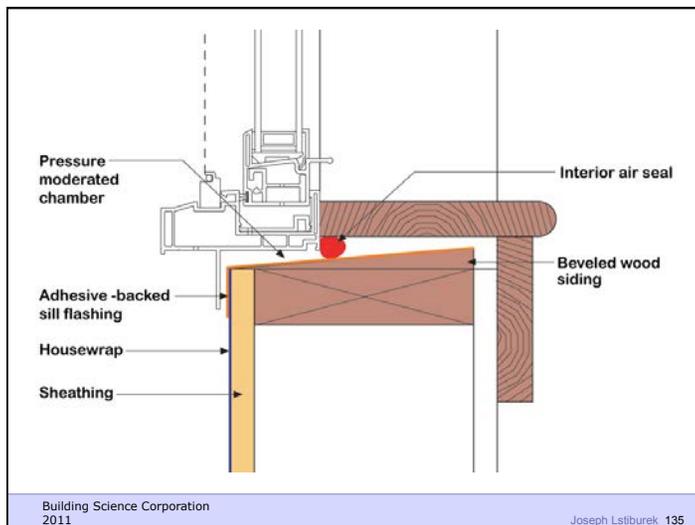
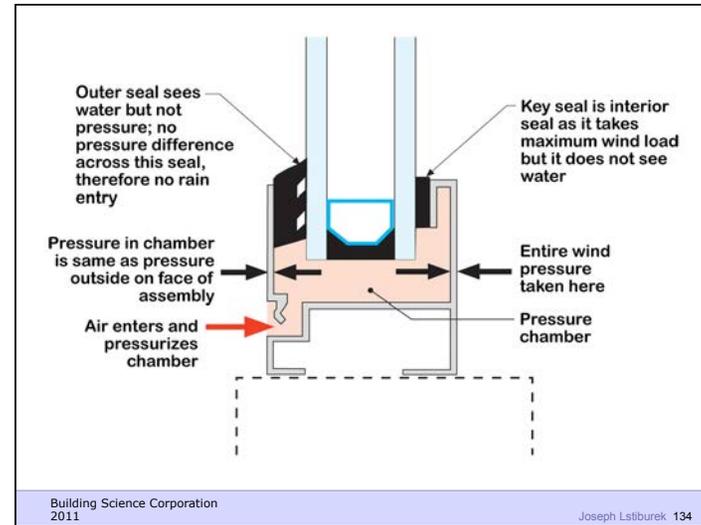
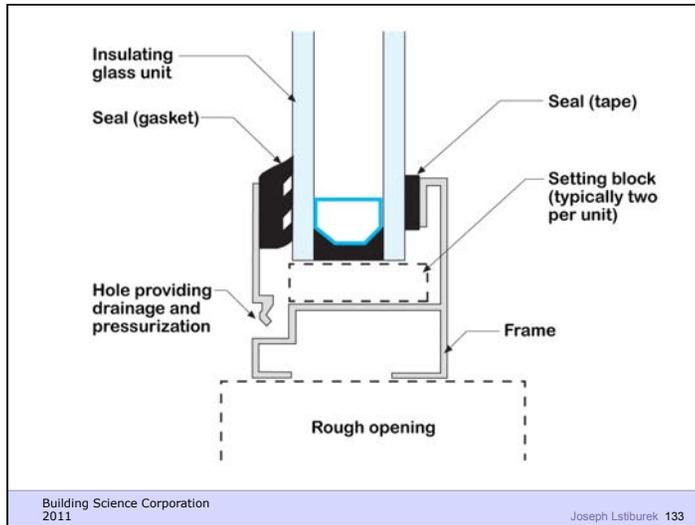
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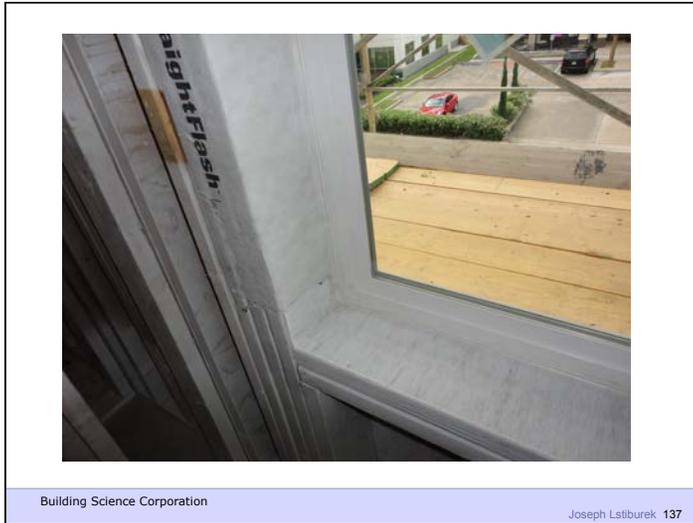
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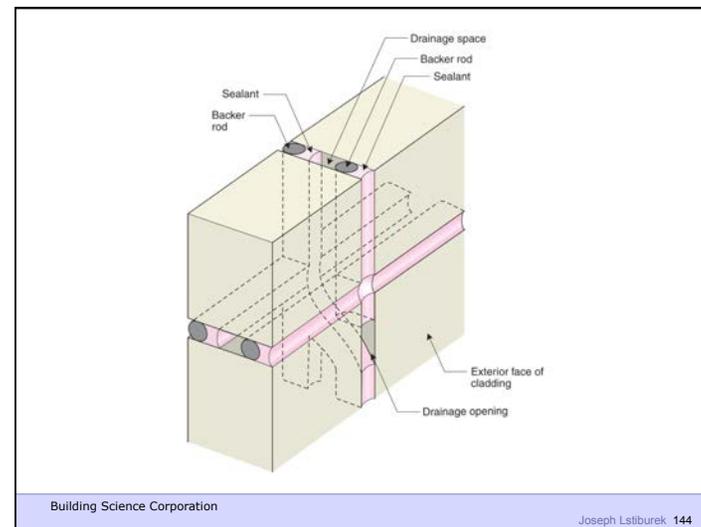
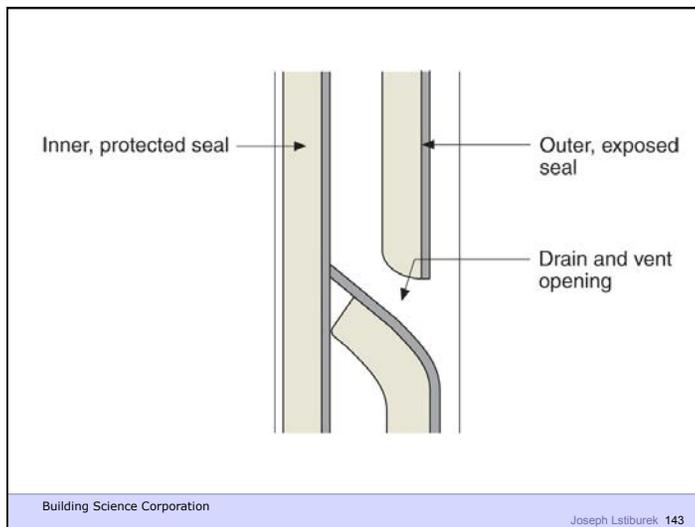
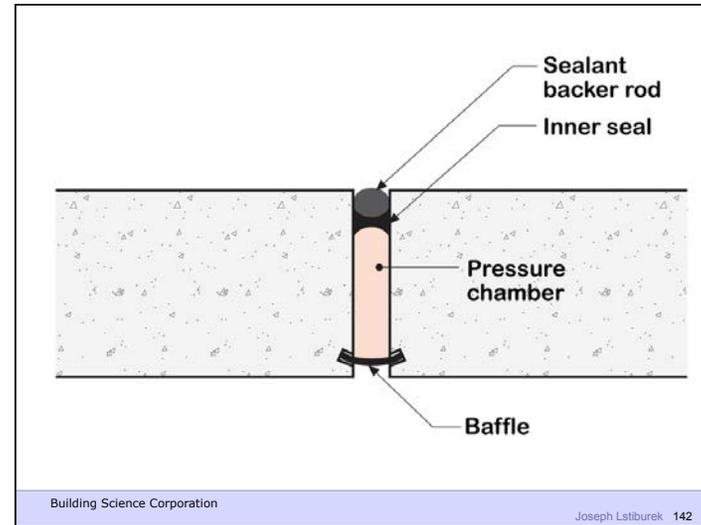
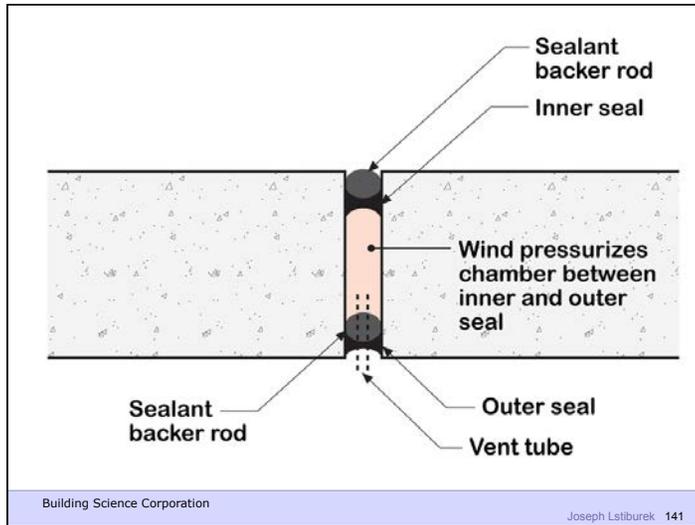


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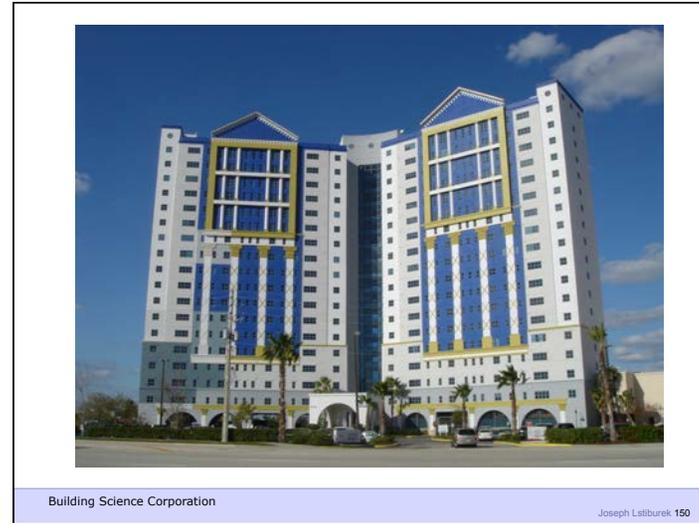
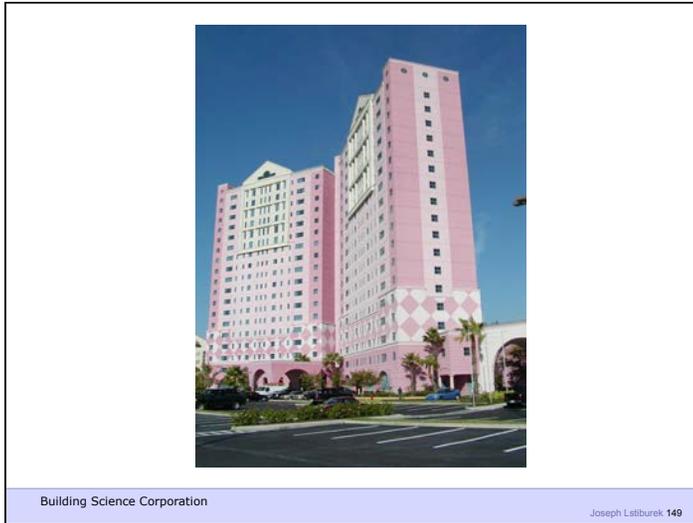
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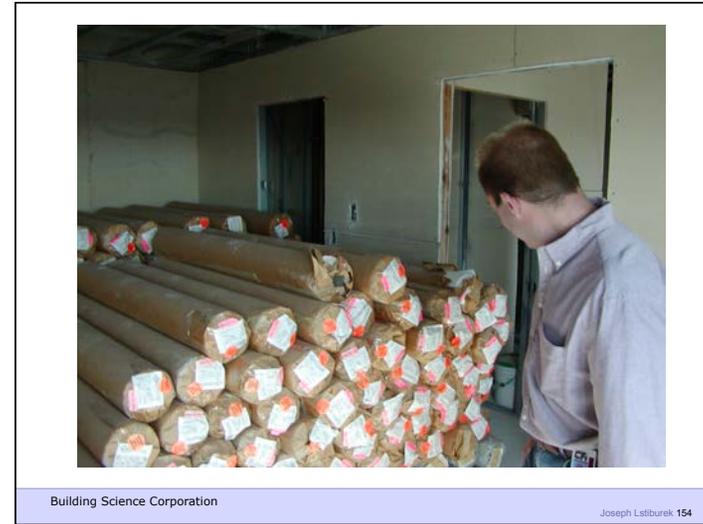


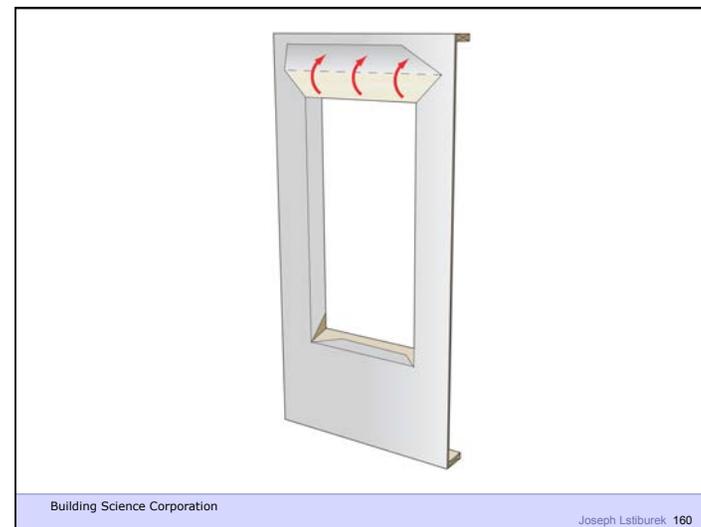
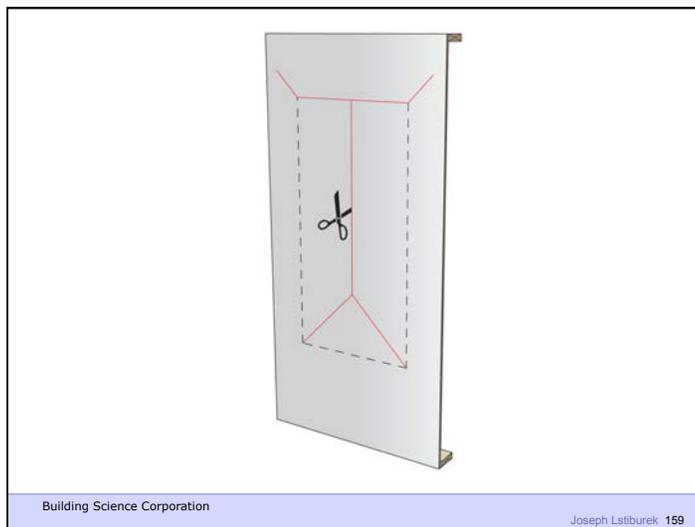
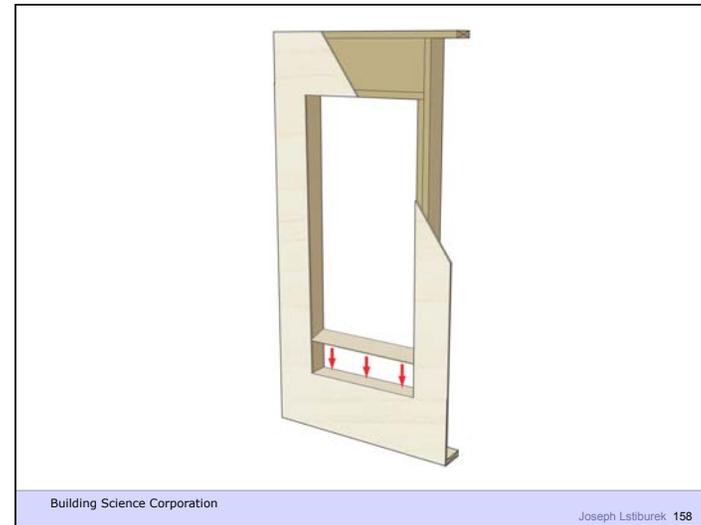
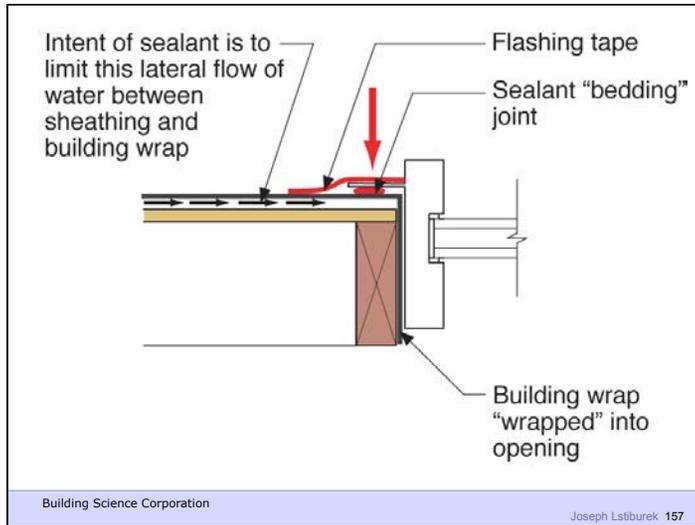


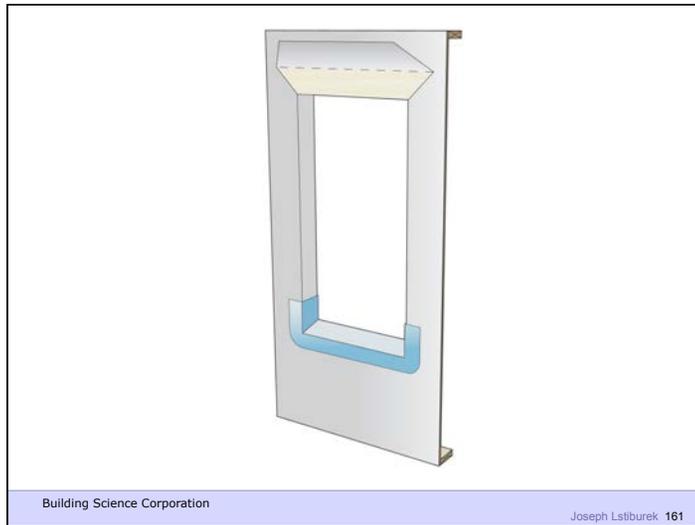




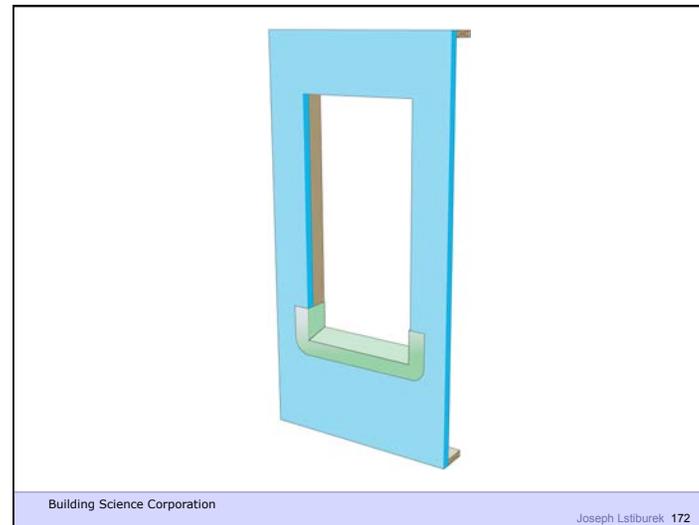
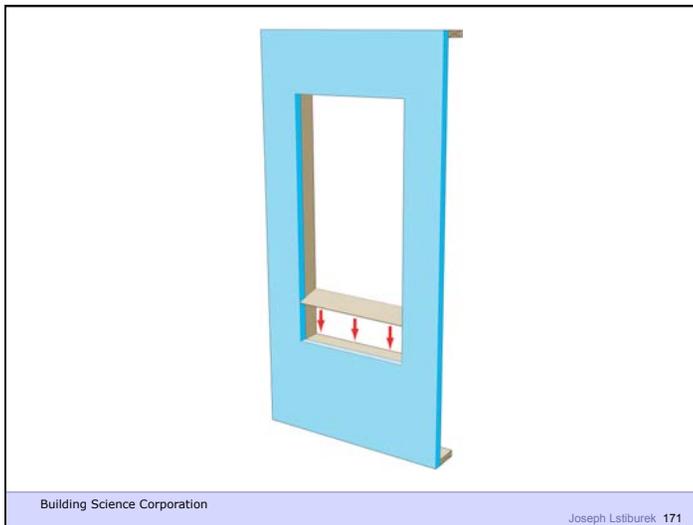
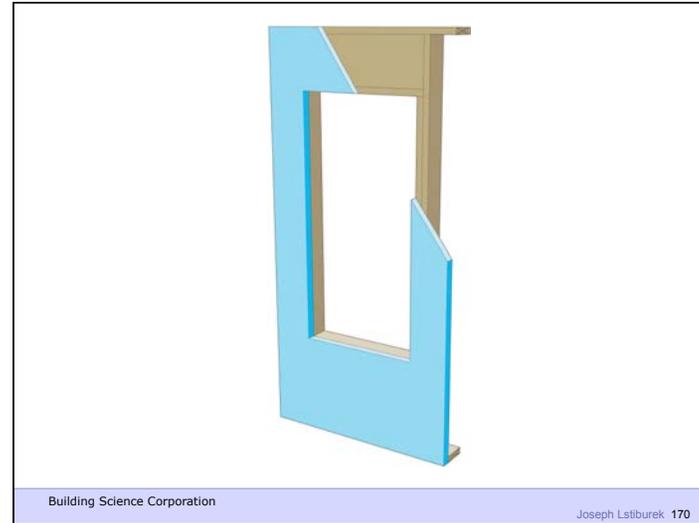


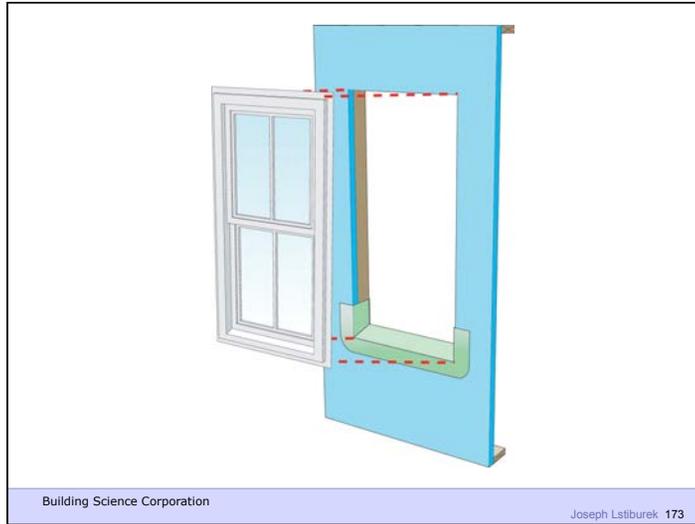




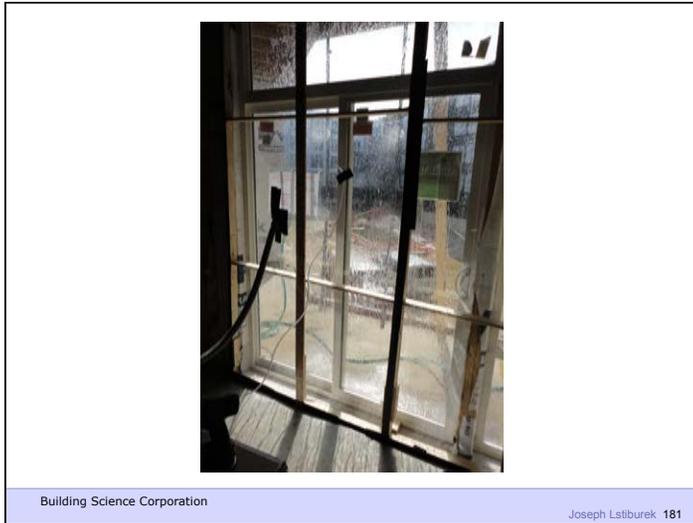






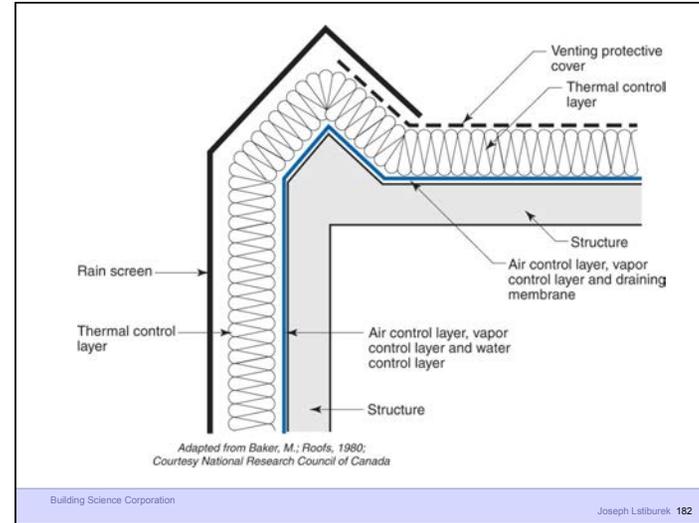






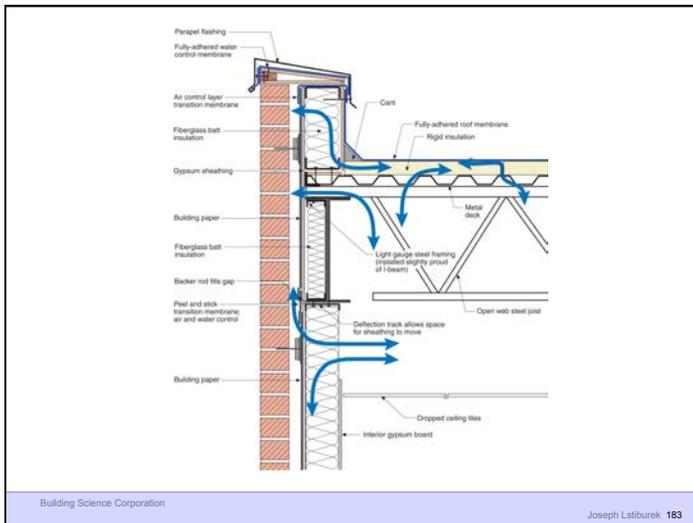
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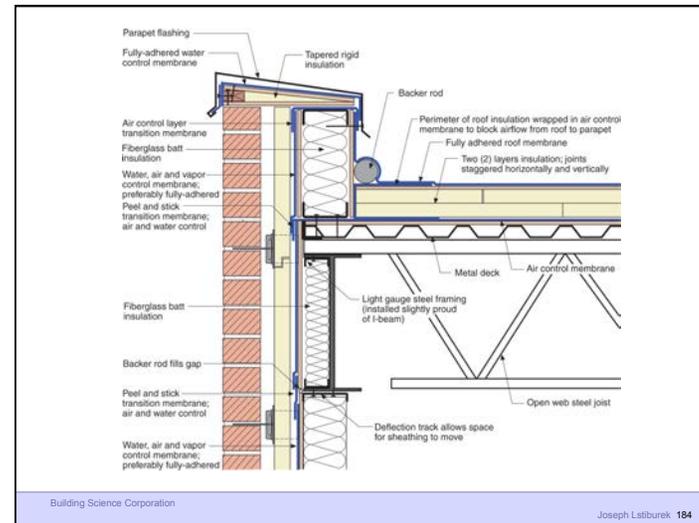
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