

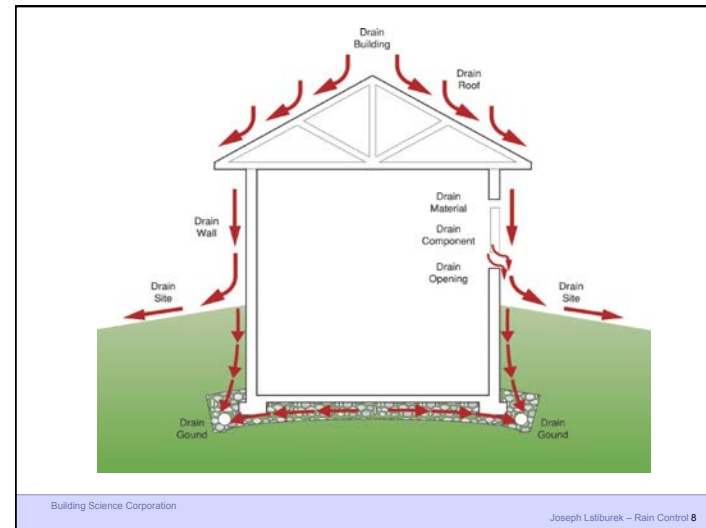
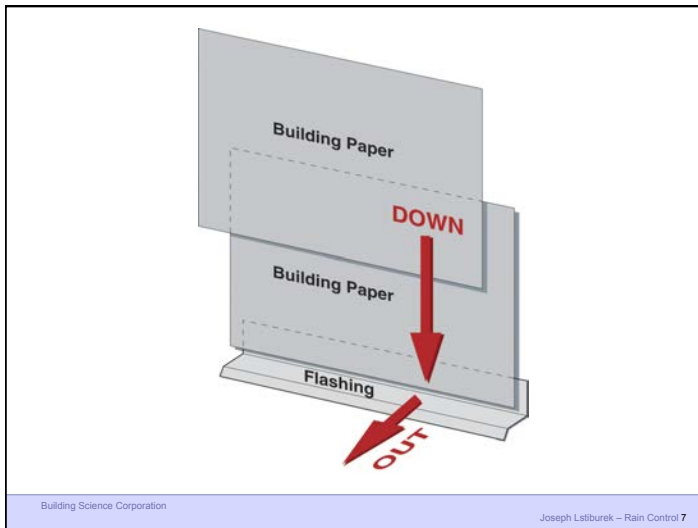
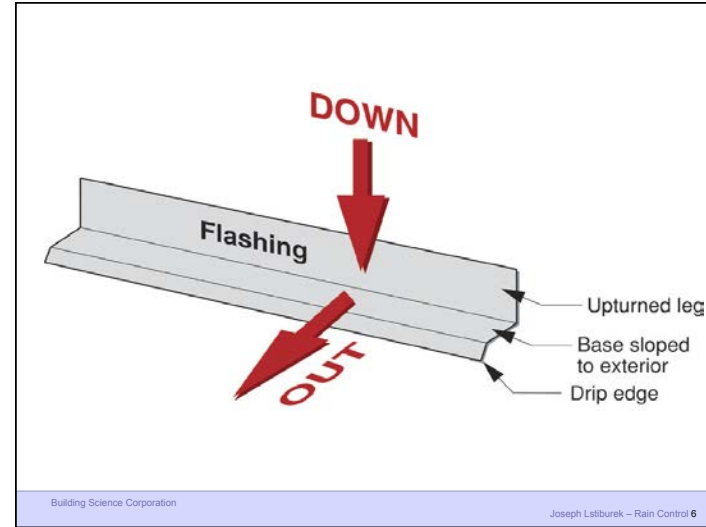
Joseph Lstiburek, Ph.D., P.Eng., ASHRAE Fellow

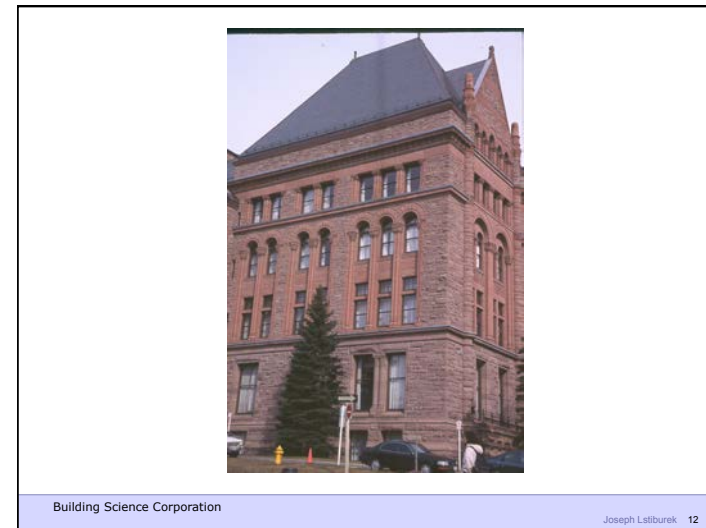
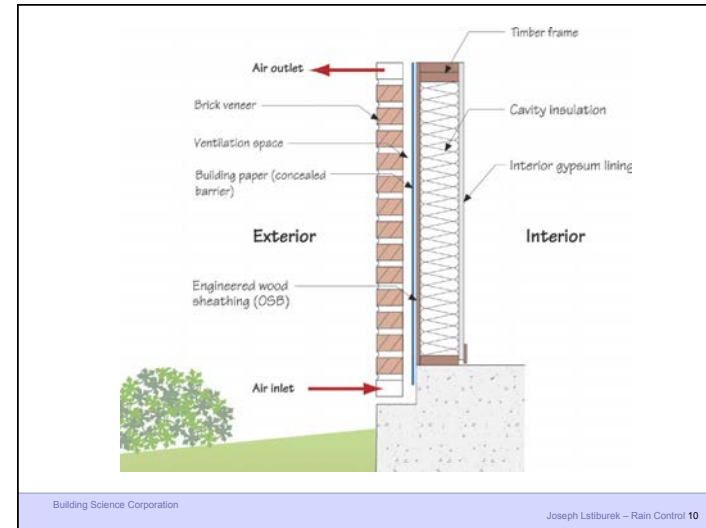
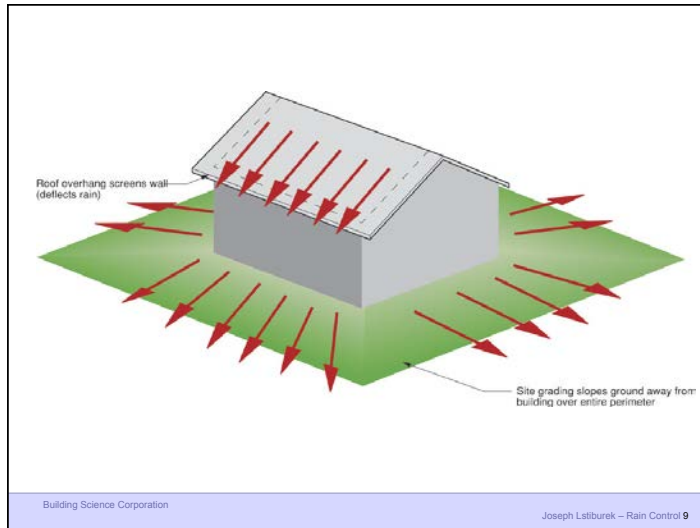
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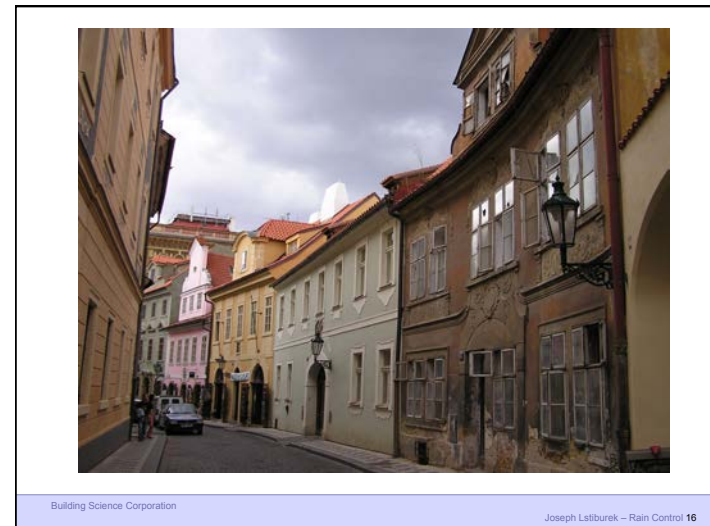
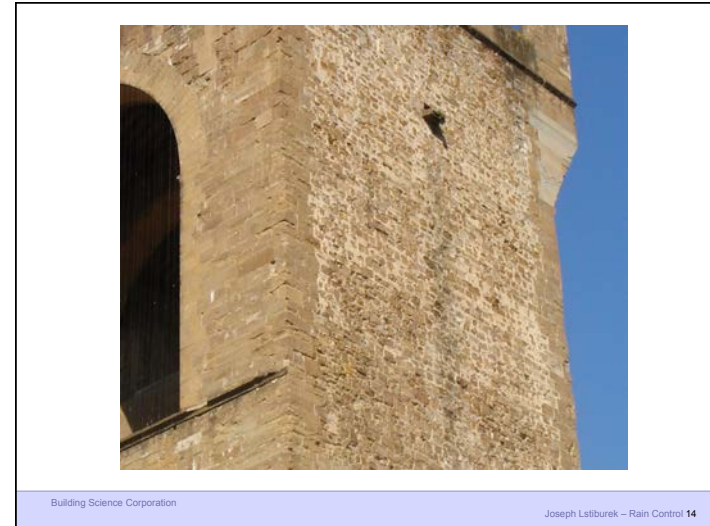
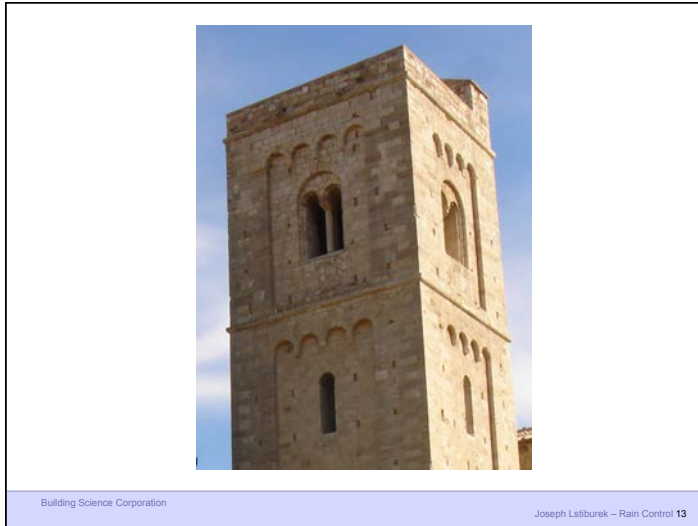
## Mass Assemblies

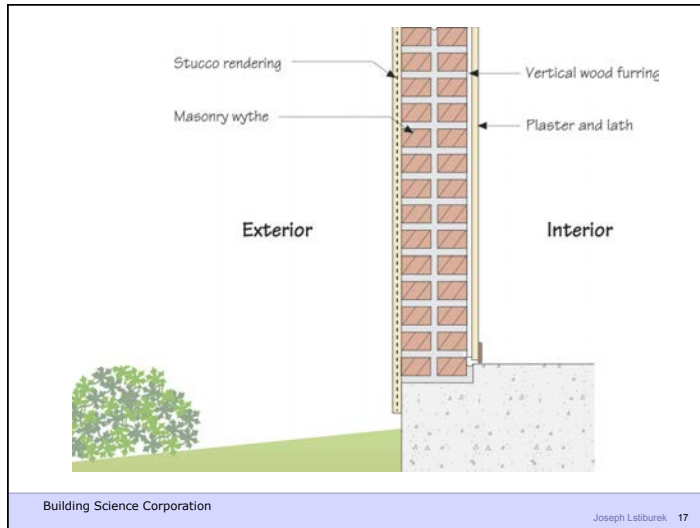
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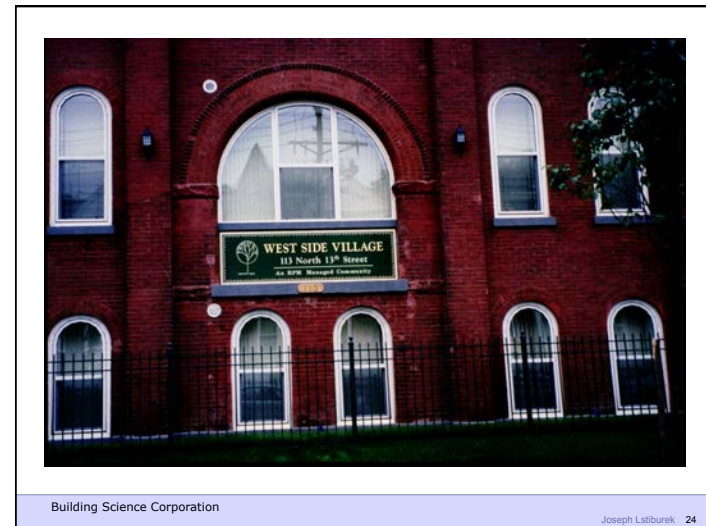
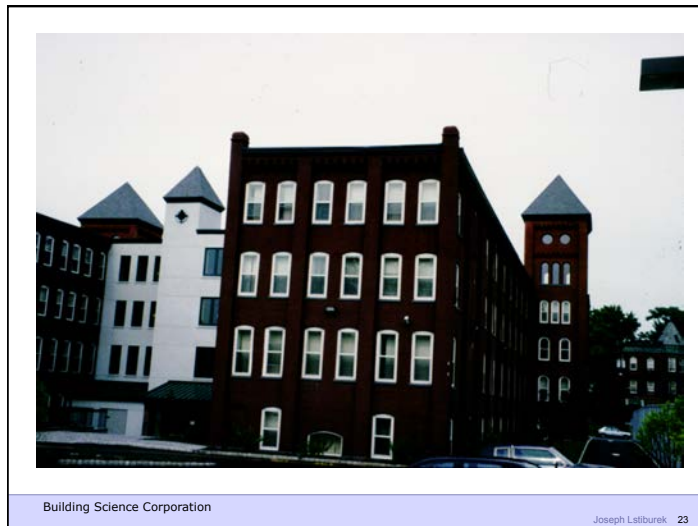
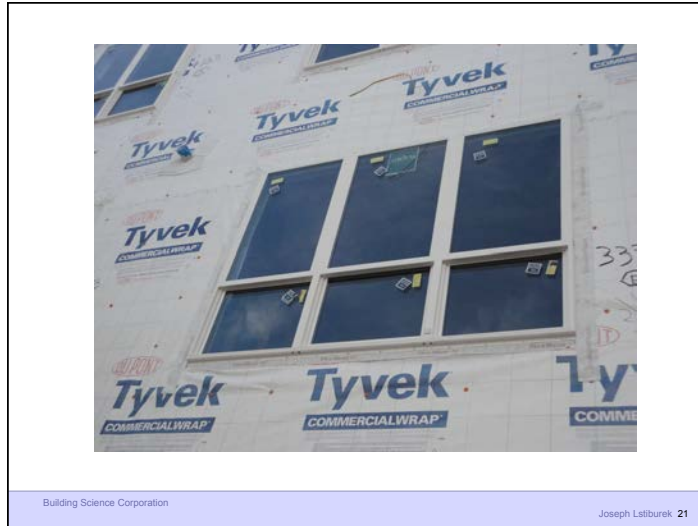


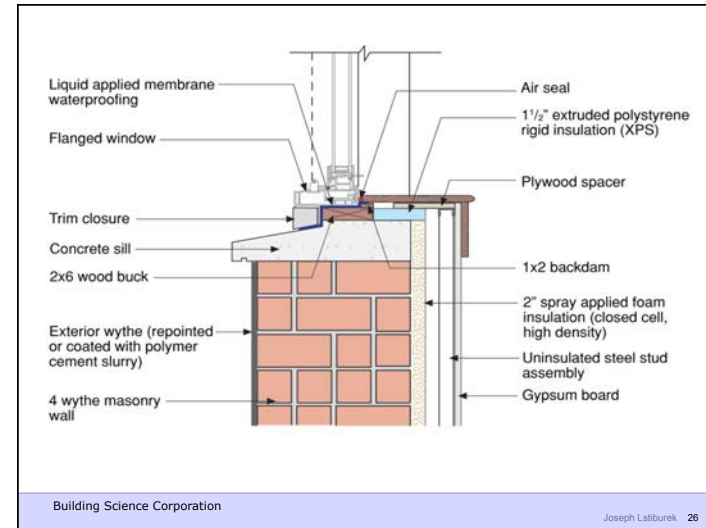
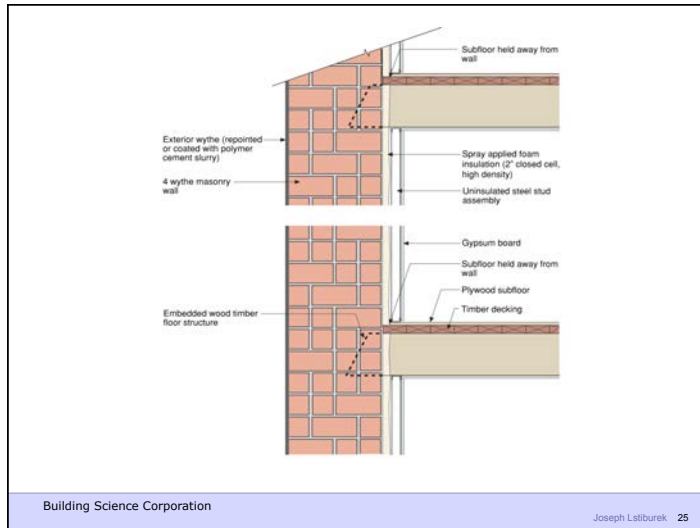


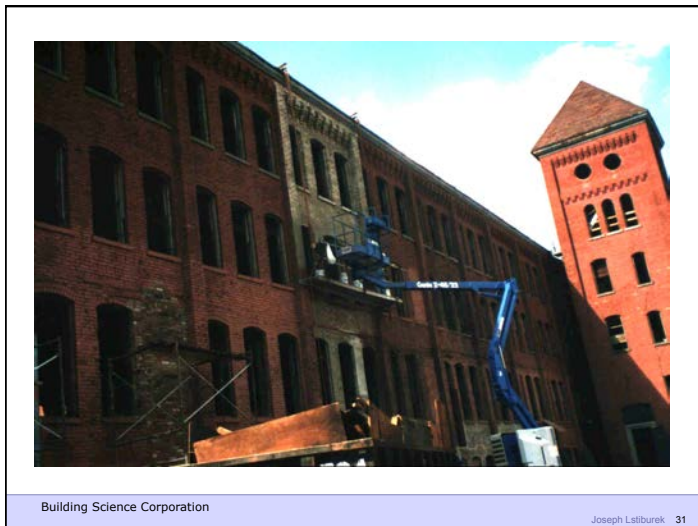
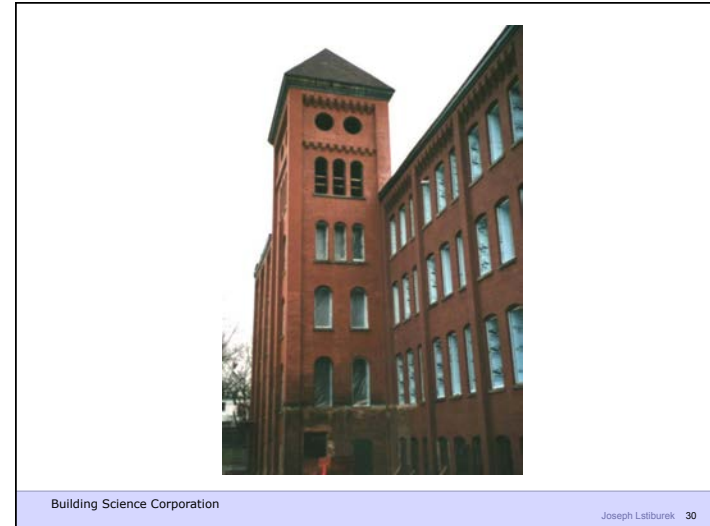
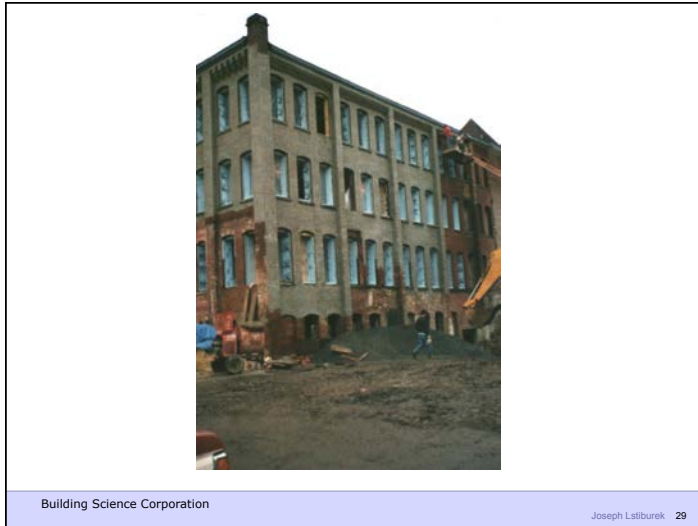




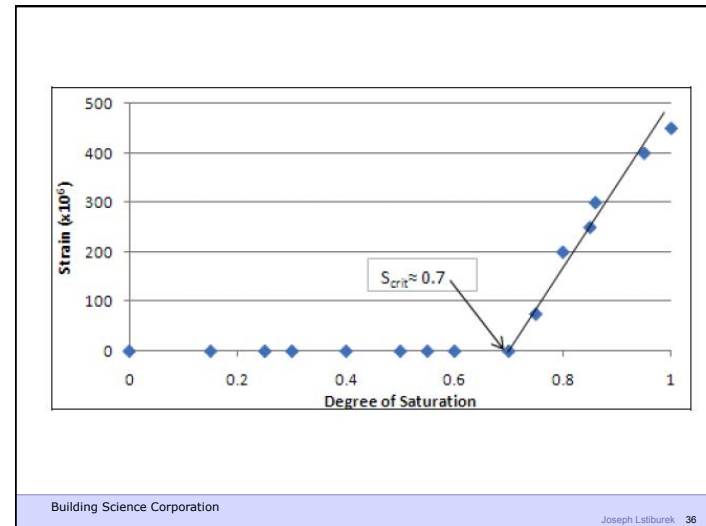
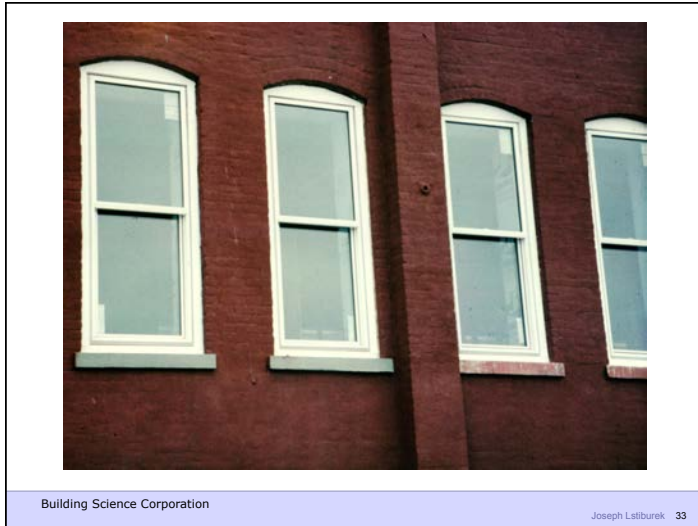


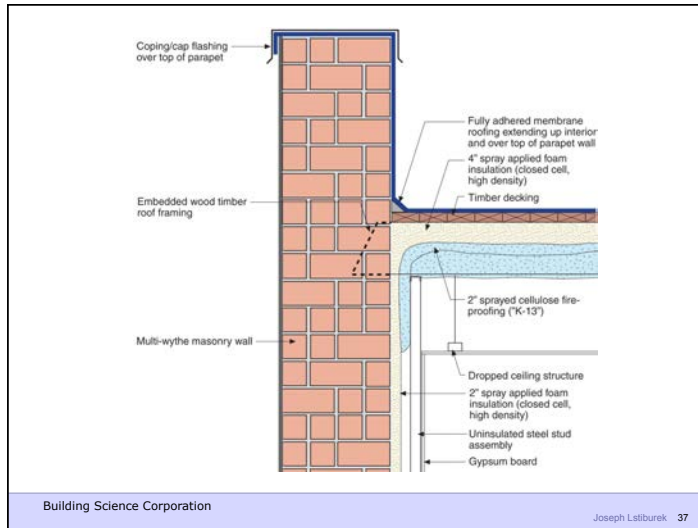


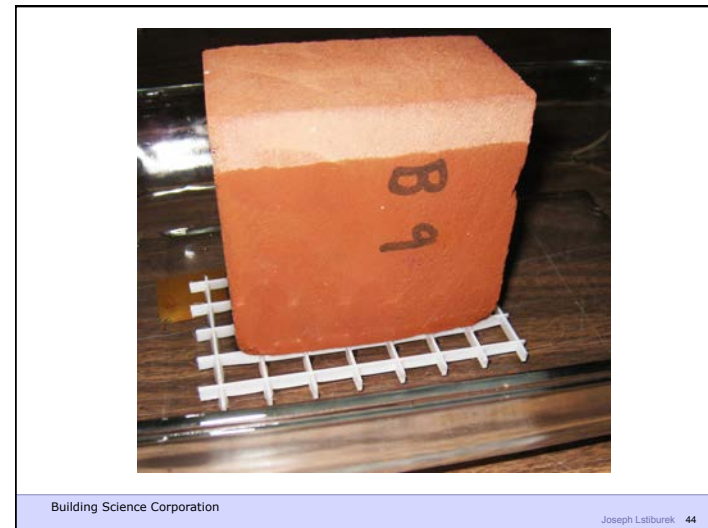
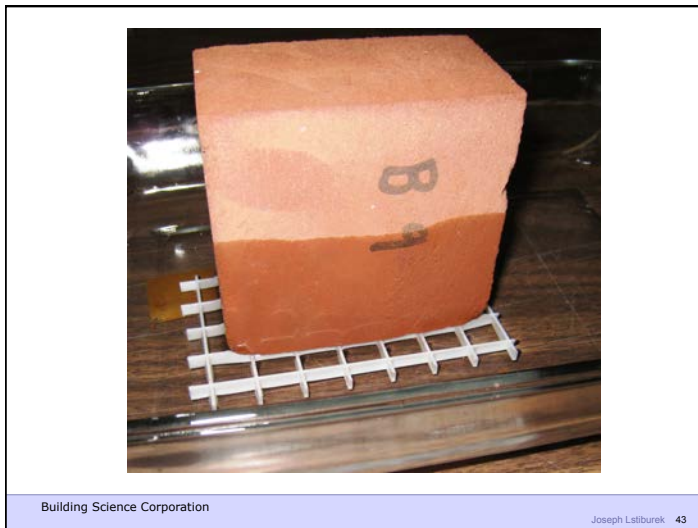
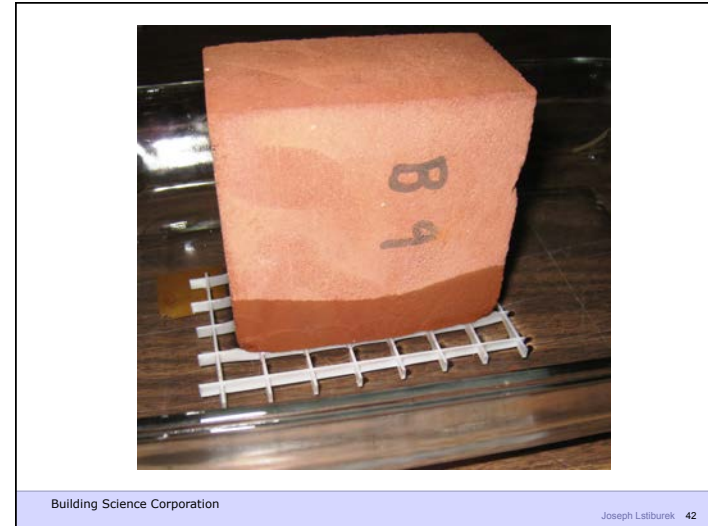


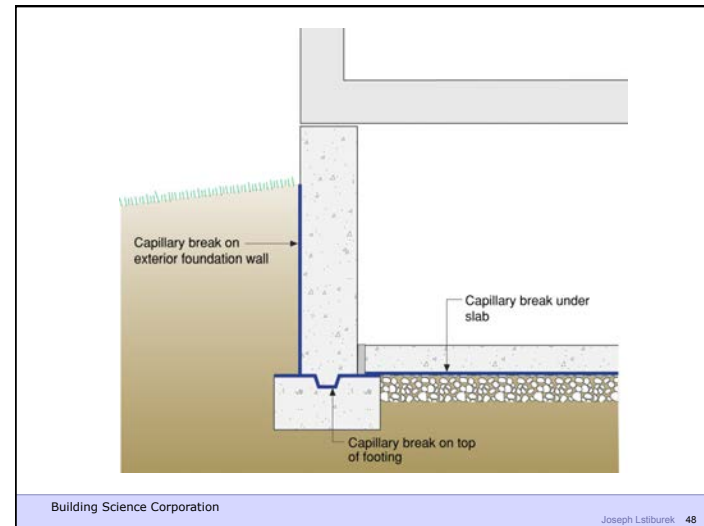
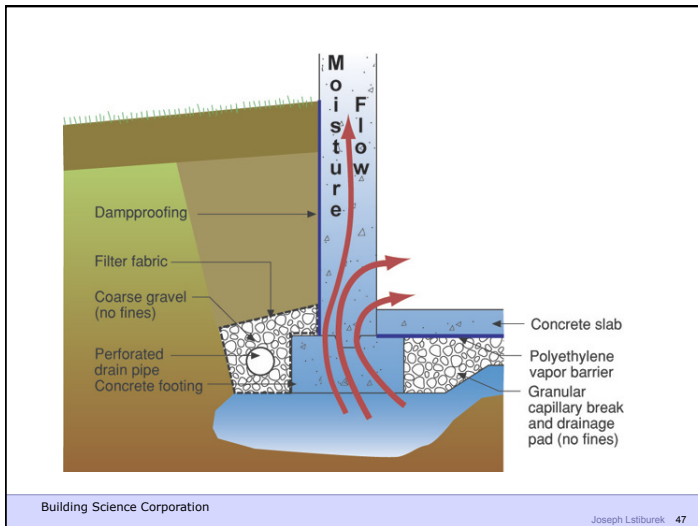
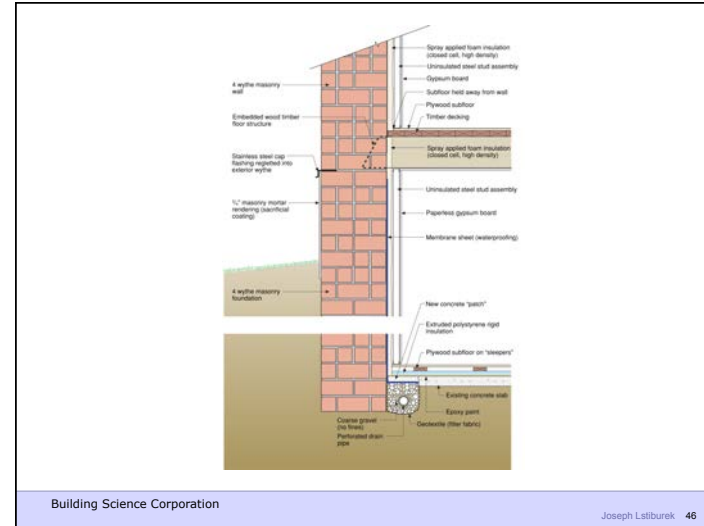














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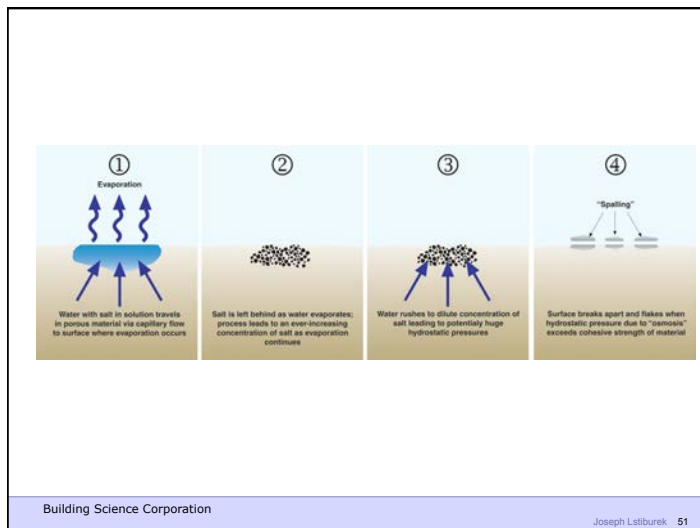
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### Capillarity + Salt = Osmosis

- Mineral salts carried in solution by capillary water
- When water evaporates from a surface the salts left behind form crystals in process called efflorescence
- When water evaporated beneath a surface the salts crystallize within the pore structure of the material in called sub-efflorescence
- The salt crystallization causes expansive forces that can exceed the cohesive strength of the material leading to spalling

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### Diffusion + Capillarity + Osmosis = Problem

• Diffusion Vapor Pressure	3 to 5 psi
• Capillary Pressure	300 to 500 psi
• Osmosis Pressure	3,000 to 5,000 psi

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