

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

Building Science

Adventures In Building Science

www.buildingscience.com



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Joseph Lstiburek 2

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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What Is A Building?

It is an environmental separator

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- Control heat flow
- Control airflow
- Control water vapor flow
- Control rain
- Control ground water
- Control light and solar radiation
- Control noise and vibrations
- Control contaminants, environmental hazards and odors
- Control insects, rodents and vermin
- Control fire
- Provide strength and rigidity
- Be durable
- Be aesthetically pleasing
- Be economical

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

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Cladding
Control layers
Structure

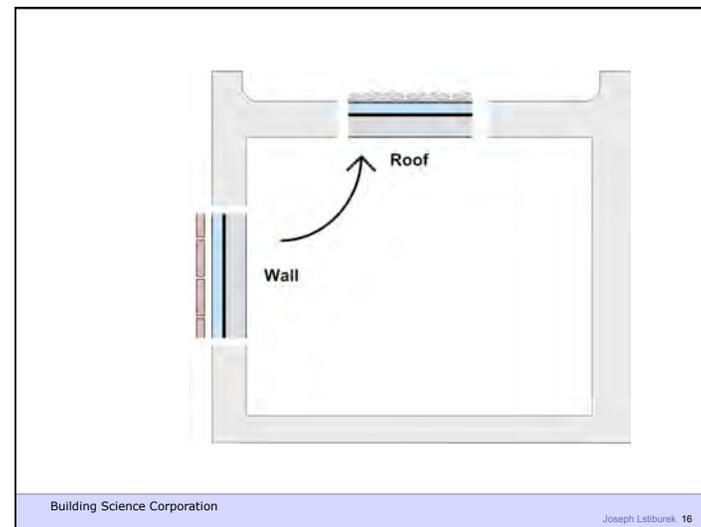
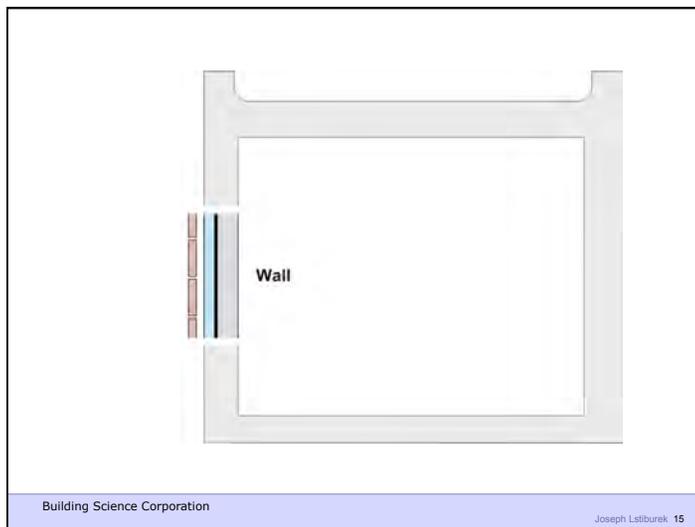
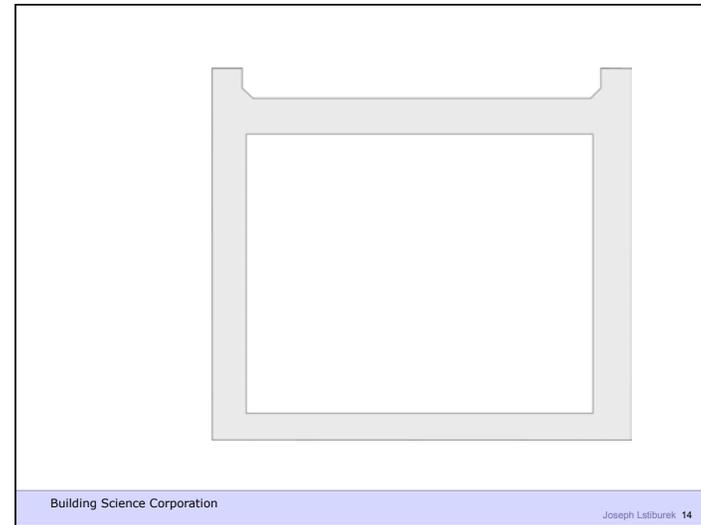
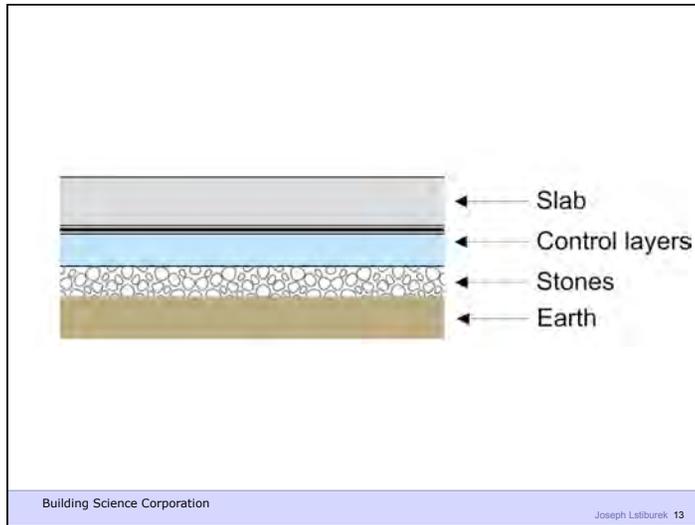
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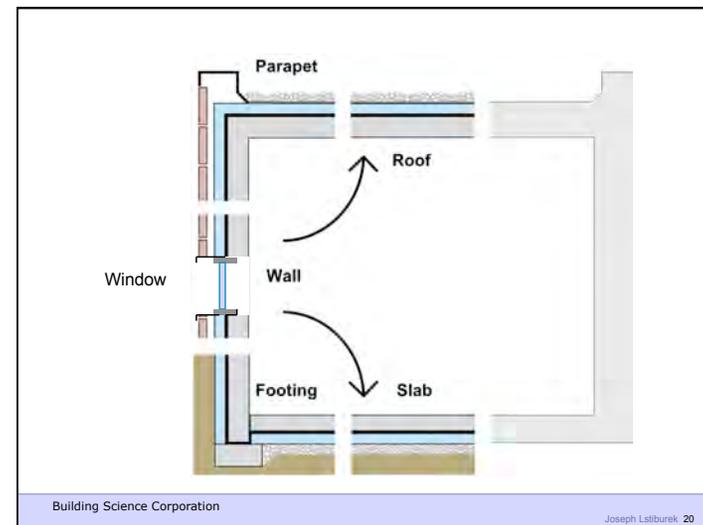
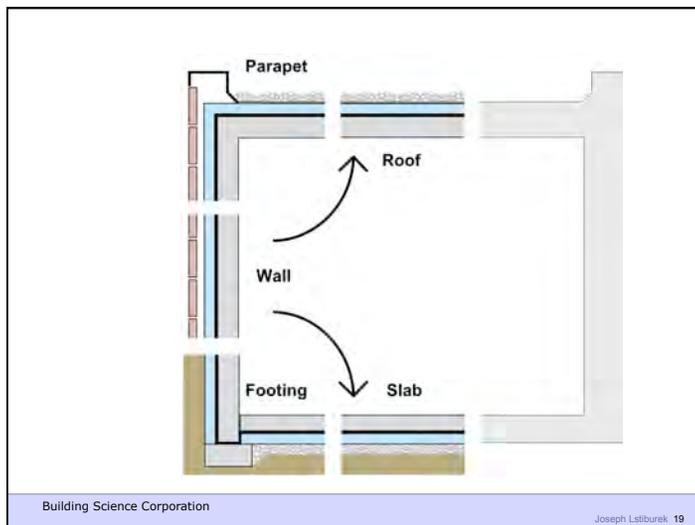
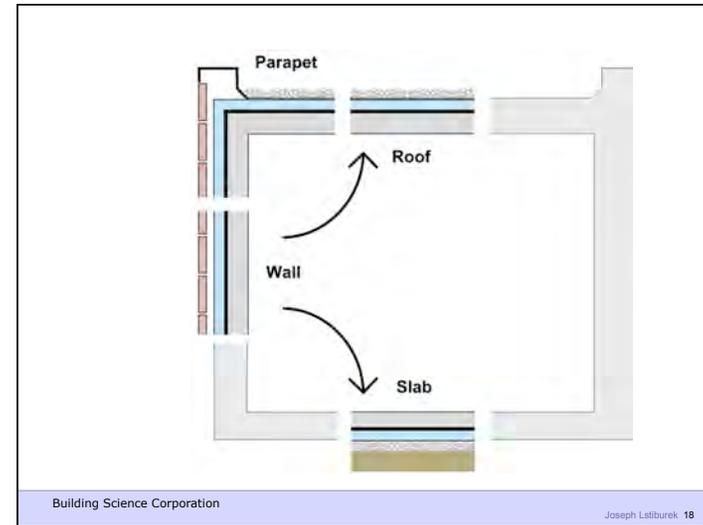
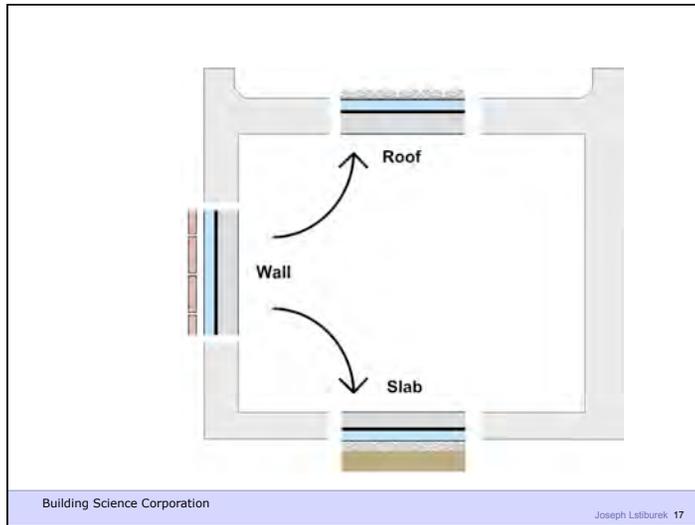
Wall
Slab
Roof

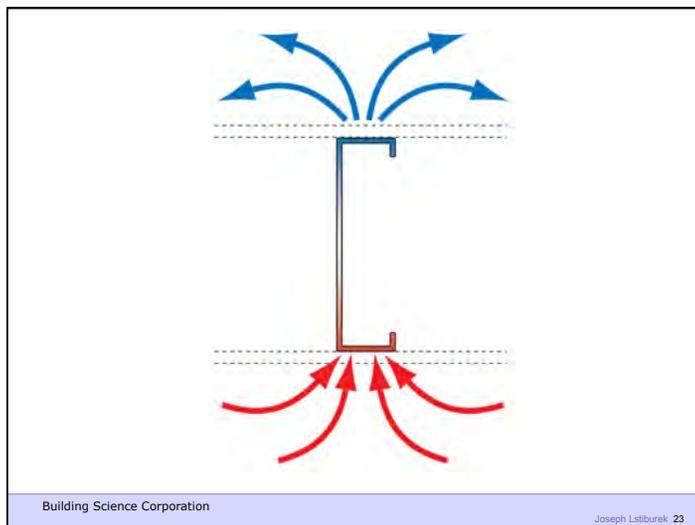
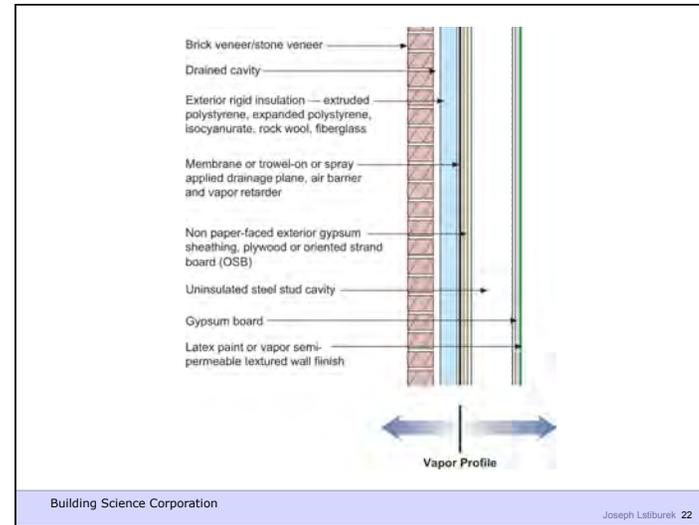
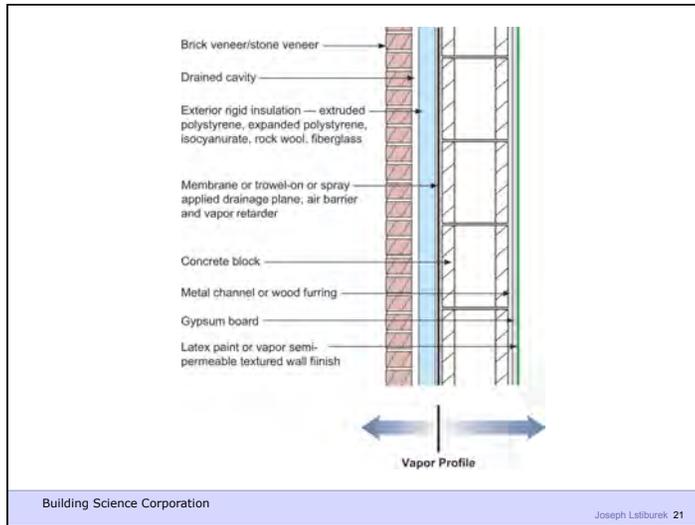
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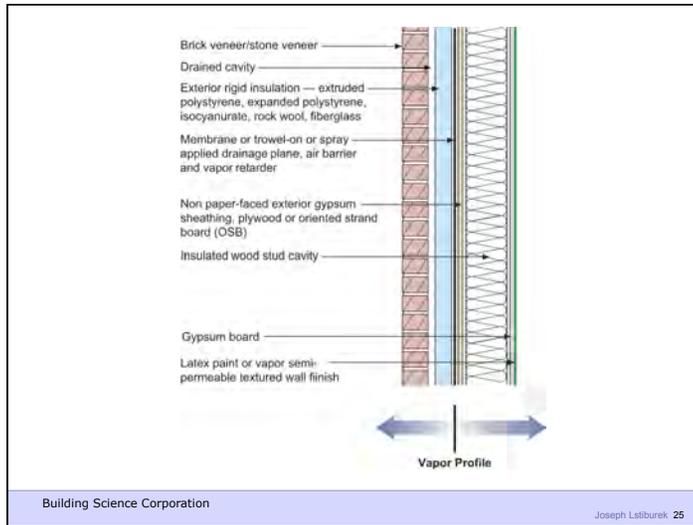
Ballast
Filter fabric
Control layers
Roof structure

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Commercial Enclosure: Simple Layers

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

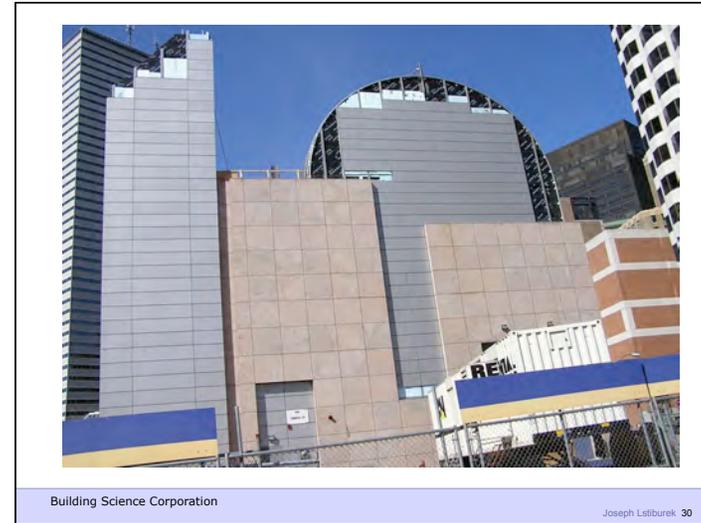
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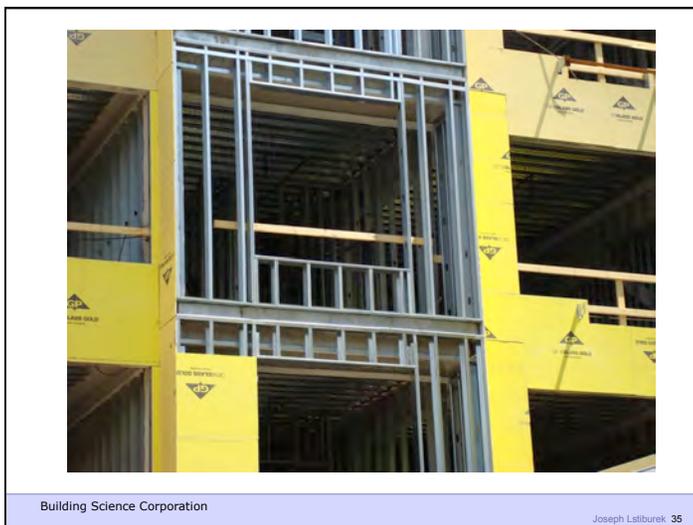
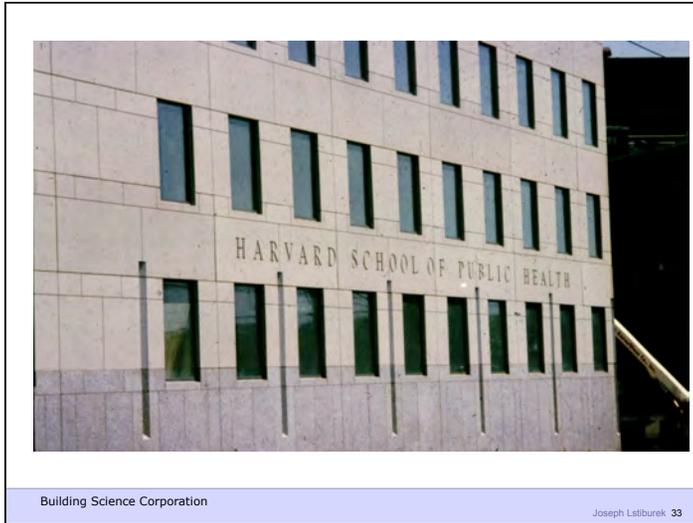
Enclosure Design: Details

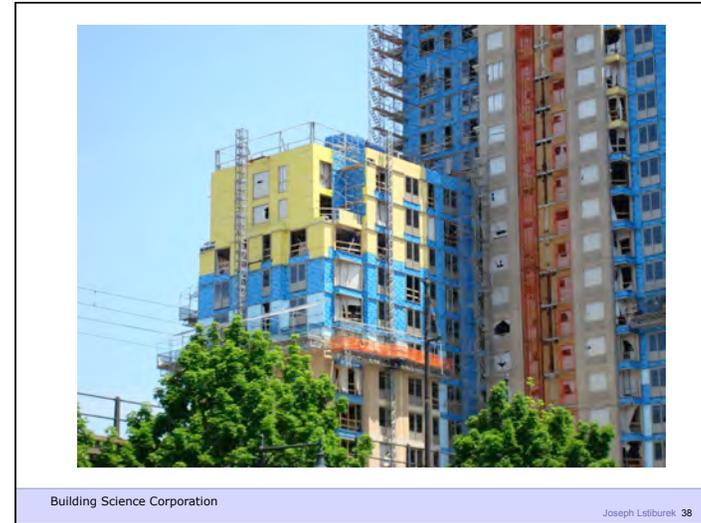
- Details demand the same approach as the enclosure.
- Scaled drawings required at 

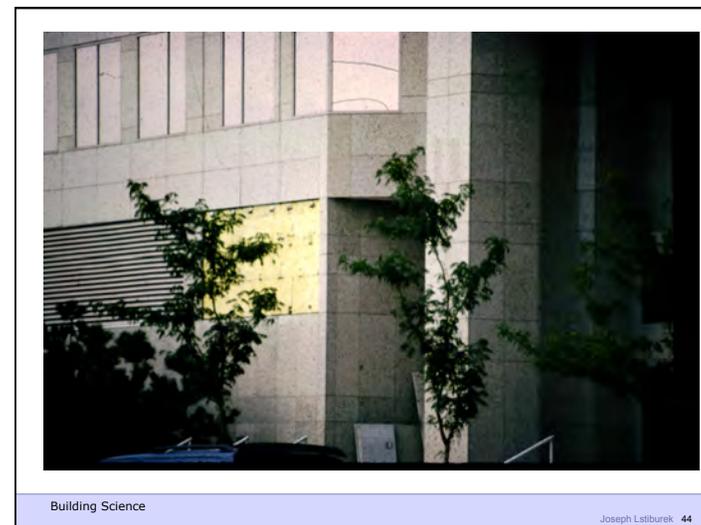
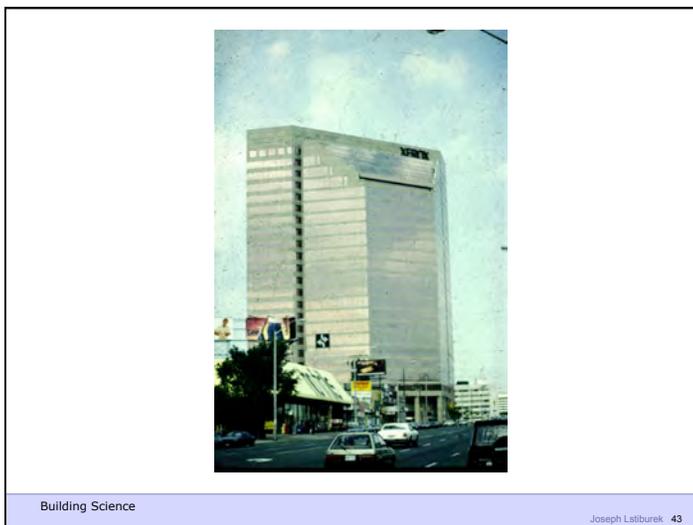
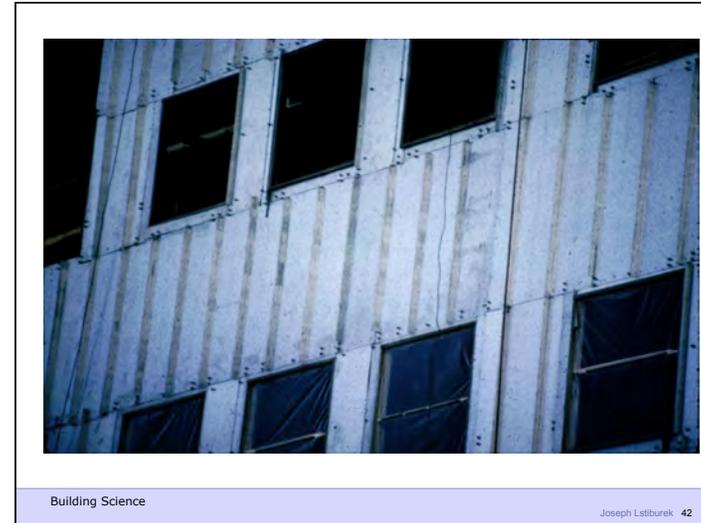
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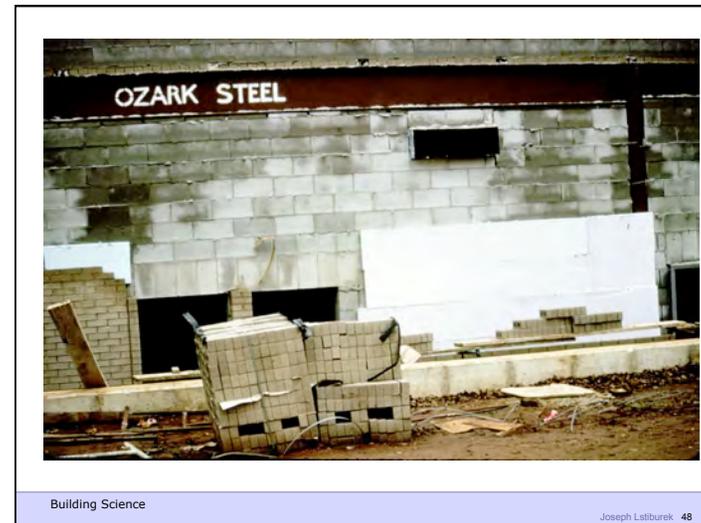
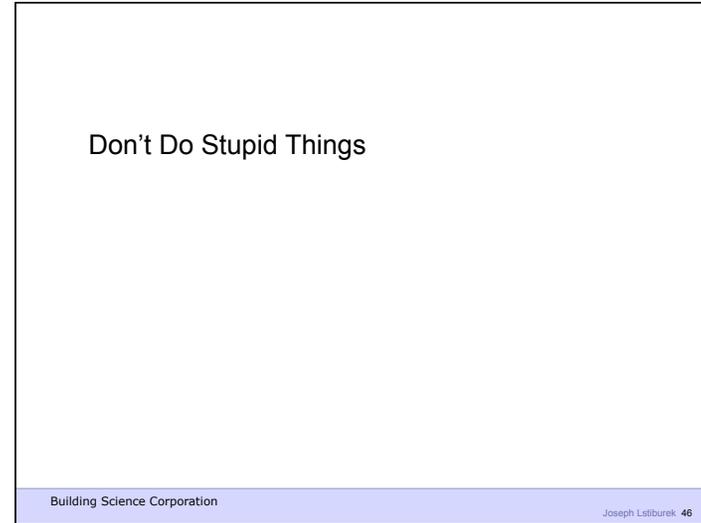
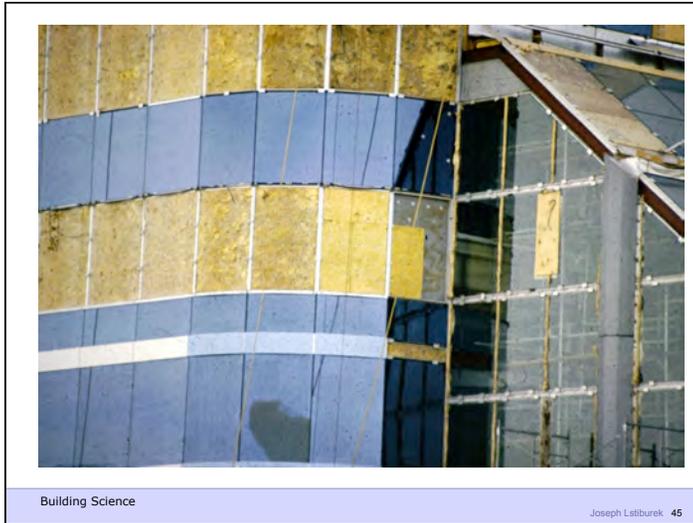


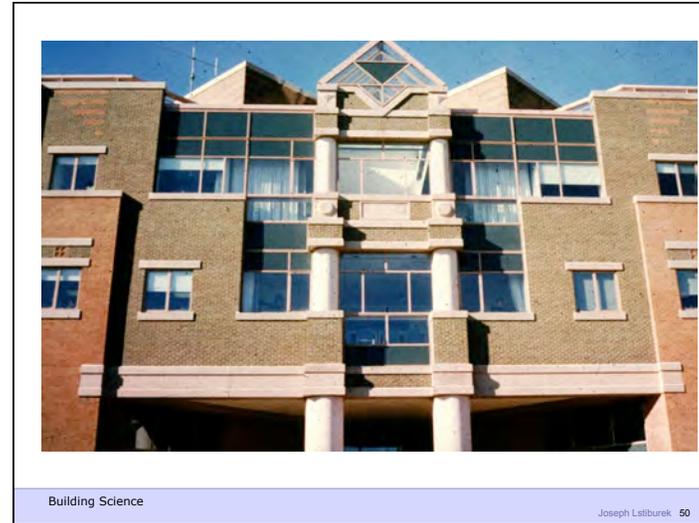


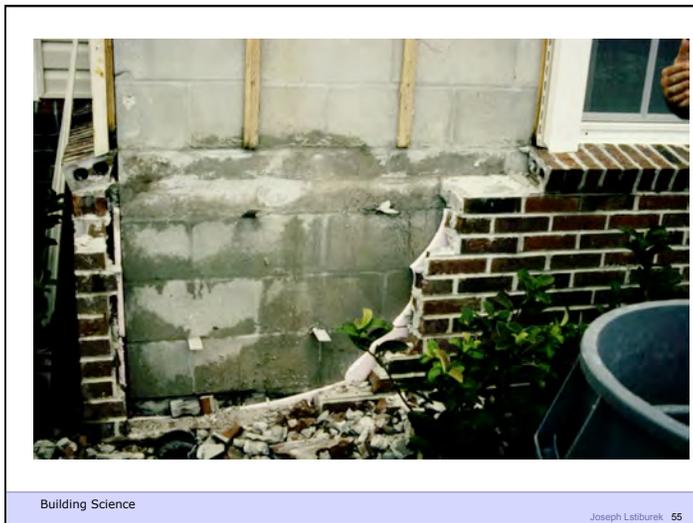


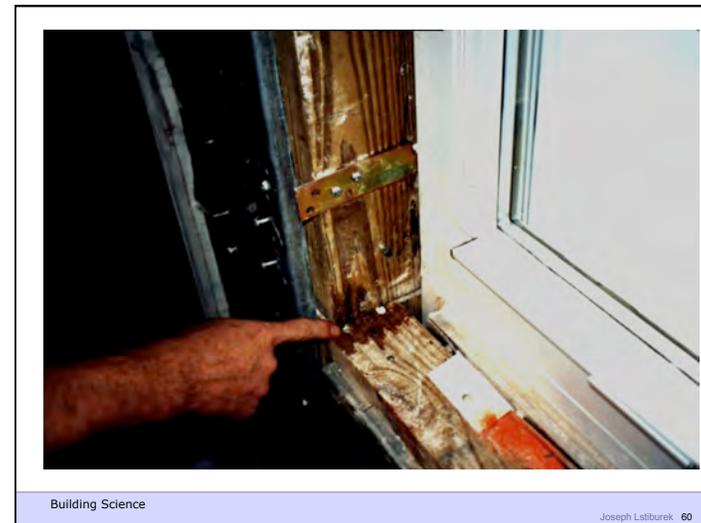
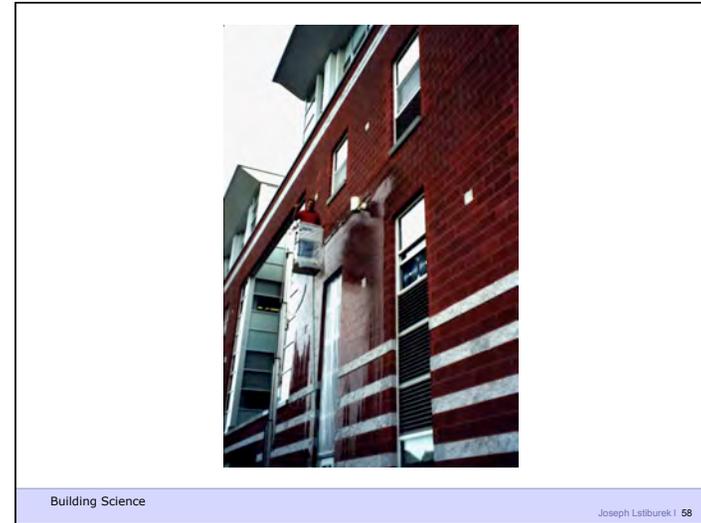
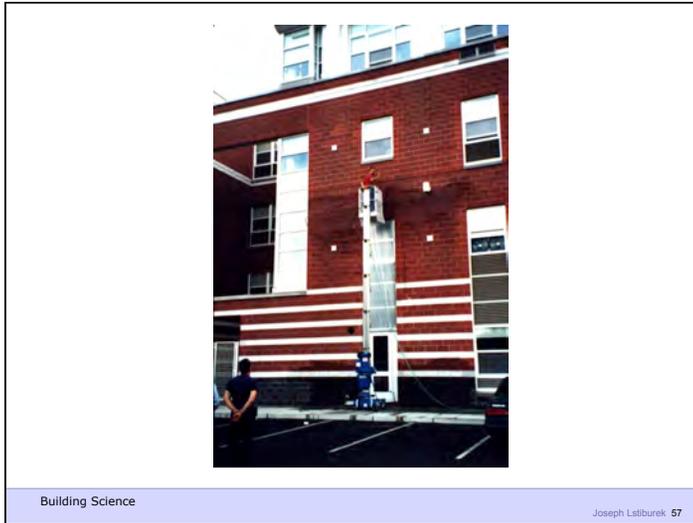


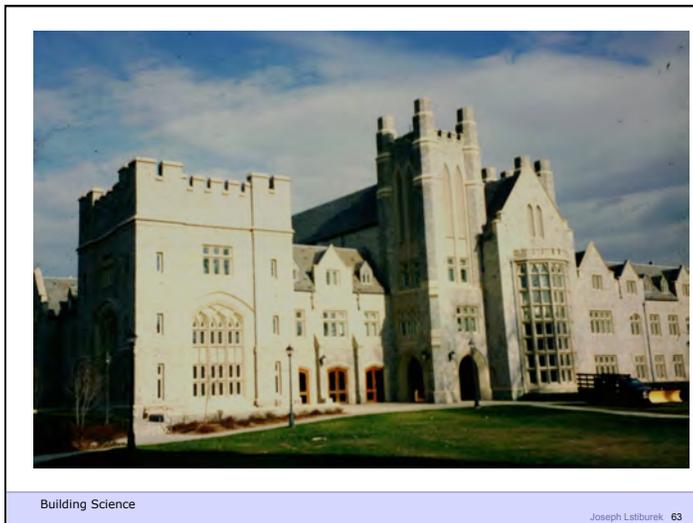
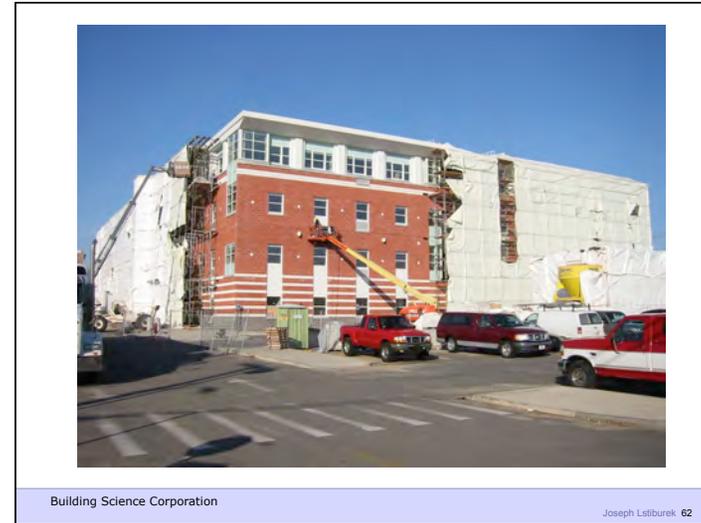














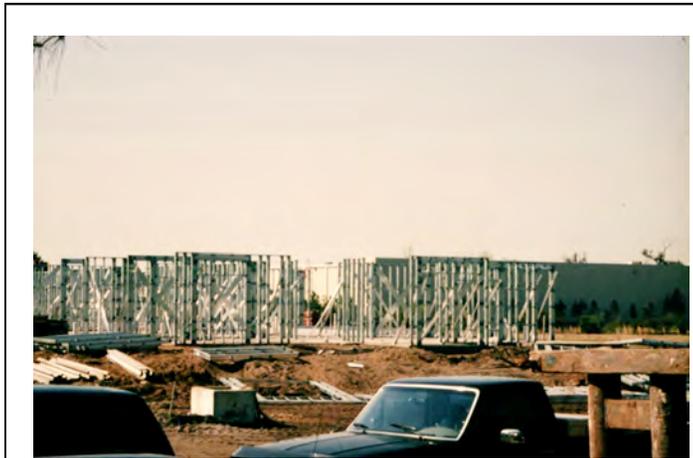
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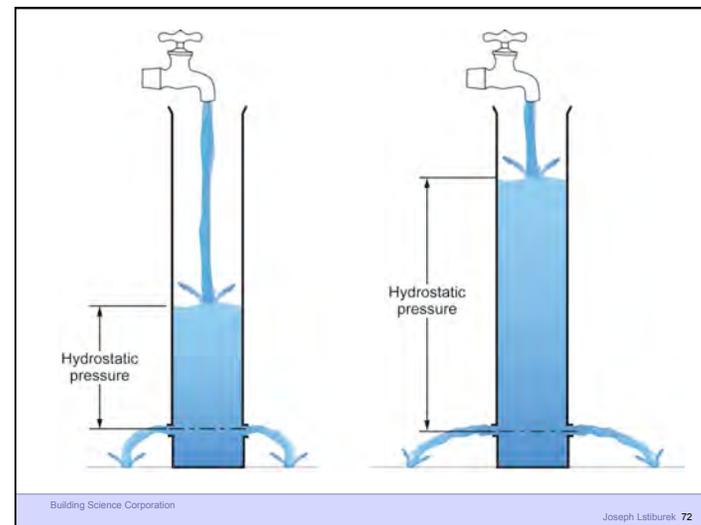
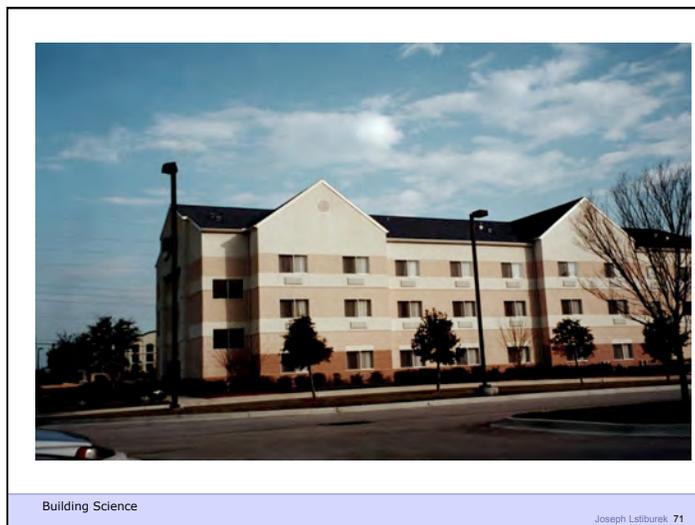
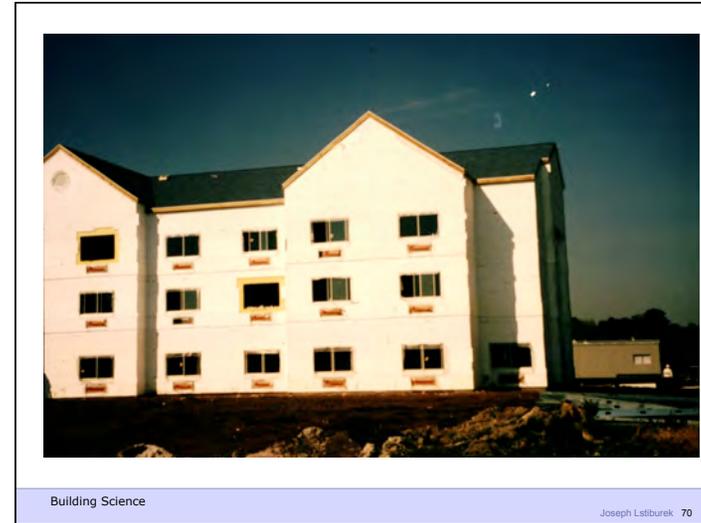
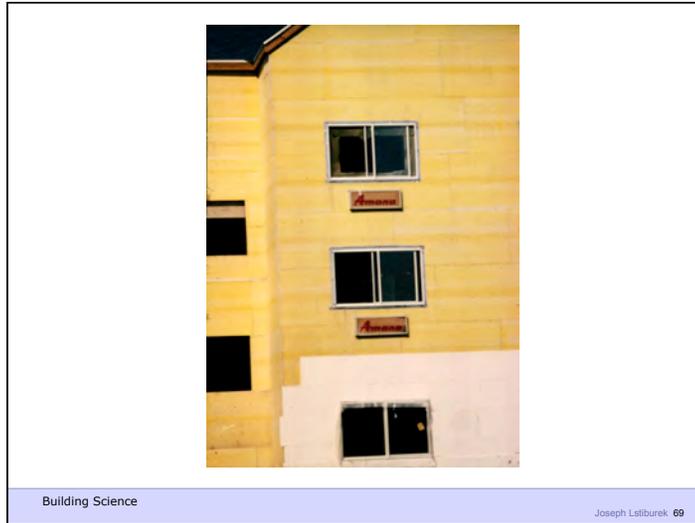
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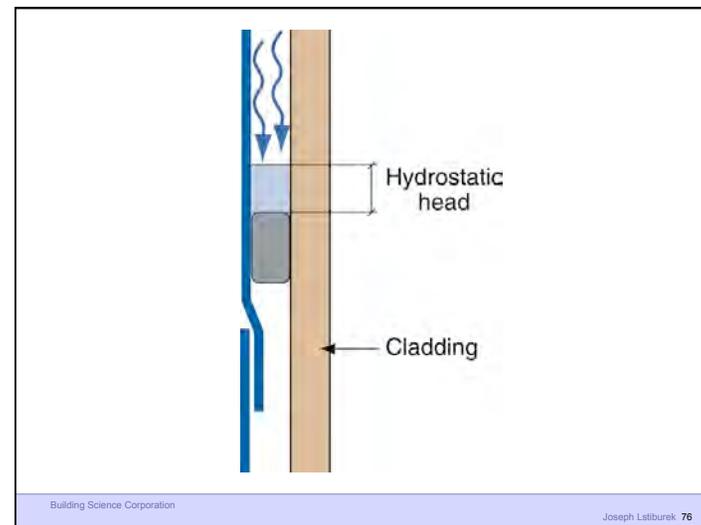
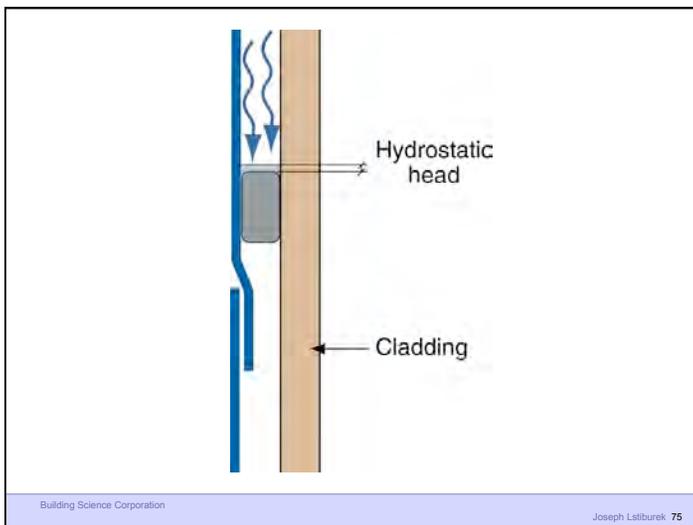
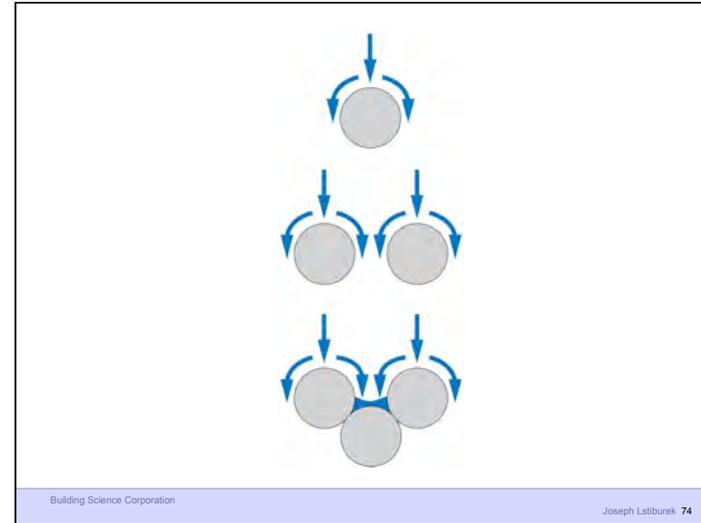
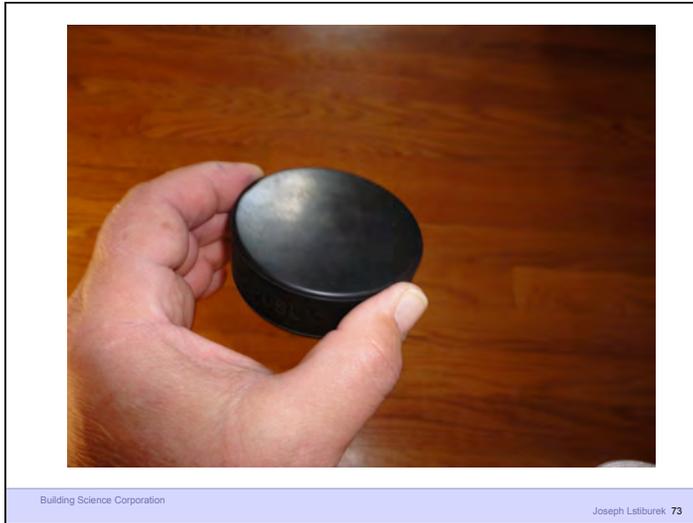
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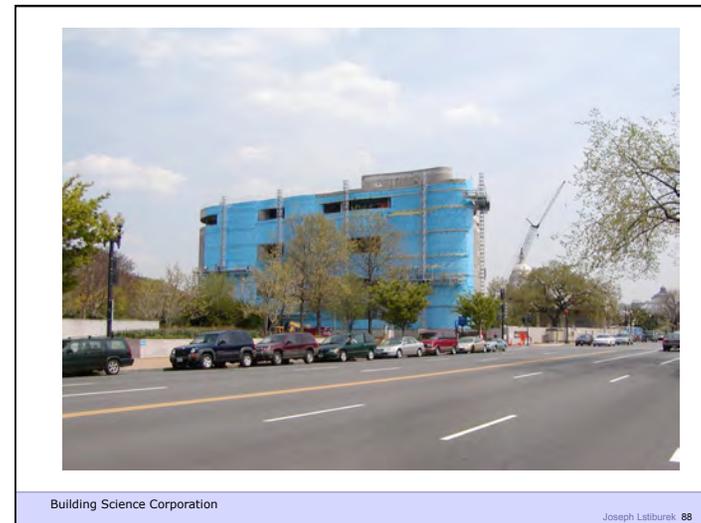
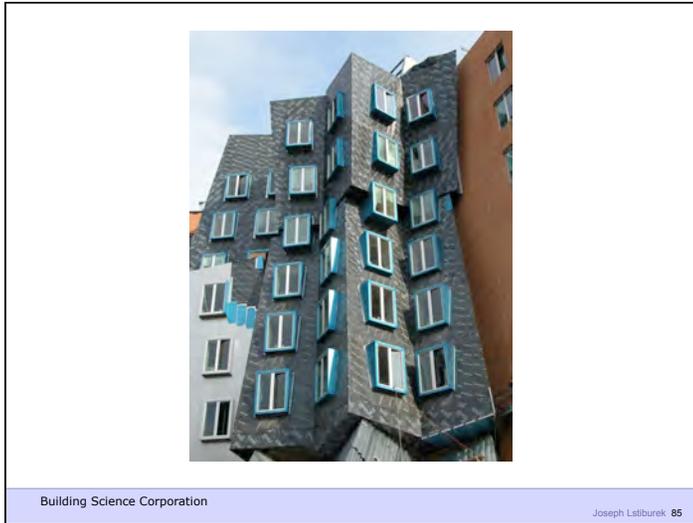
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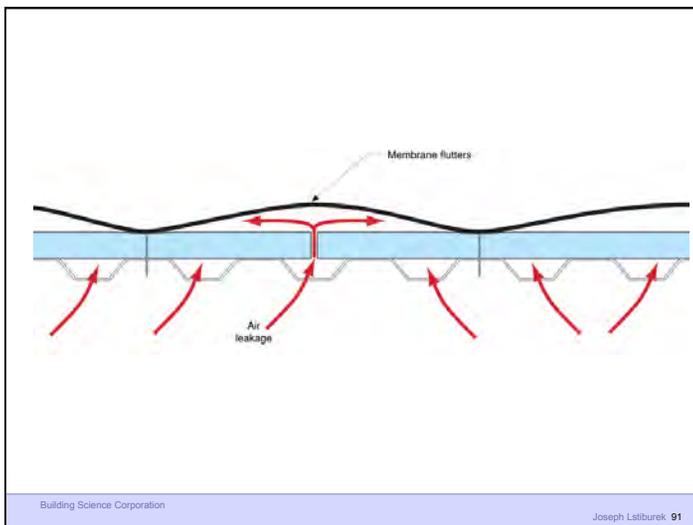
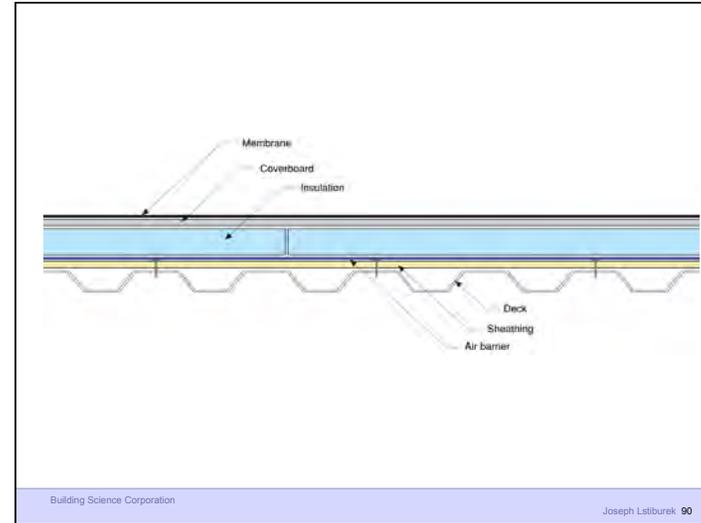
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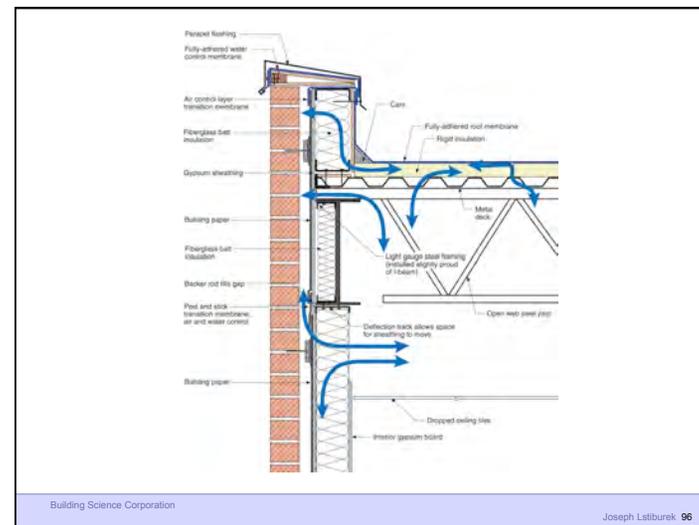
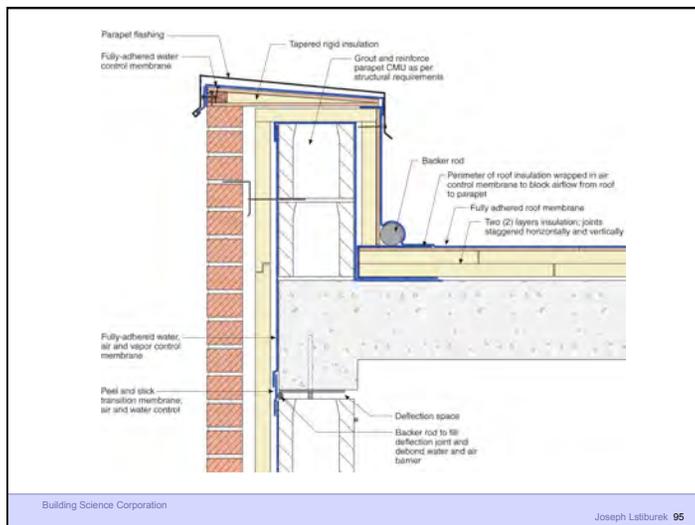
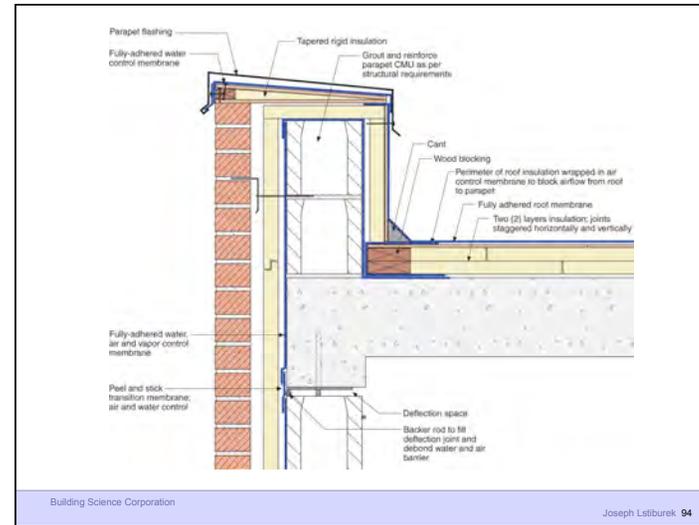
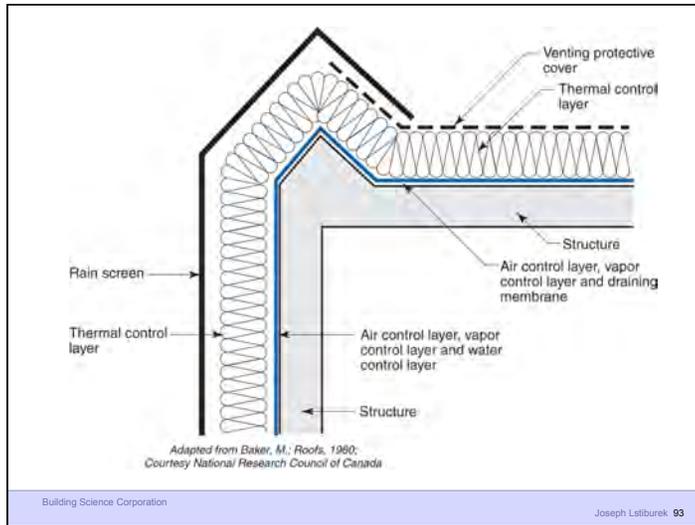


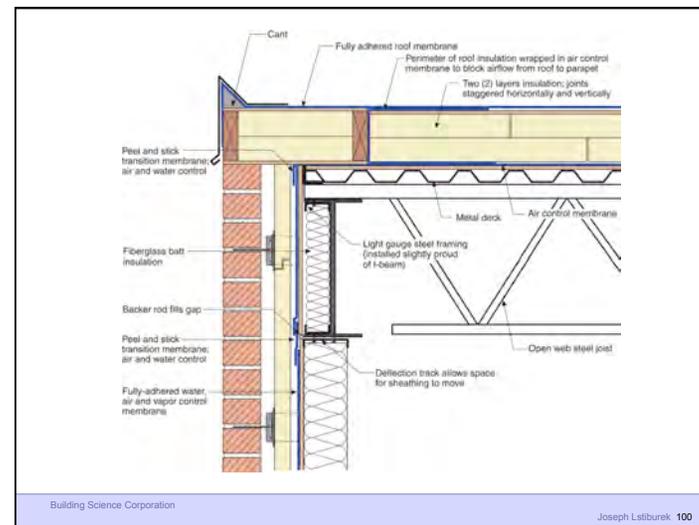
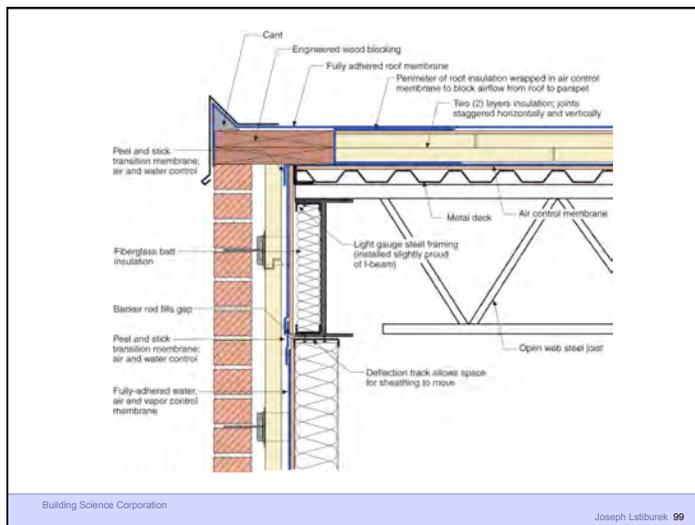
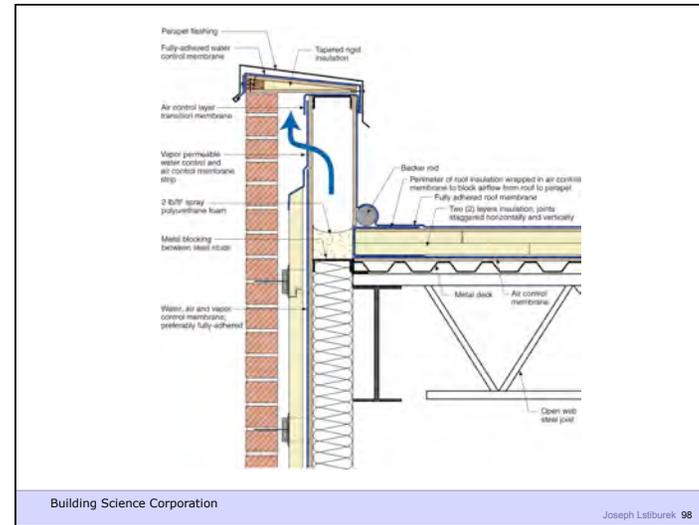
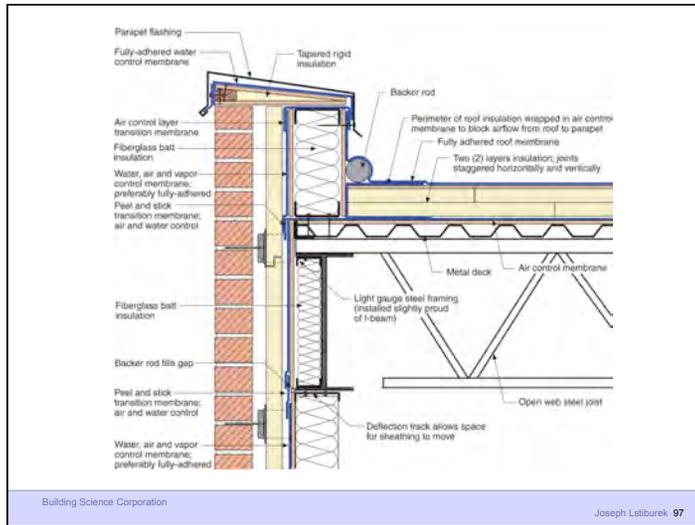














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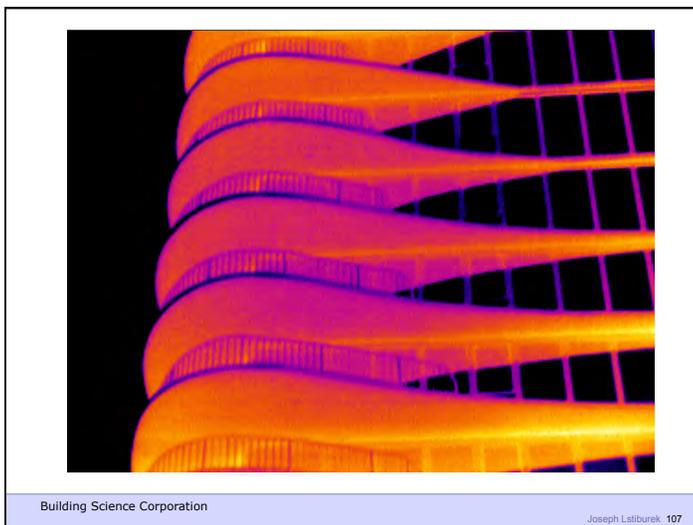
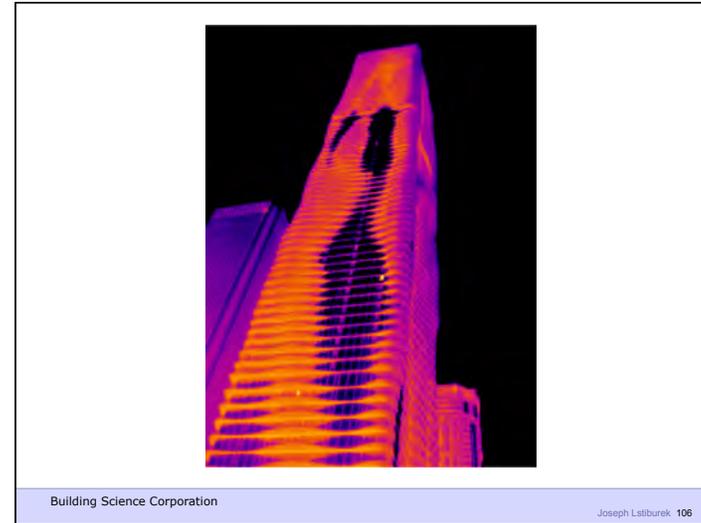
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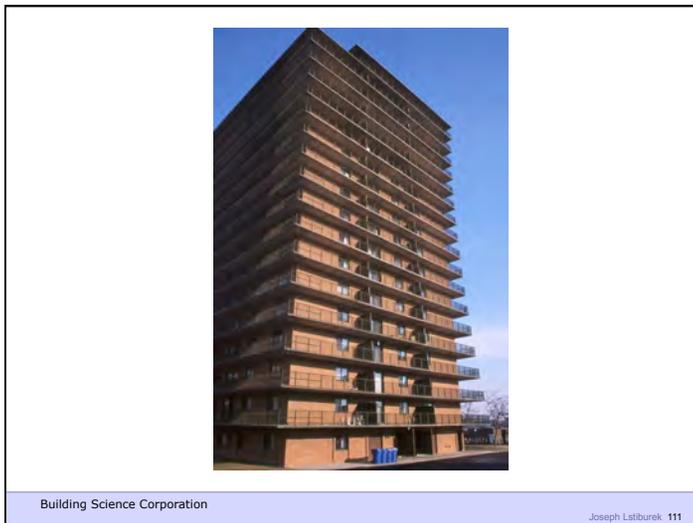
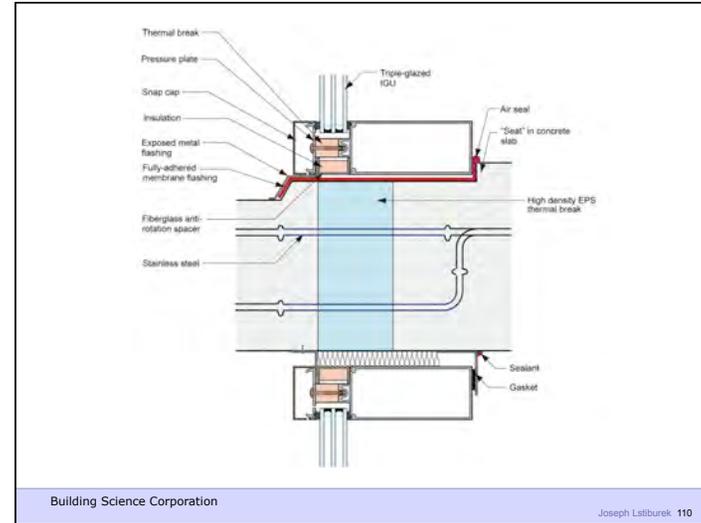
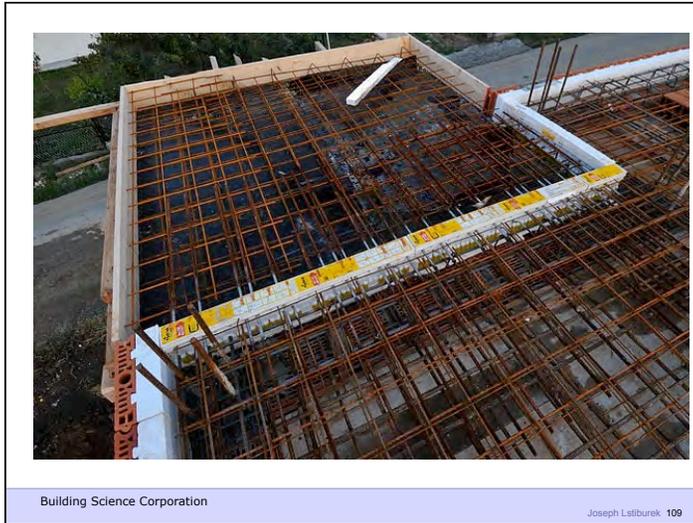
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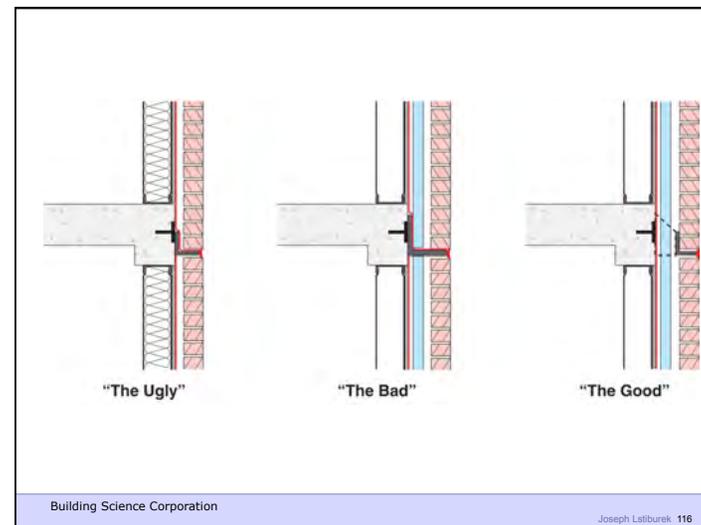
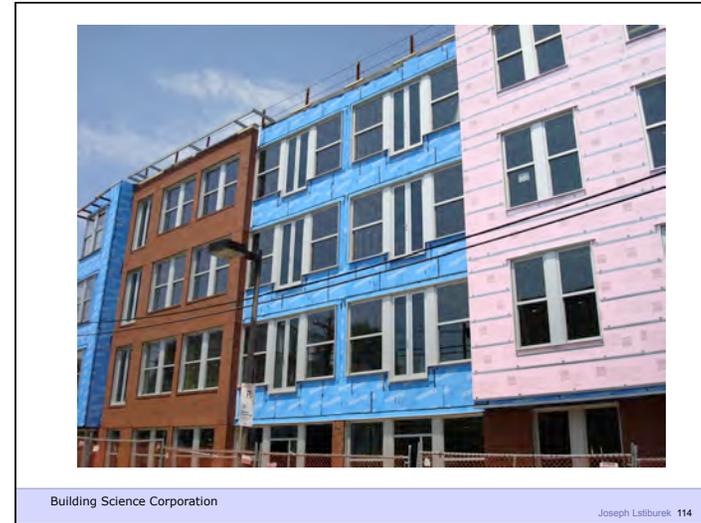
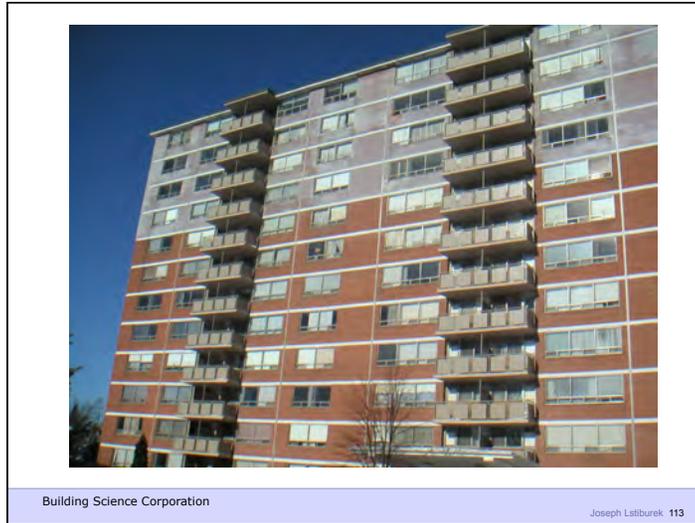


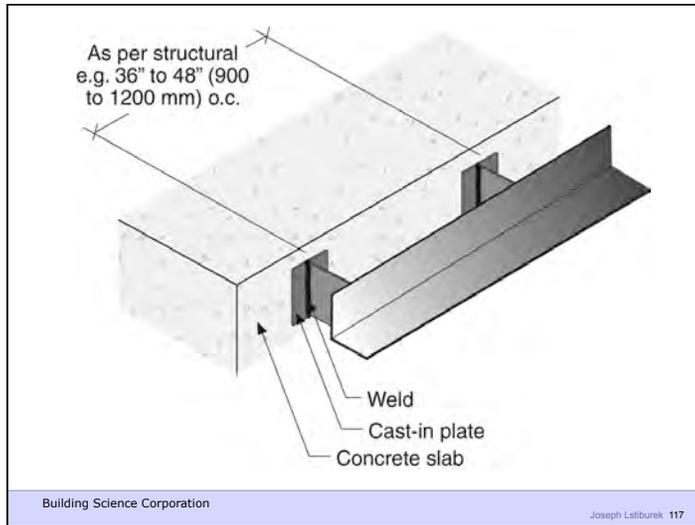
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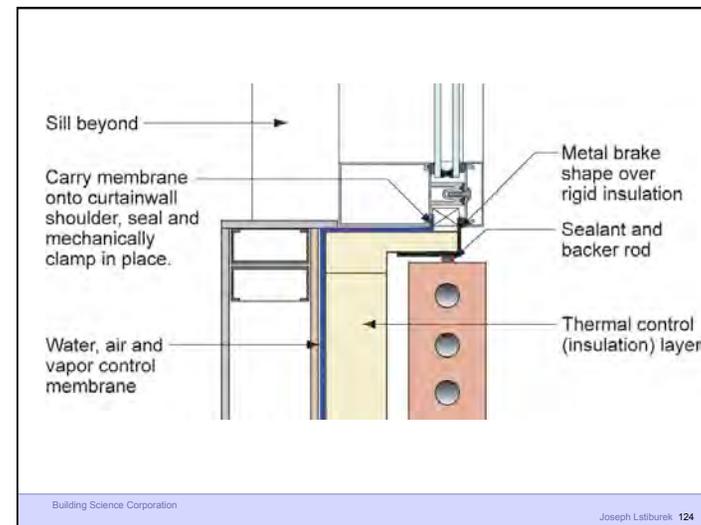
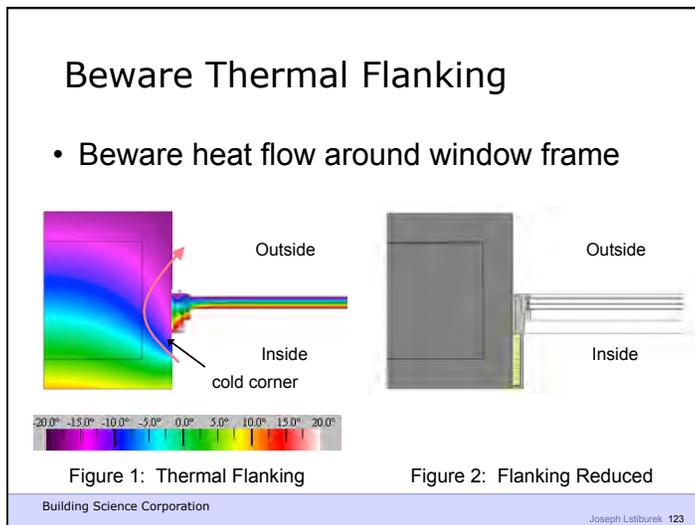
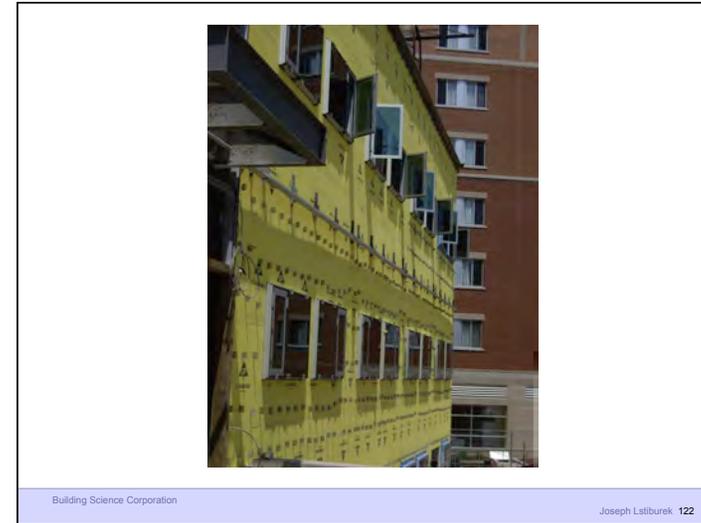
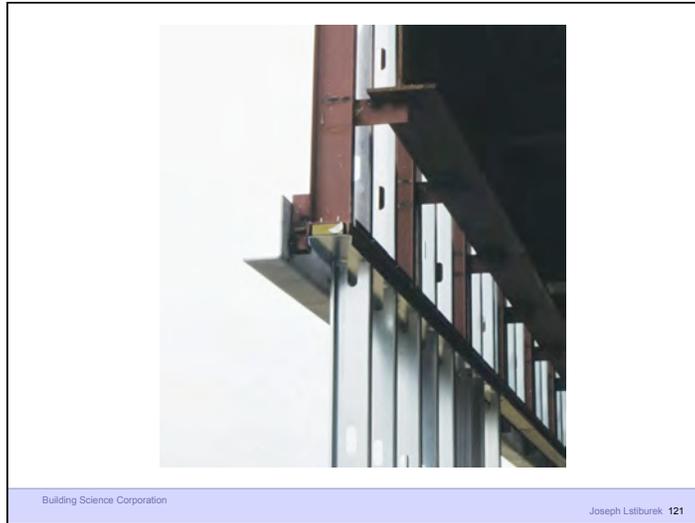
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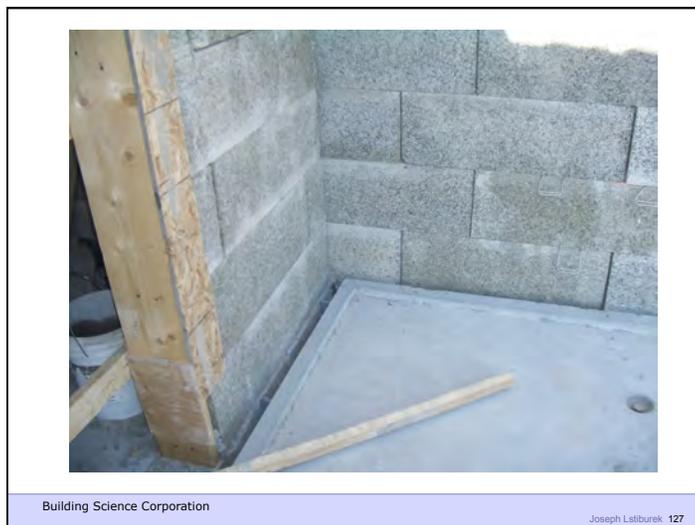
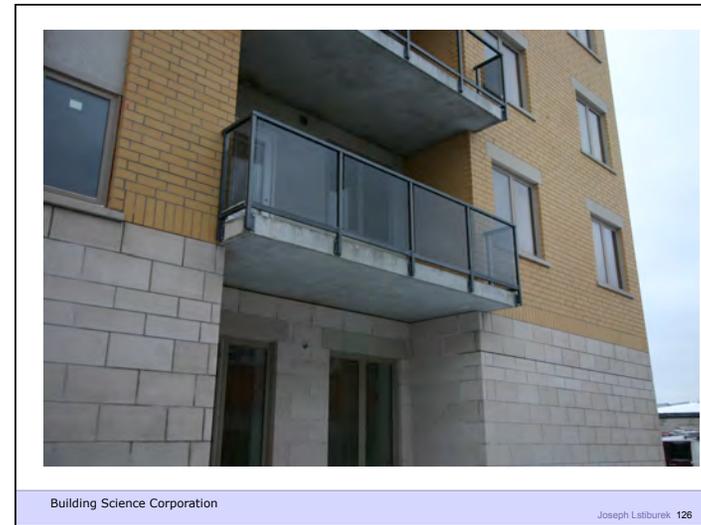
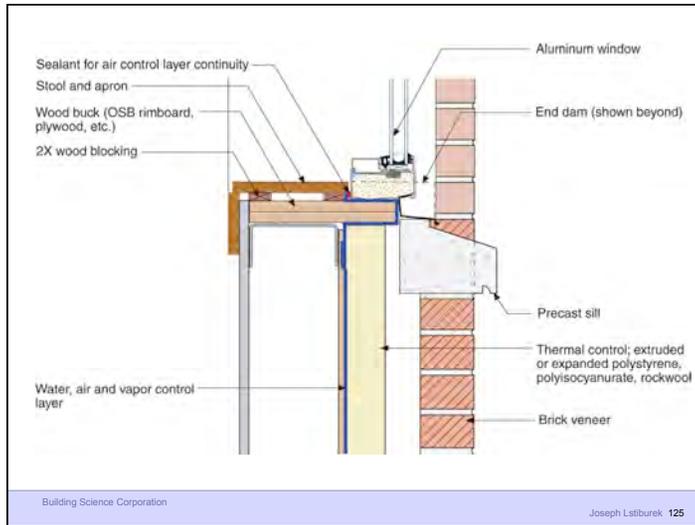


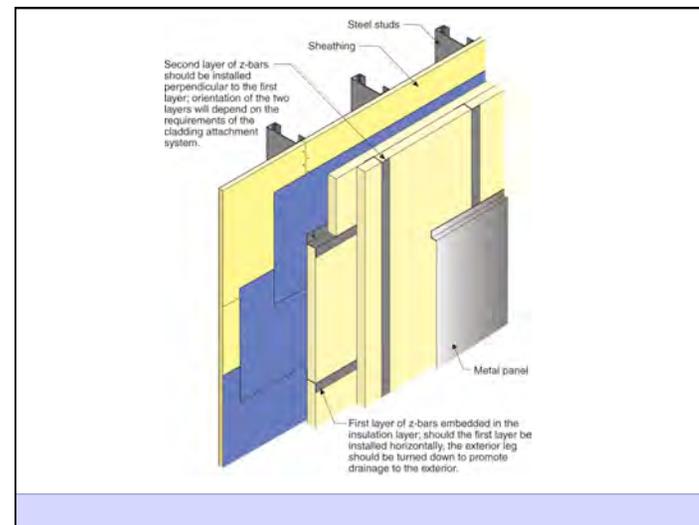
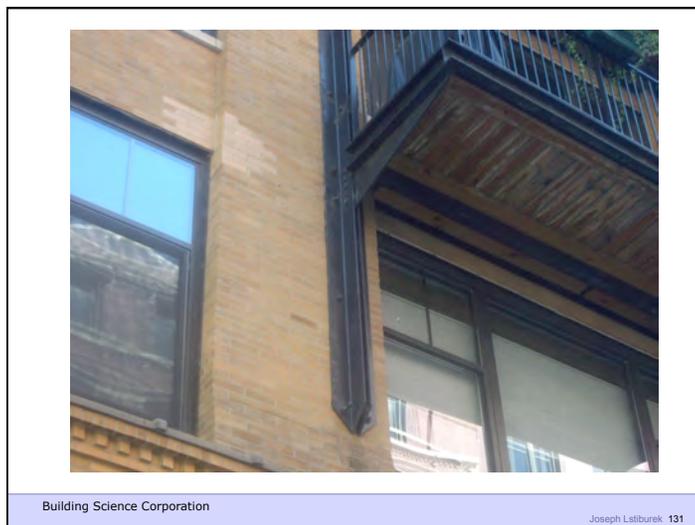
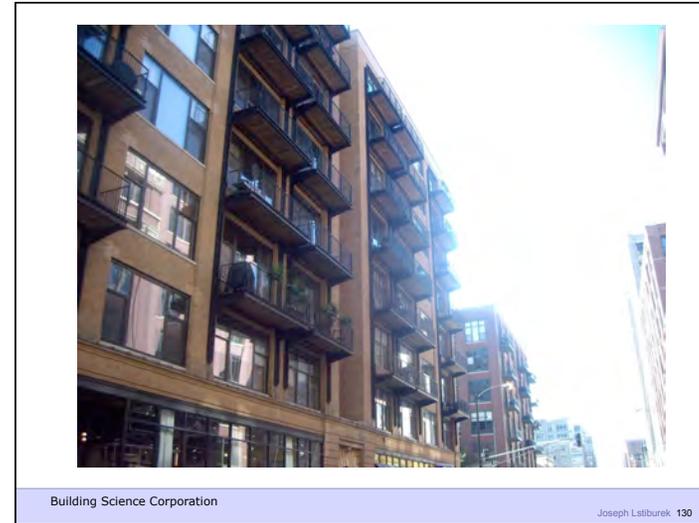
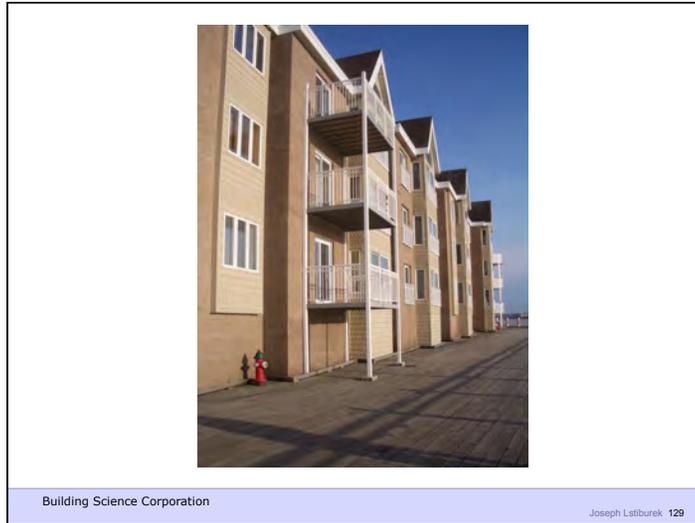


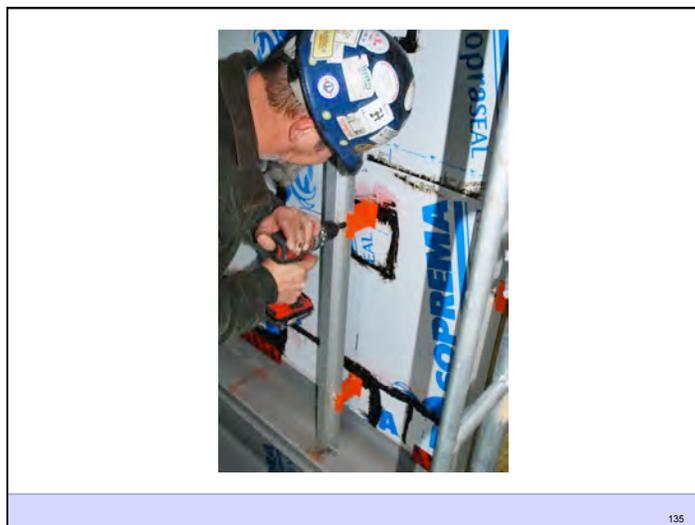
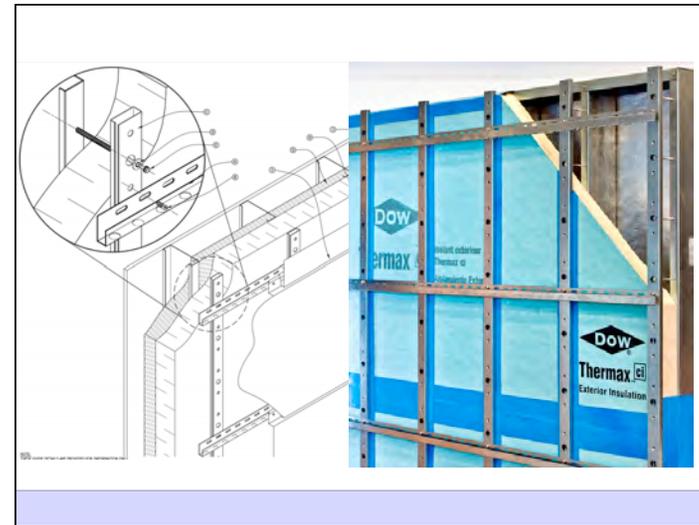
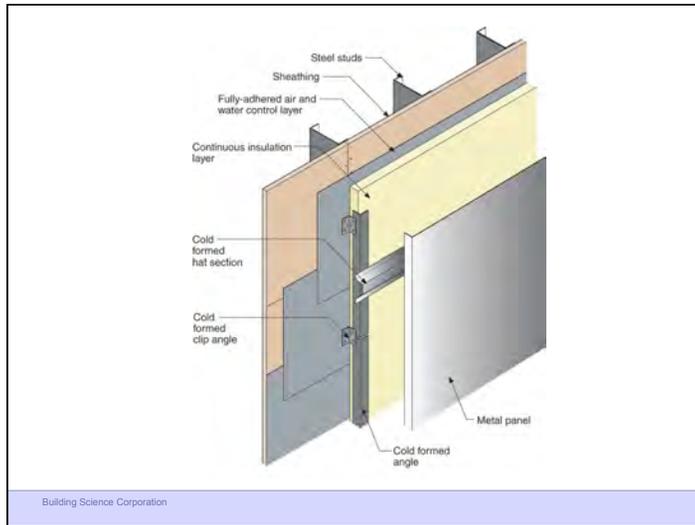












Rockwool

1x3 furring @ 24" o.c.
 #10 screws @ 16" o.c. vertically
 Result: 20 psf cladding weight
 with < 2/100" deflection

Graph Data (Approximate):

| Average Cladding Weight (psf) | Average Deflection of Framing (inches) |
|-------------------------------|--|
| 0 | 0.00 |
| 100 | 0.01 |
| 200 | 0.02 |
| 300 | 0.03 |
| 400 | 0.04 |
| 500 | 0.05 |
| 600 | 0.06 |
| 700 | 0.07 |
| 800 | 0.08 |
| 900 | 0.09 |
| 1000 | 0.10 |

