



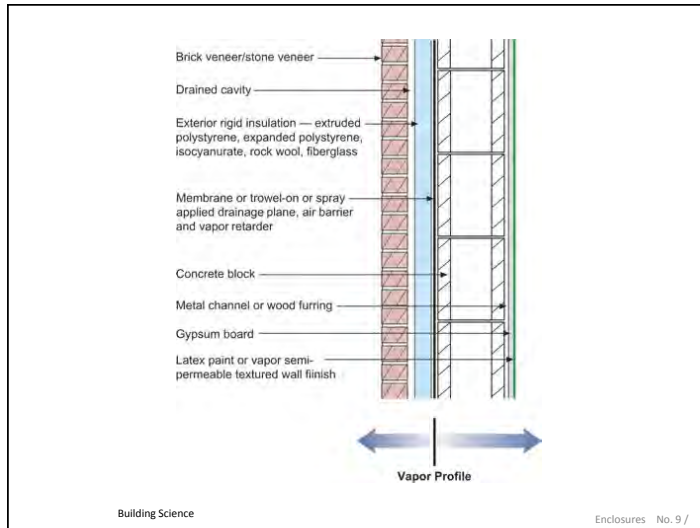
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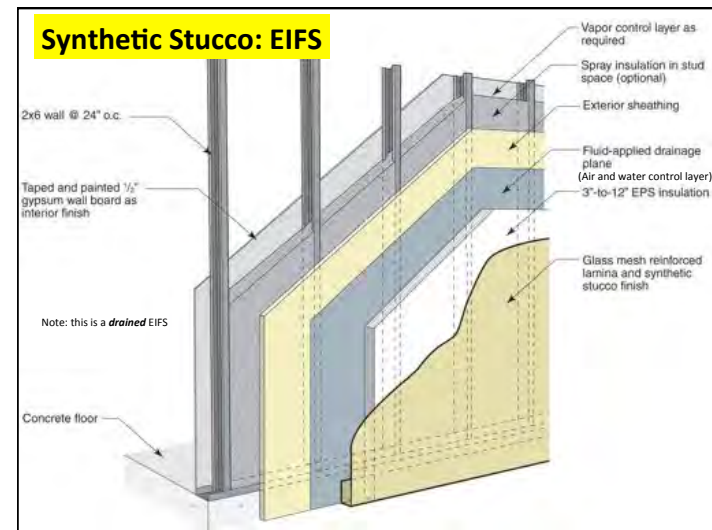
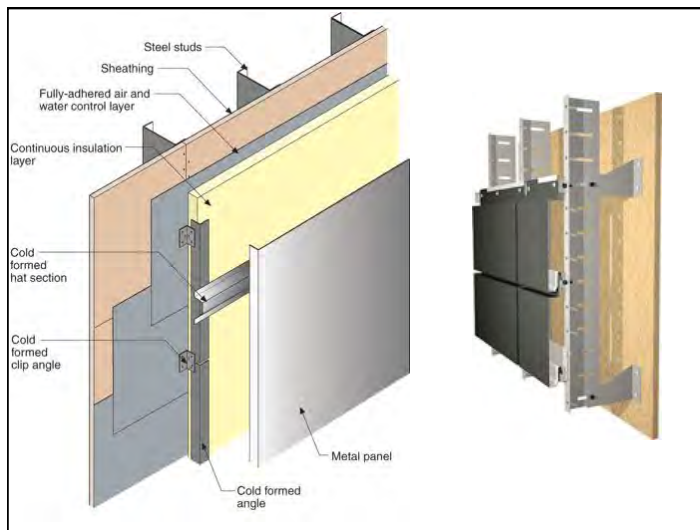
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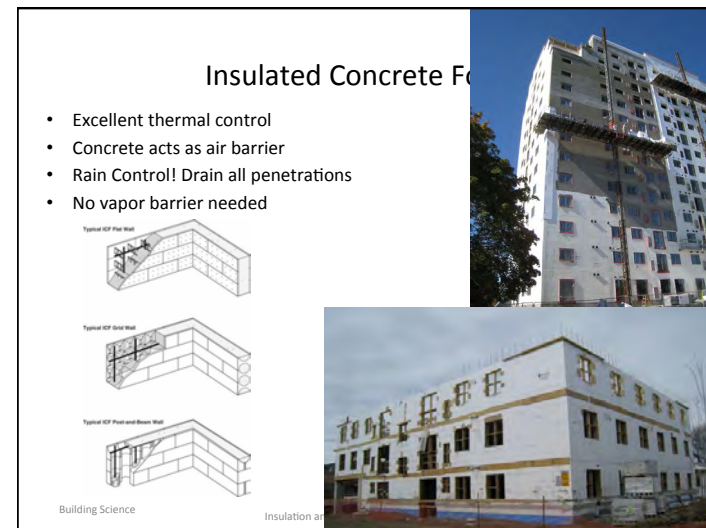
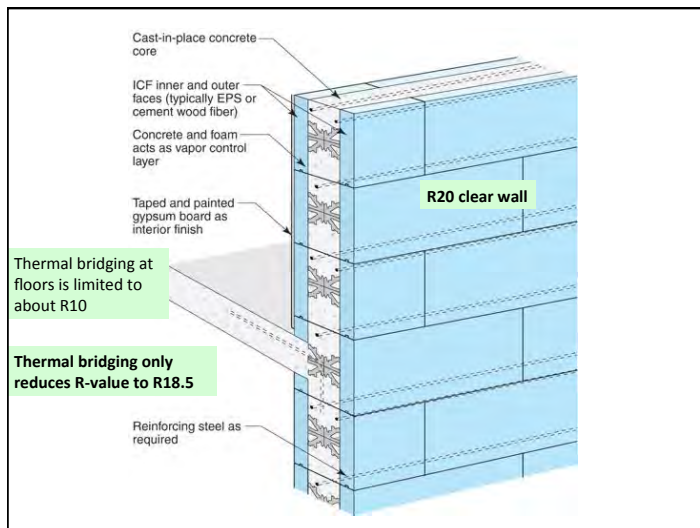
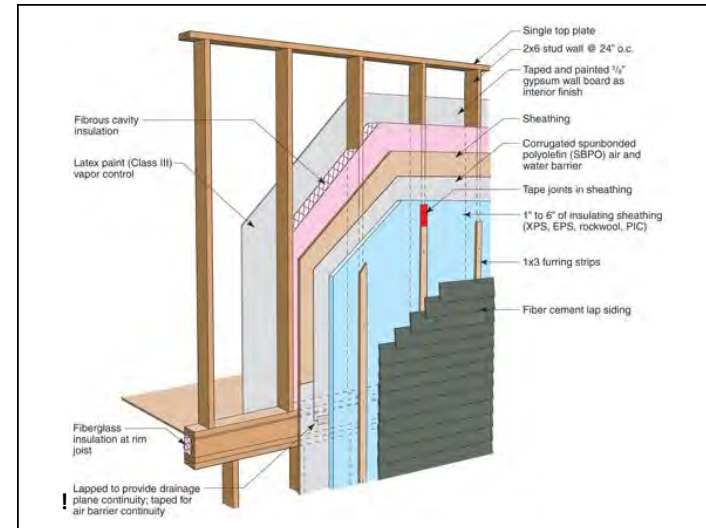


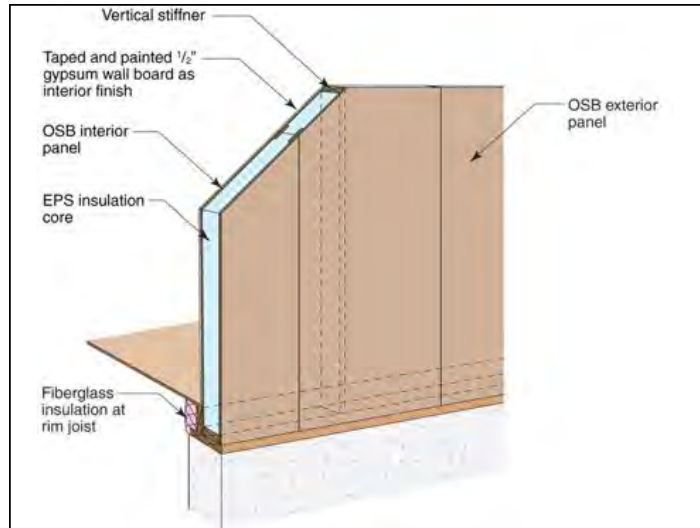
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Structural Insulated Panels

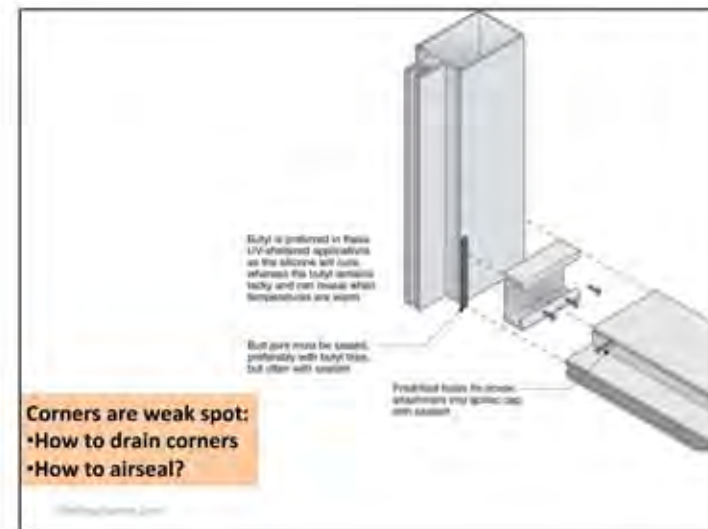
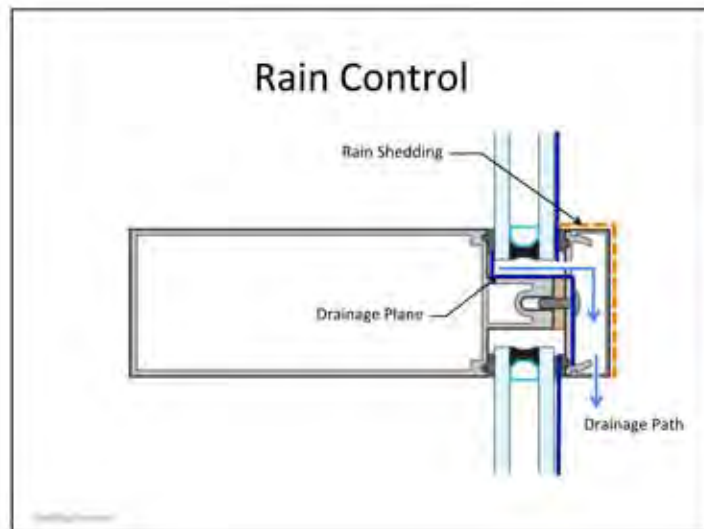
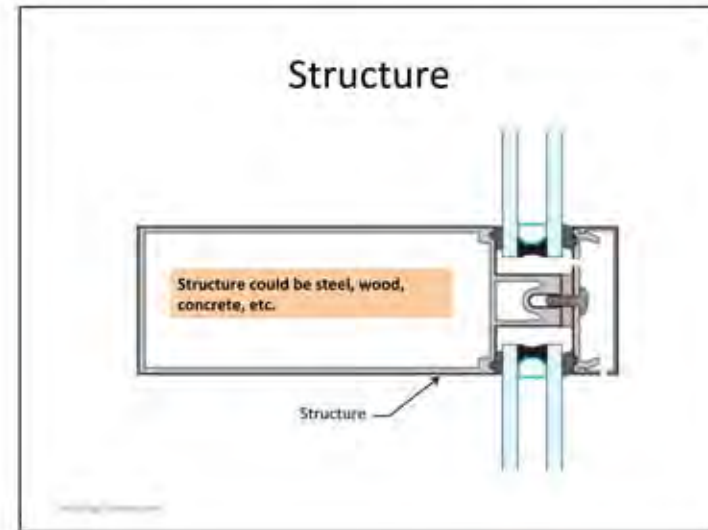
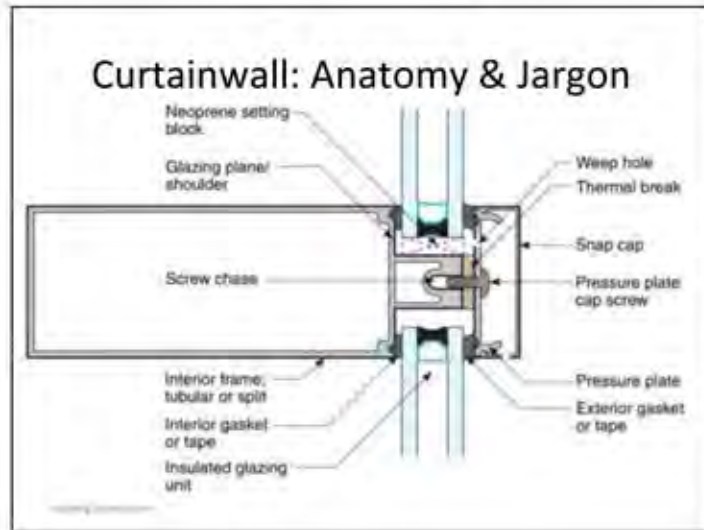
- Advantages
 - Superior blanket of insulation
 - if no voids then no convection or windwashing
 - May seal OSB joints for excellent air barrier system
- Therefore, done right = excellent
- Small air leaks at joints in roofs can cause problems
- Don't get them too wet from rain
 - Low perm layers means limited drying
 - Always use drained / ventilated cladding! Stucco!

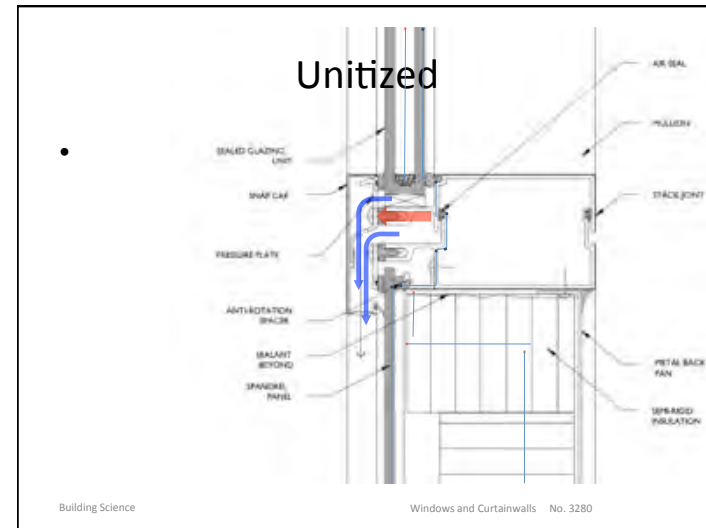
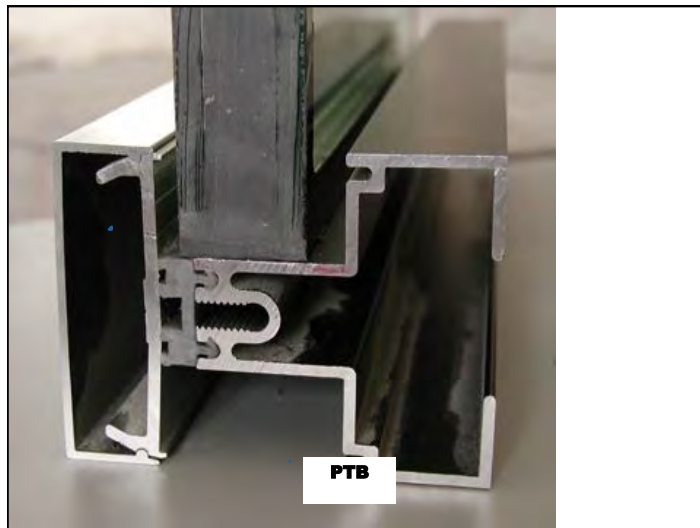
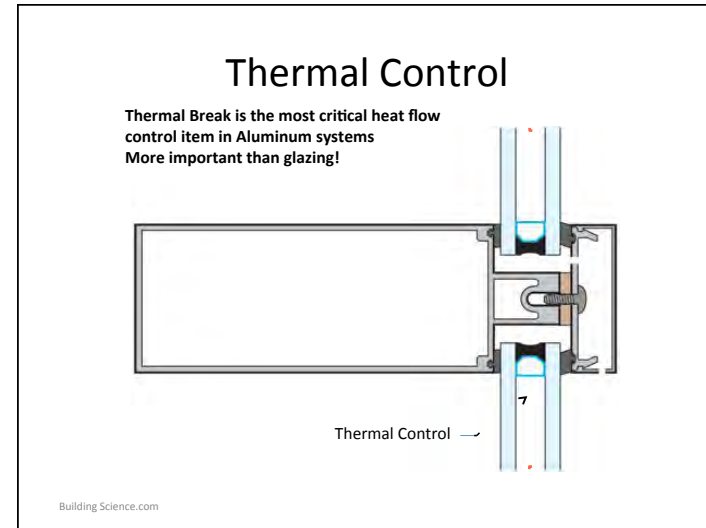
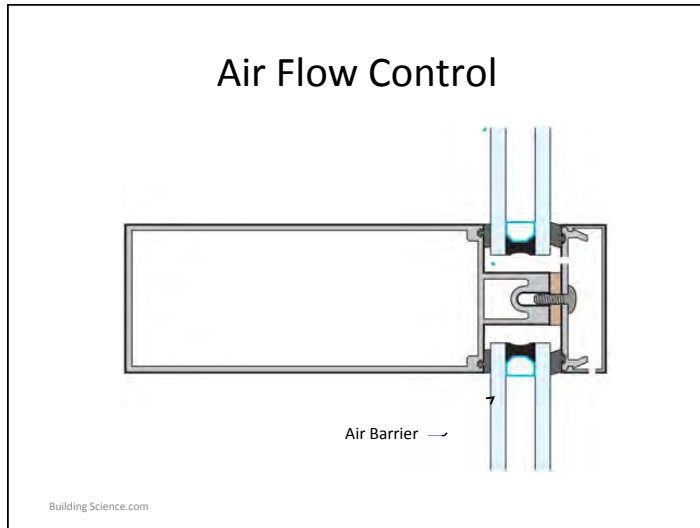
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Insulated metal panels

- Can be high-performance low-cost system
- Use thicker panels (4-8") and/or hybrid with interior fibrous insulation
- Great for arenas, pools, warehouses, big box stores
- Protect from impact at grade

Same material fulfills several functions
Finish (paint)
Control (metal, foam)
Support (metal+foam)



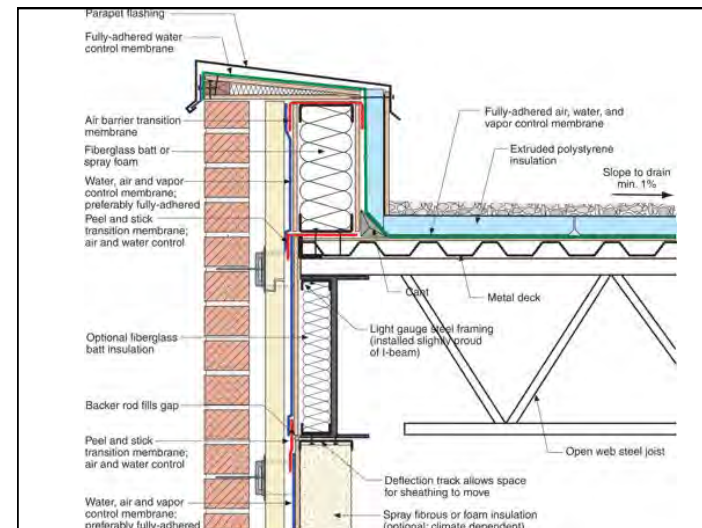
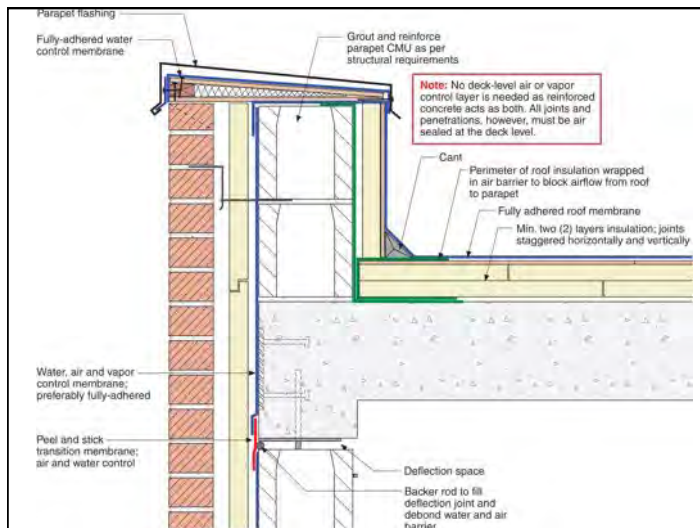


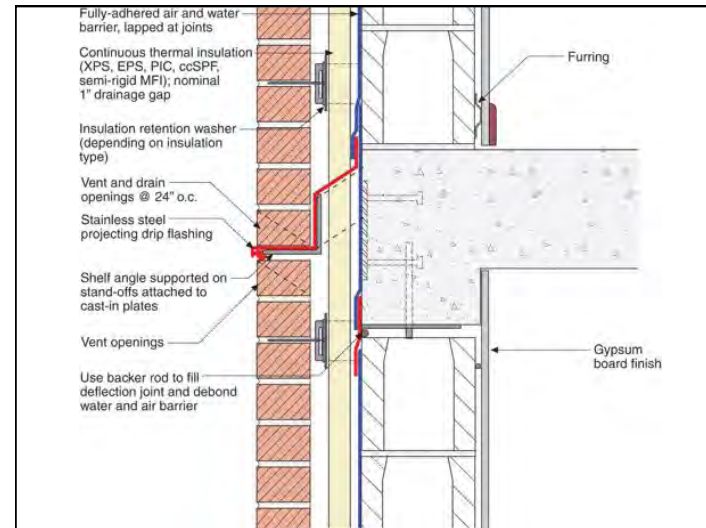
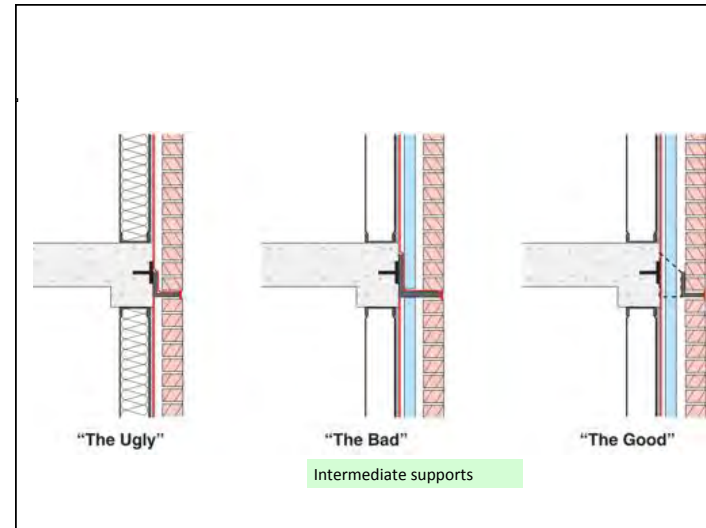
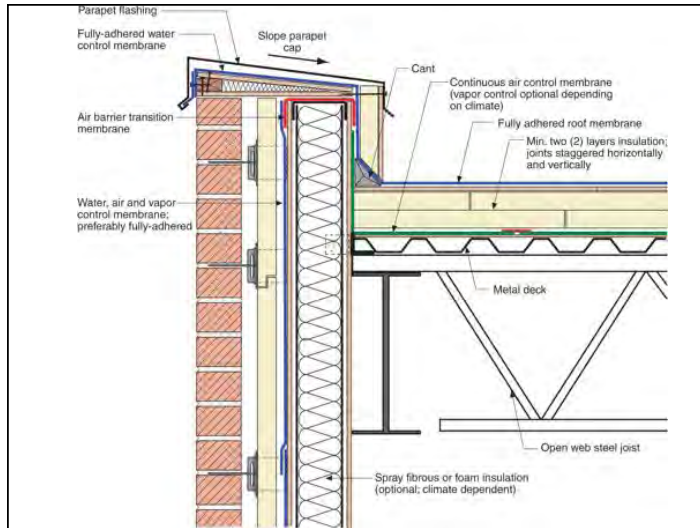


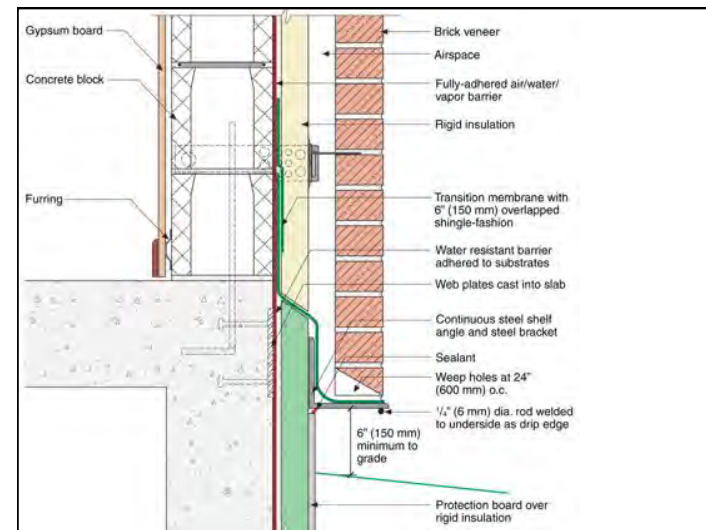
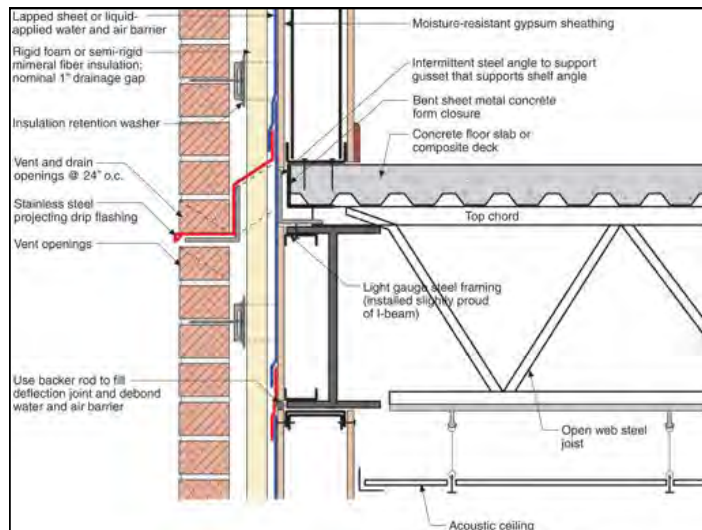
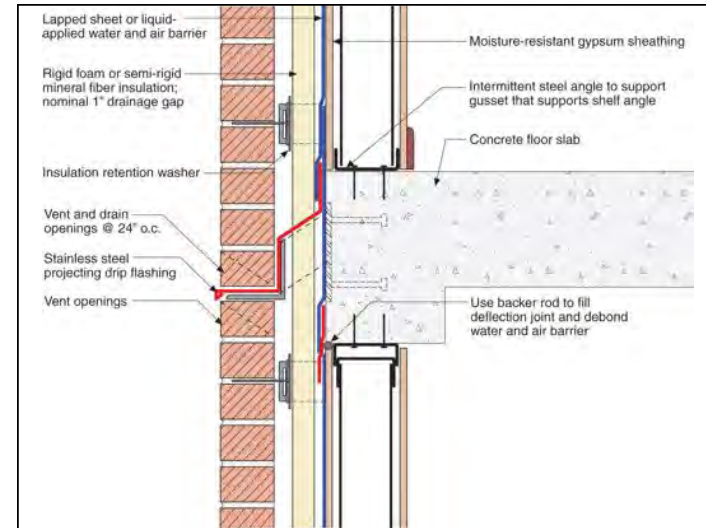
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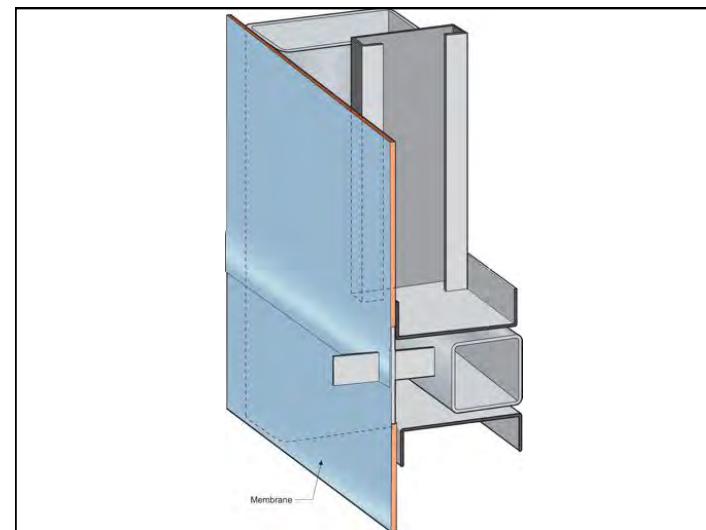
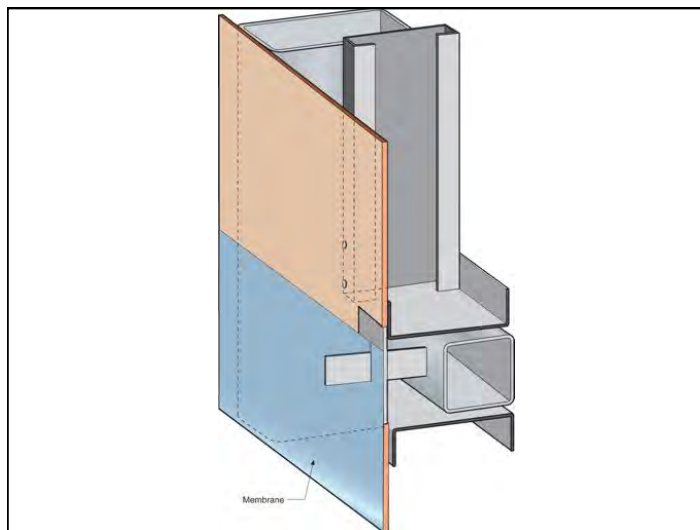
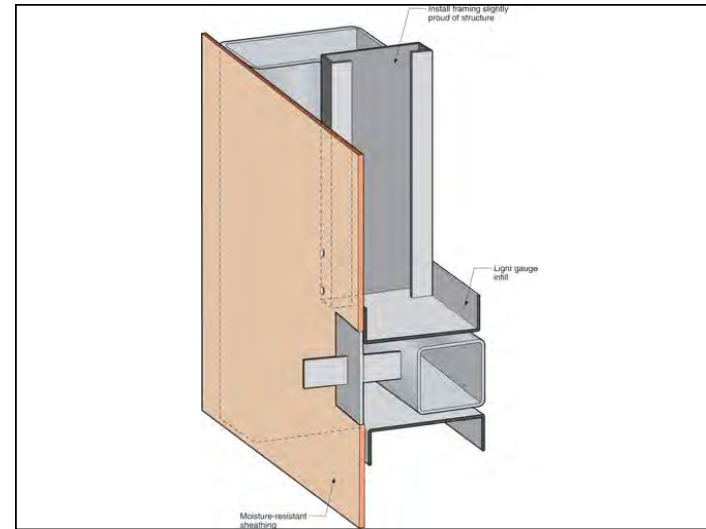
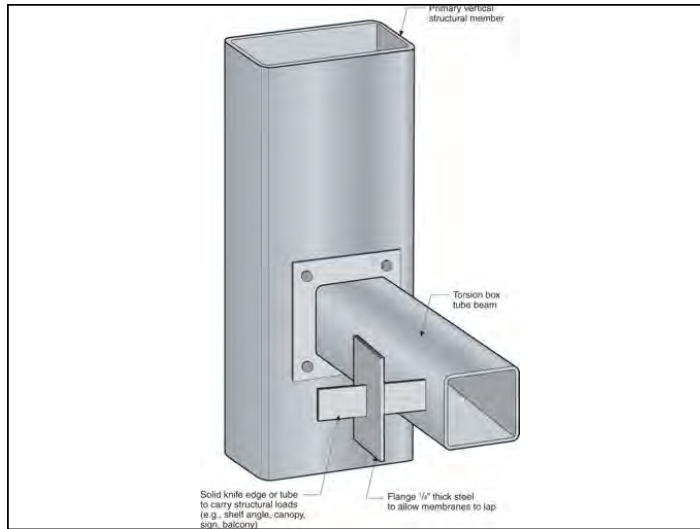
- Integration of penetrations and transitions is critical
 - Must maintain continuity of rain, air, thermal and vapor control through the transition!
 - Exposure and performance expectations guide designers level of compromise

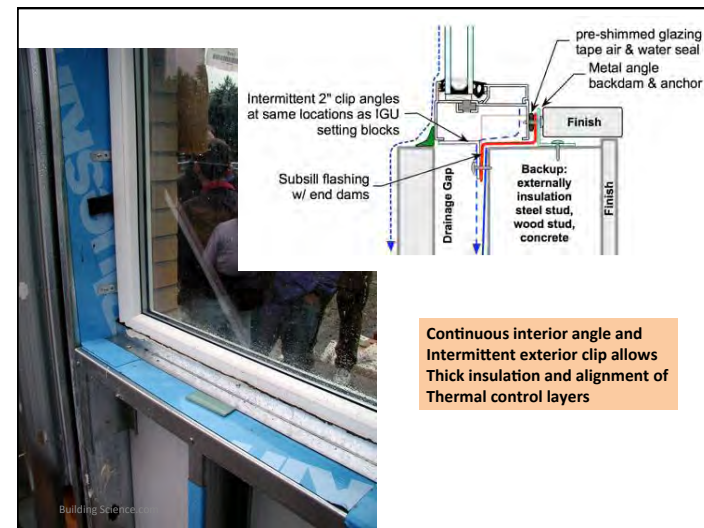
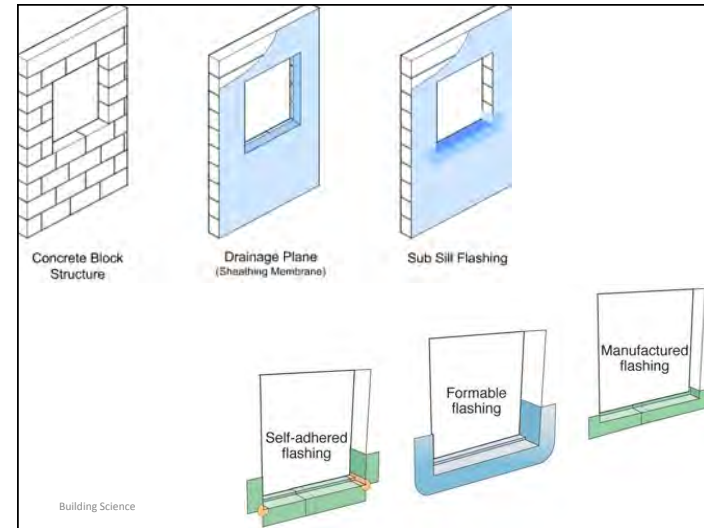
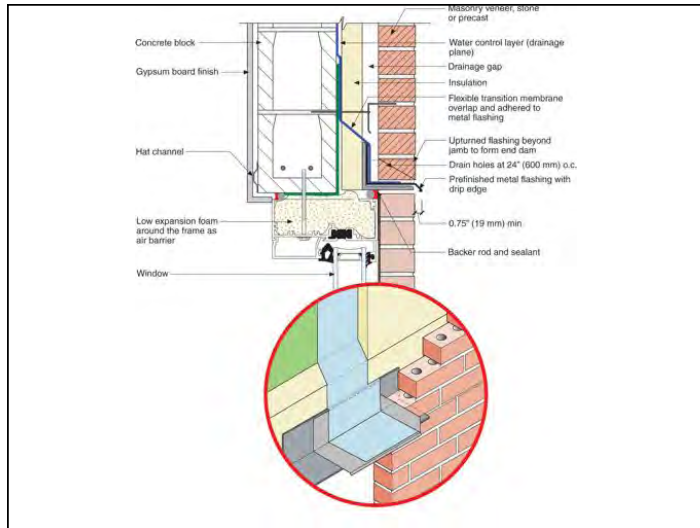
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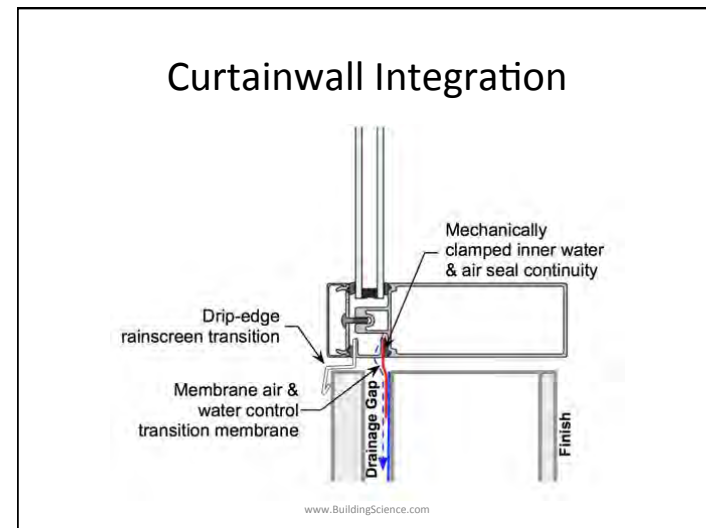
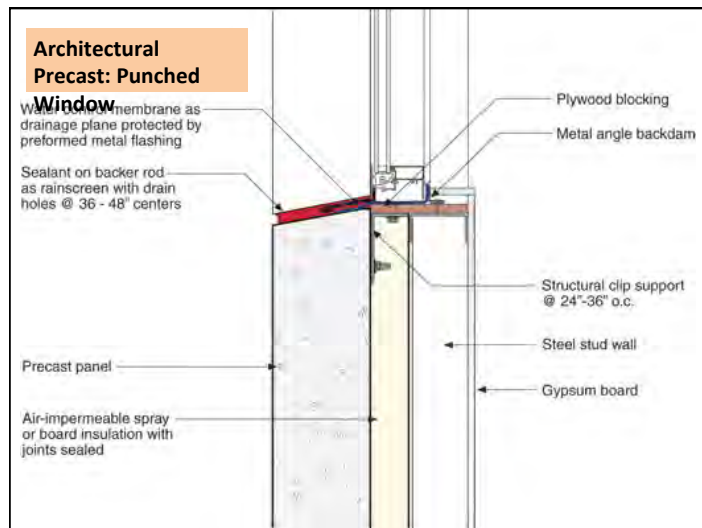
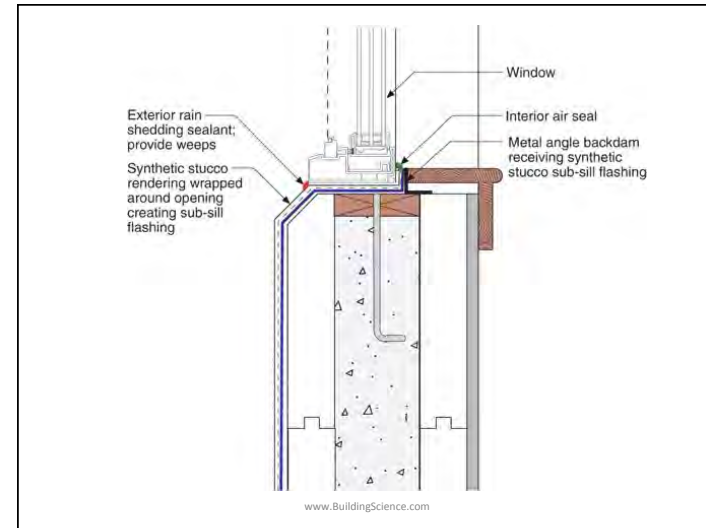
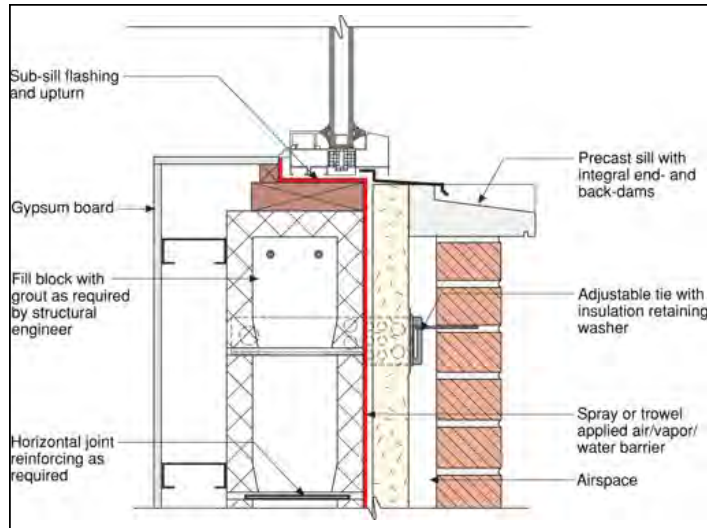


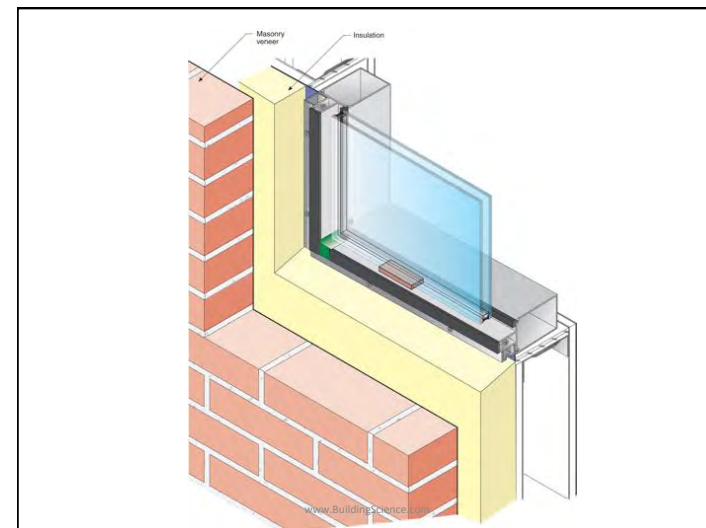
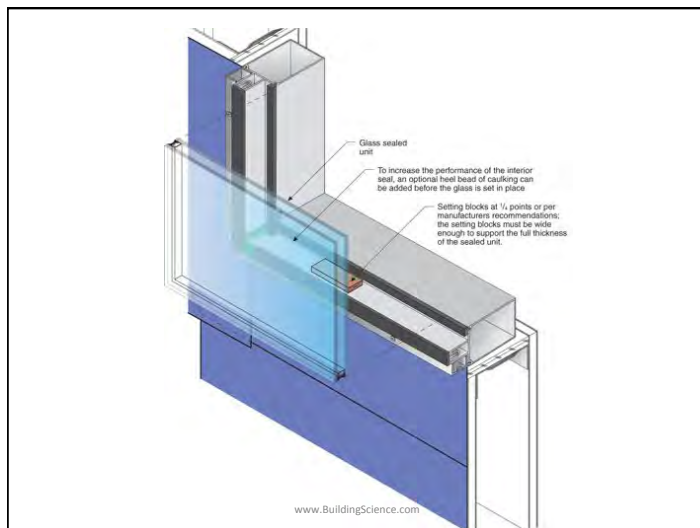
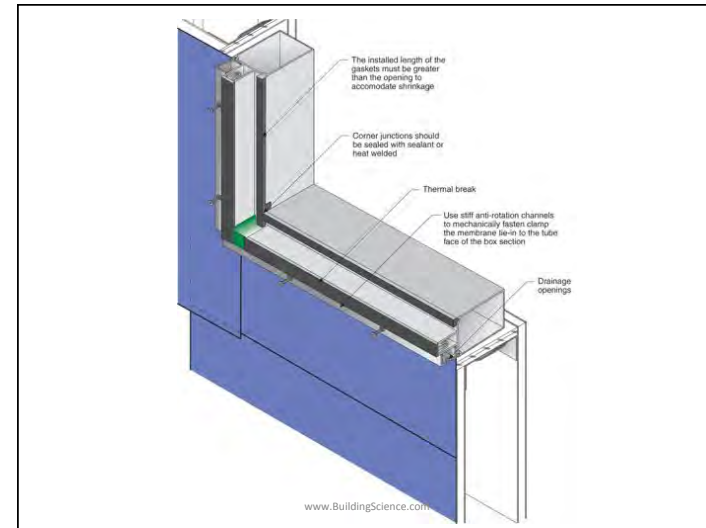
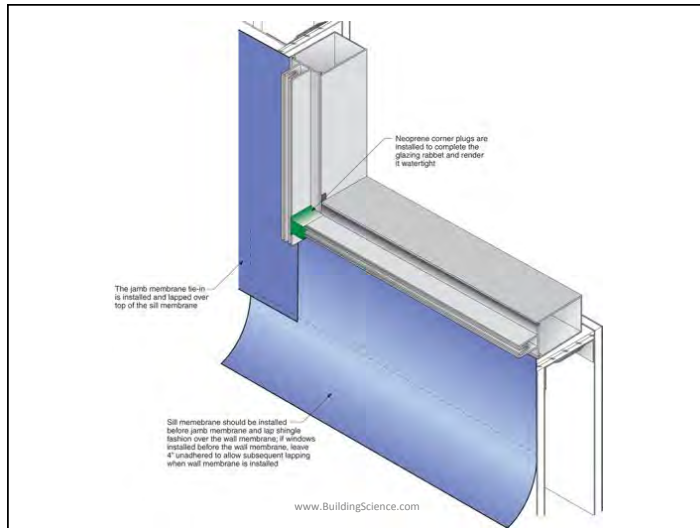


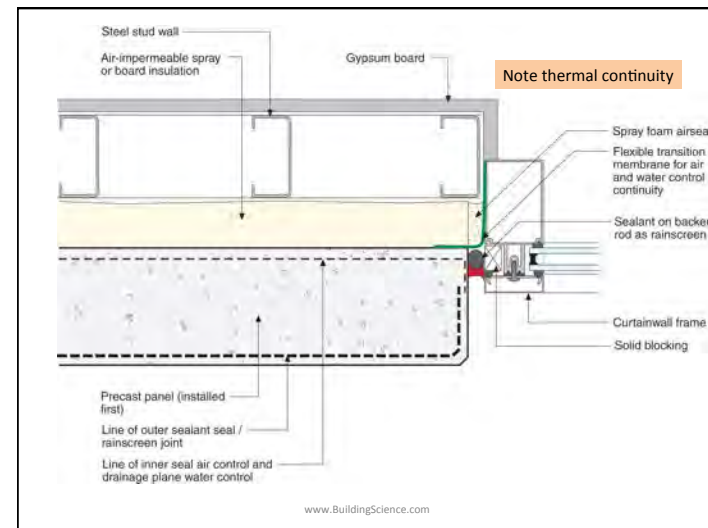
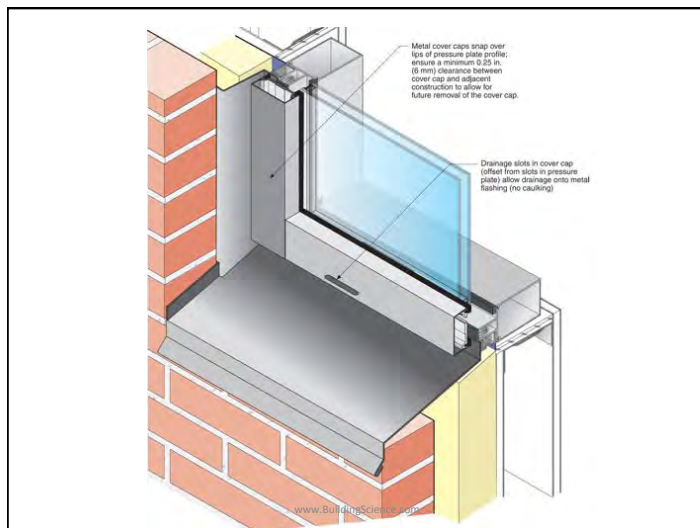
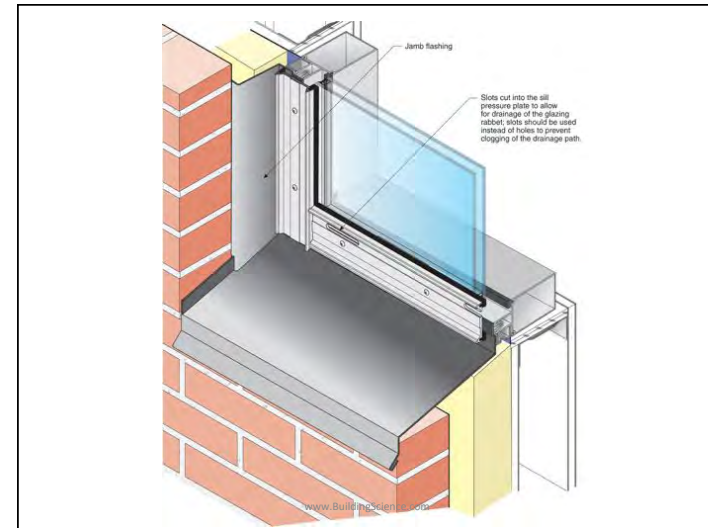
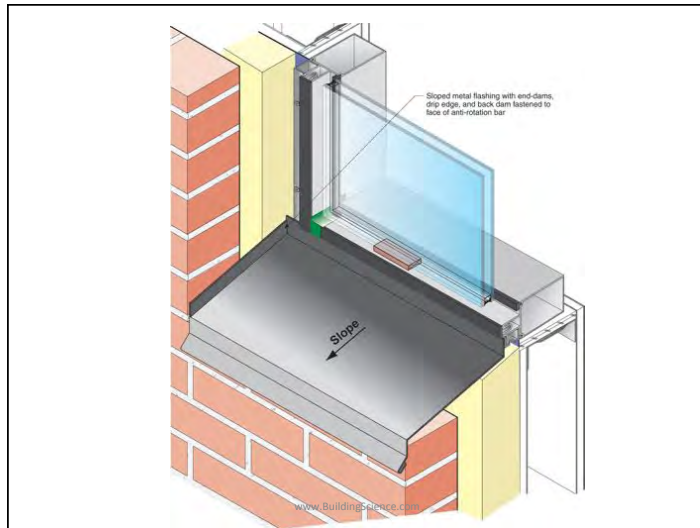


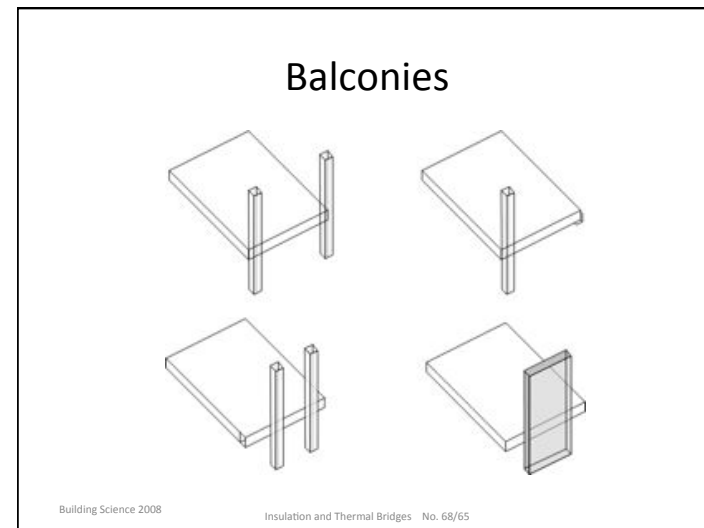
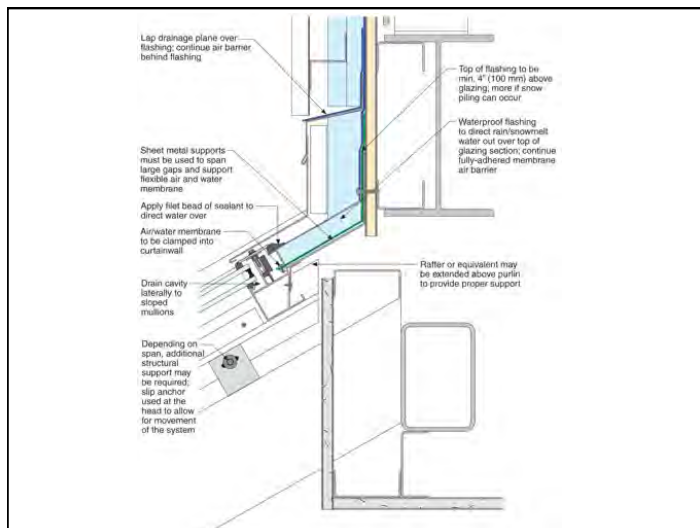
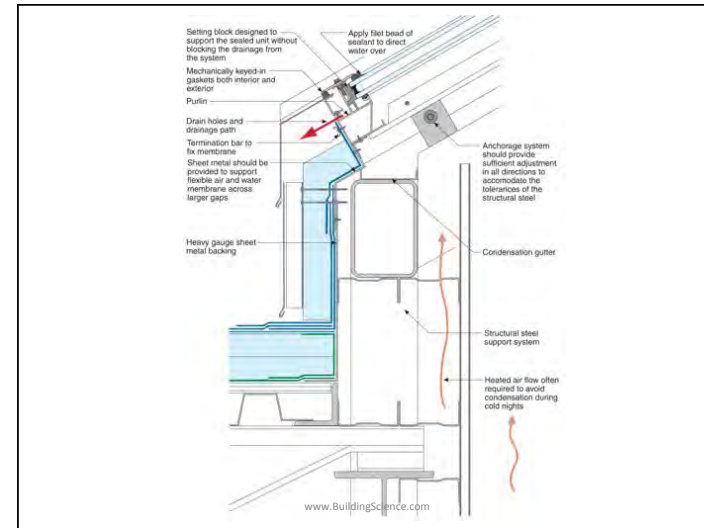
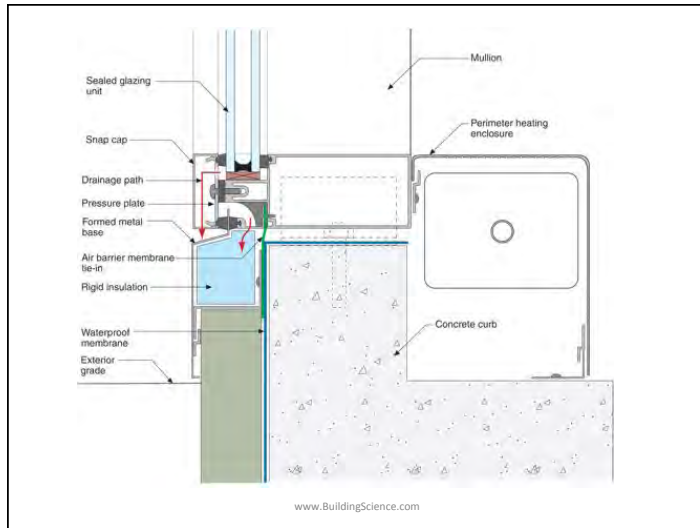


Continuous interior angle and Intermittent exterior clip allows Thick insulation and alignment of Thermal control layers

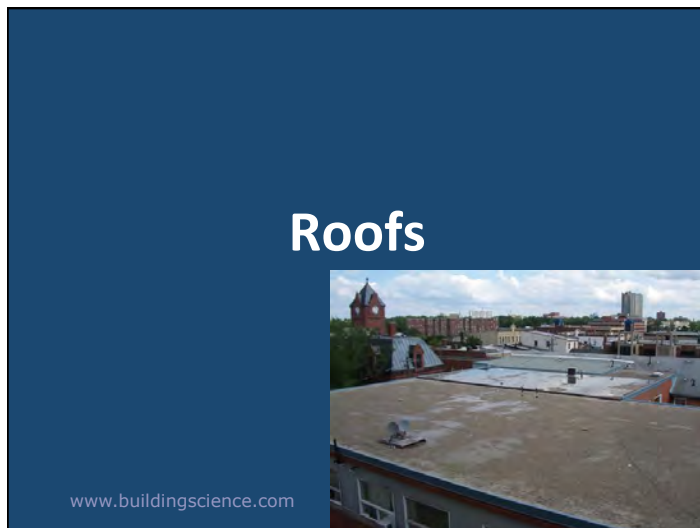
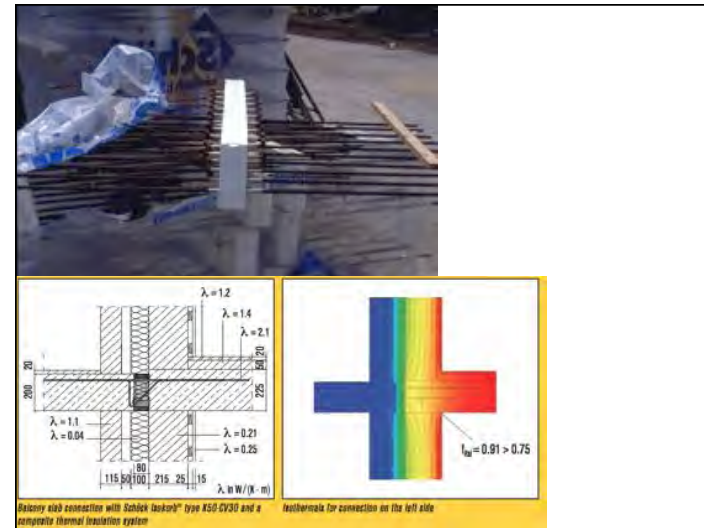
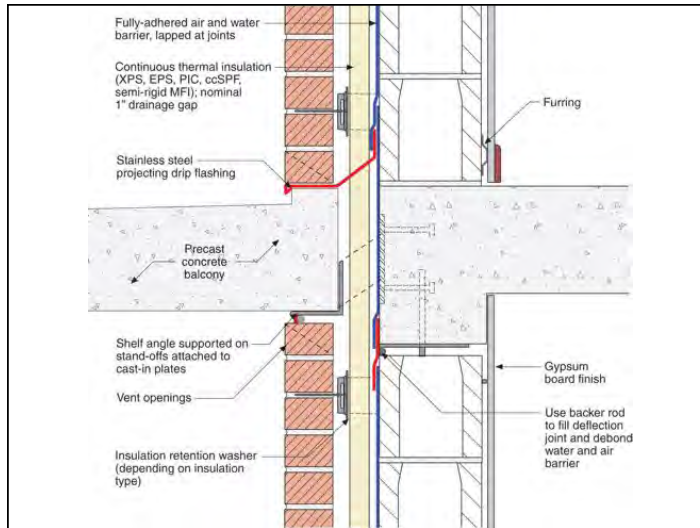








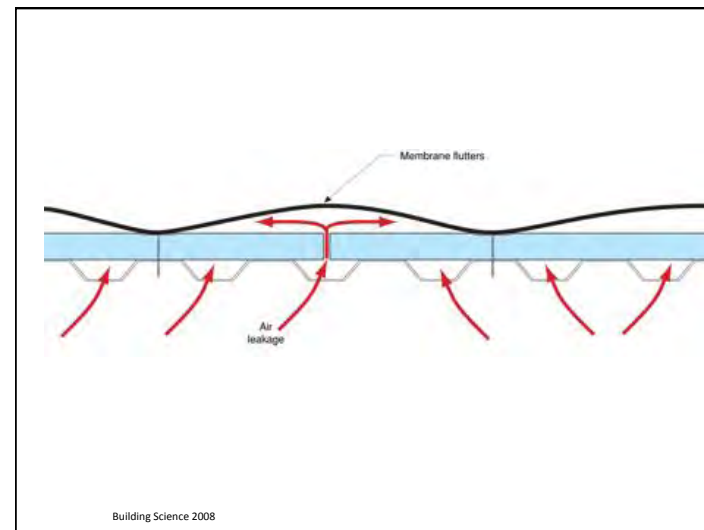
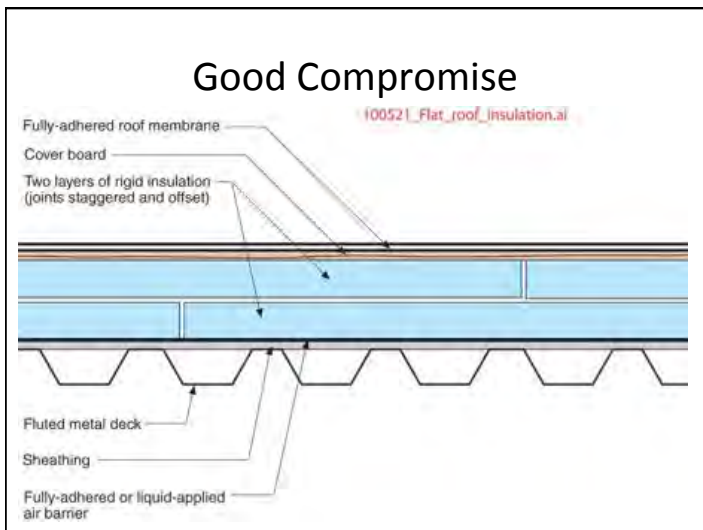
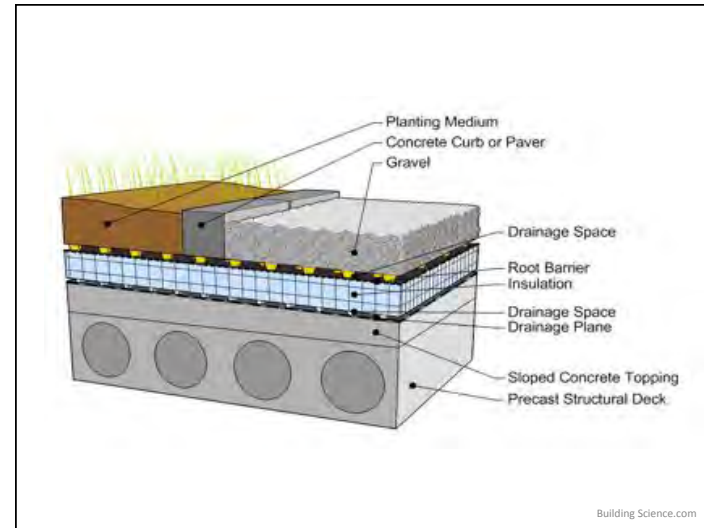
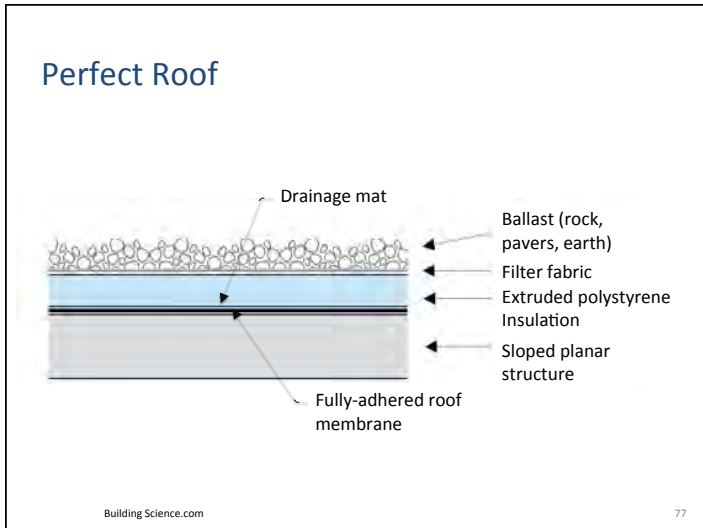


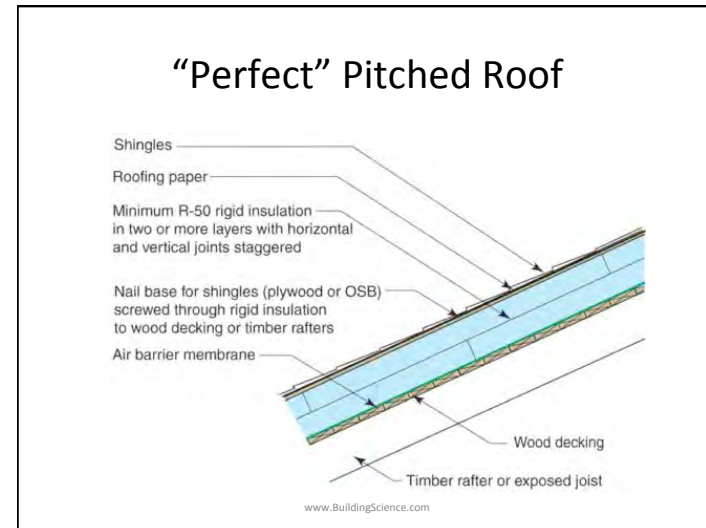
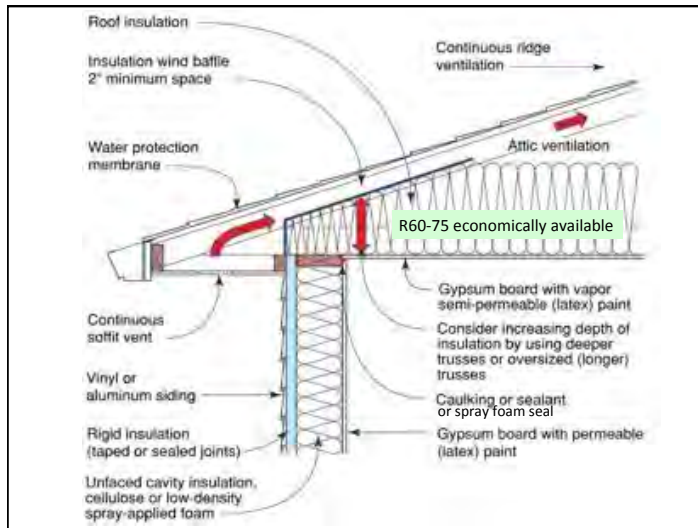
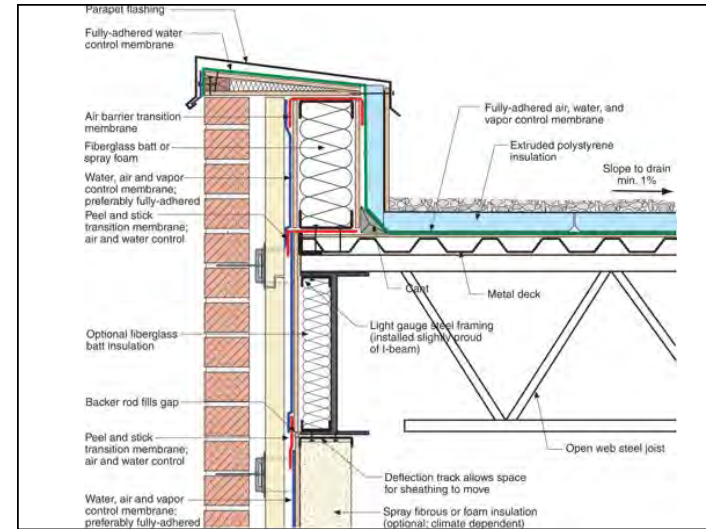


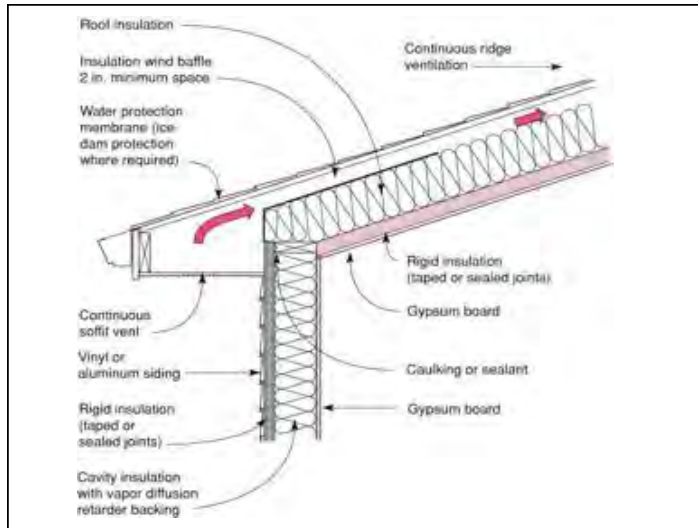
Low-Slope Roofs

- Not flat. Ponding is not acceptable.
- Get water right, then worry about energy!
- Components
 - Rain barrier is roof membrane
 - Drainage gap is the outdoors
 - Air barrier can be roof membrane
 - Better to install interior
 - Insulation is rigid, polyiso, XPS, EPS, rockwool

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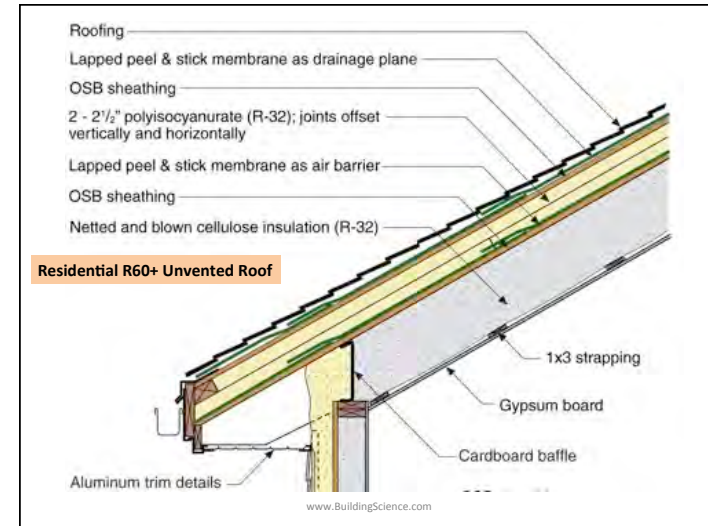
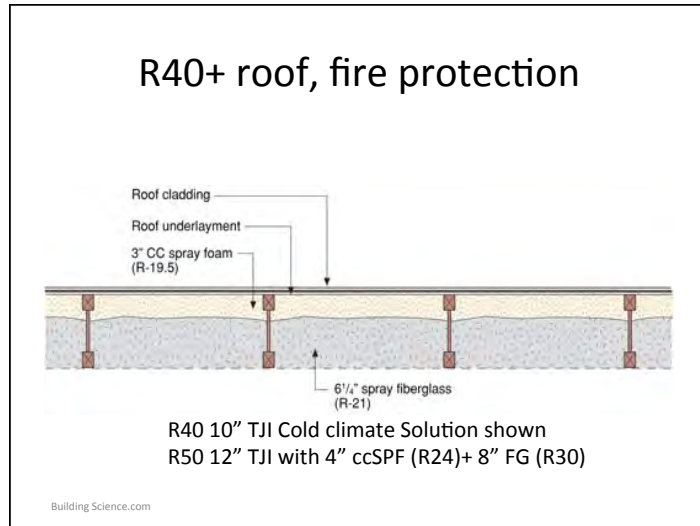


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Unvented Cathedralized Attics

- Move air and insulation control from ceiling plane to roof plane
- Moves HVAC into conditioned space
 - Saves lots of energy, reduce problems with comfort, extends life of equipment
- Avoids wind blown rain, snow, and burning wildfire embers

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- ### Summary
- High-performance enclosures
 - Continuous & high levels
 - Rain
 - Air
 - Thermal
 - Vapor
 - Now add high performance HVAC
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- ### Top Ten List
- Commercial and institutional mid-size buildings, Canadian climates
- **Limit window-to-wall ratio (WWR)** to the range of 20-40%, 50% with ultra-performance windows
 - **Increase window performance** (lowest U-value affordable in cold climates, including frame effects)
 - **Increase wall/roof insulation** (esp. by controlling thermal bridging) and **airtighten**
 - Separate **ventilation** air supply from heating and cooling.
 - Use **occupancy** and **daylighting controls** for lights and equipment
 - **Reduce** equipment/plug & lighting **power densities**
 - Don't over ventilate, use **heat recovery & demand controlled ventilation**
 - Improve boiler and **chiller efficiency** & recover waste heat (eg IT rooms!)
 - Use **variable speed controls** for all large pumps and fans and implement **low temperature hydronic** heating and cooling where appropriate.
 - Use a simple and compact building form, oriented to the sun, with a depth that allows daylight harvesting.
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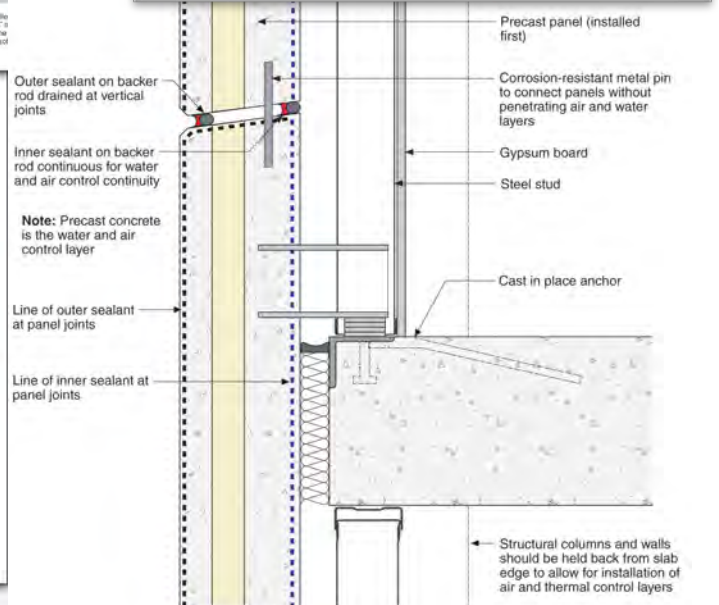
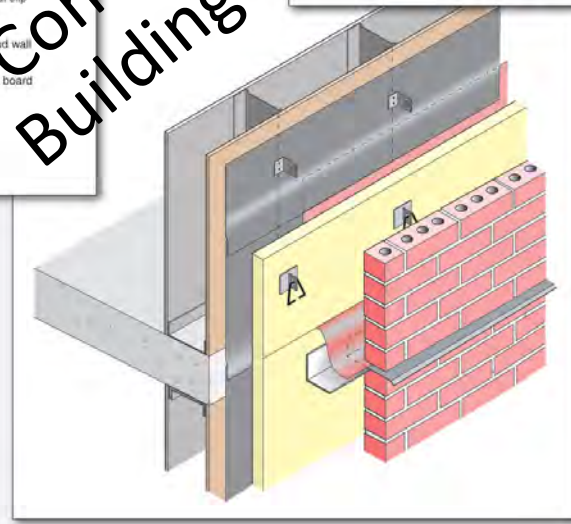
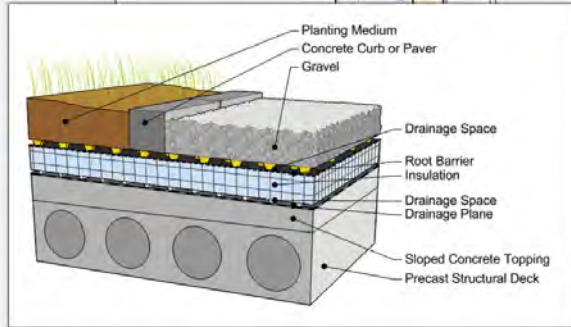
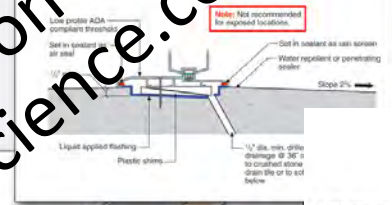
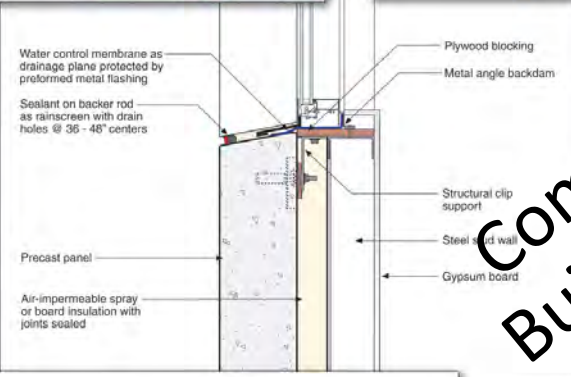
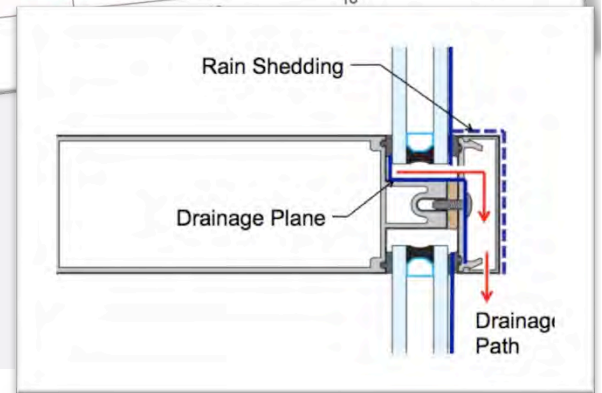
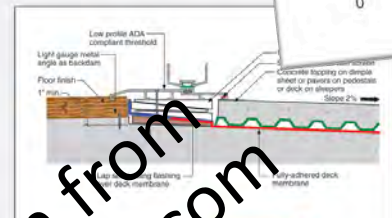
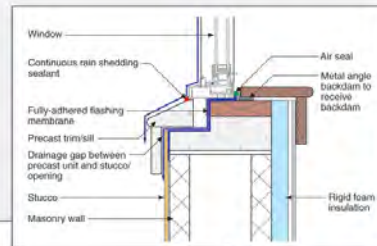
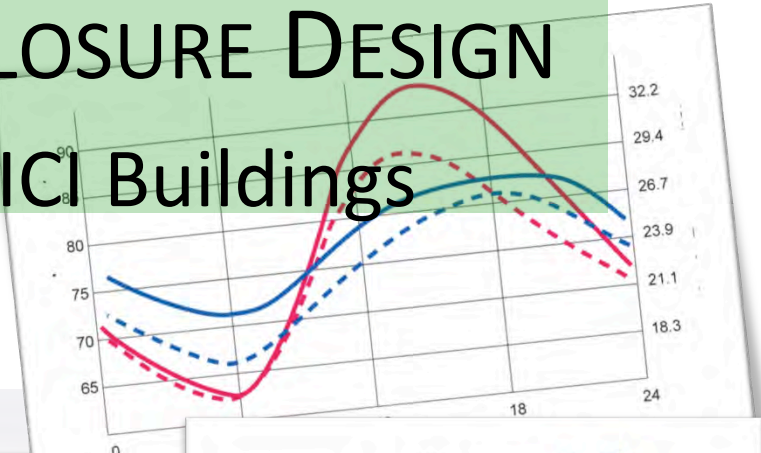
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