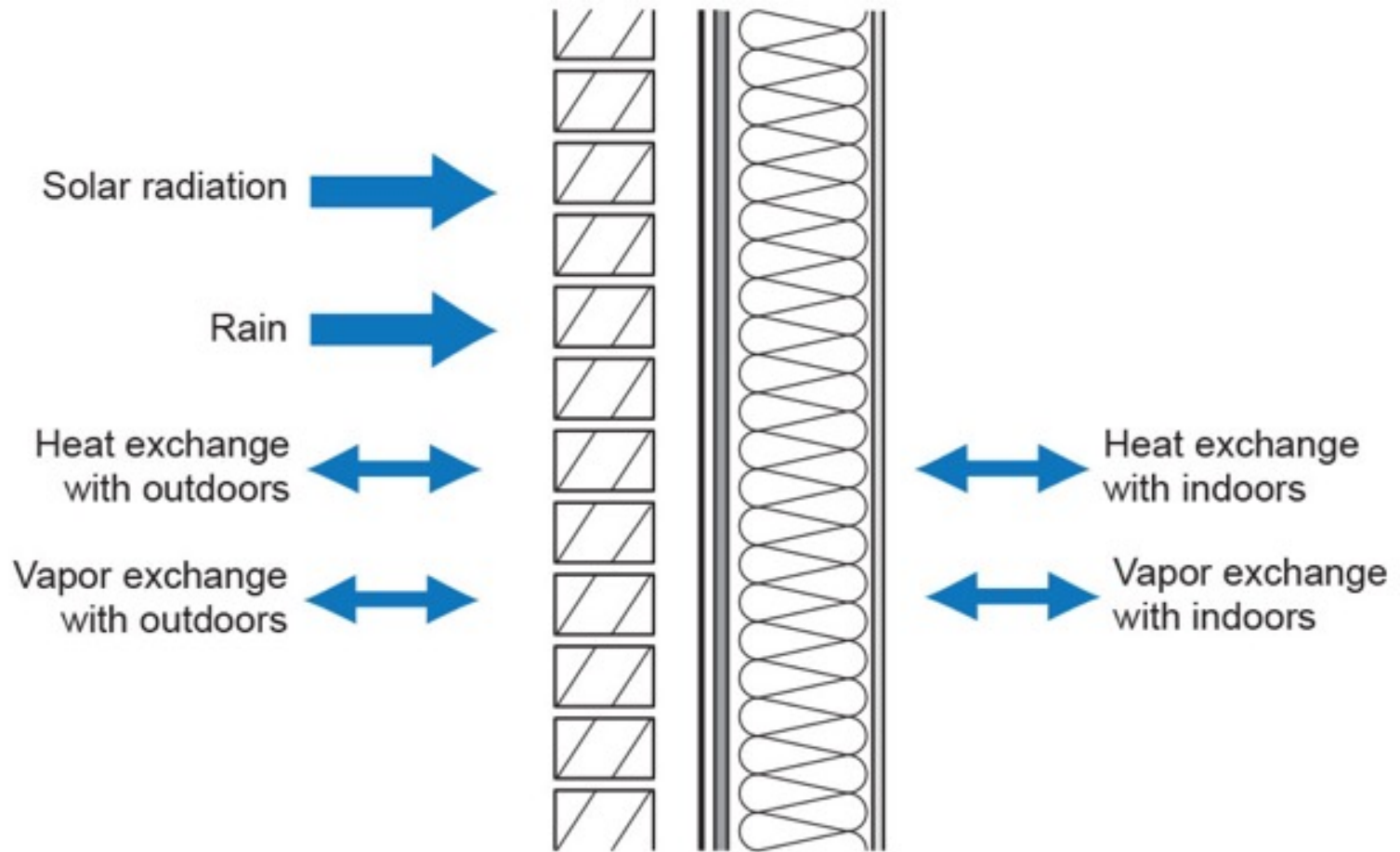
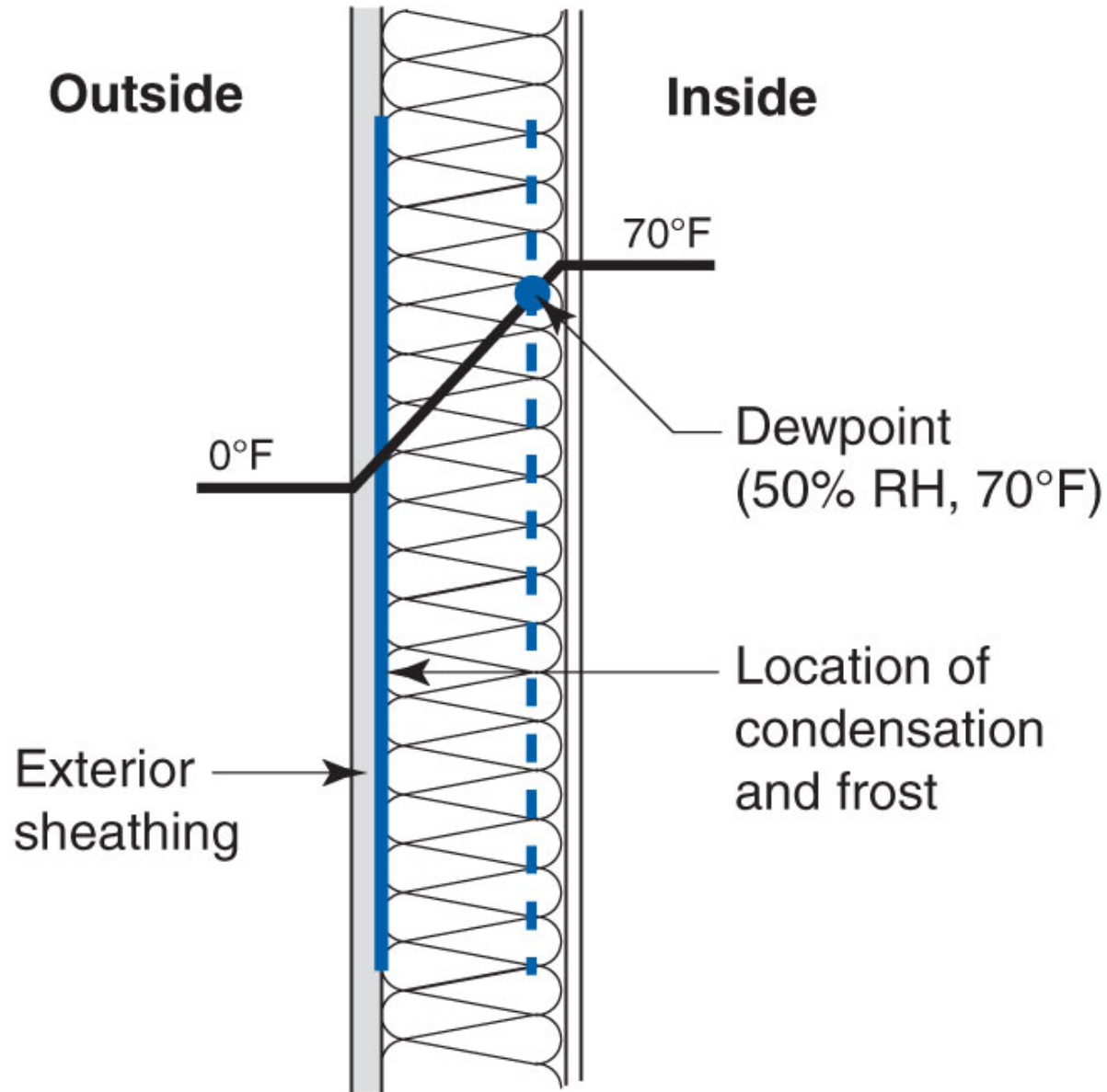
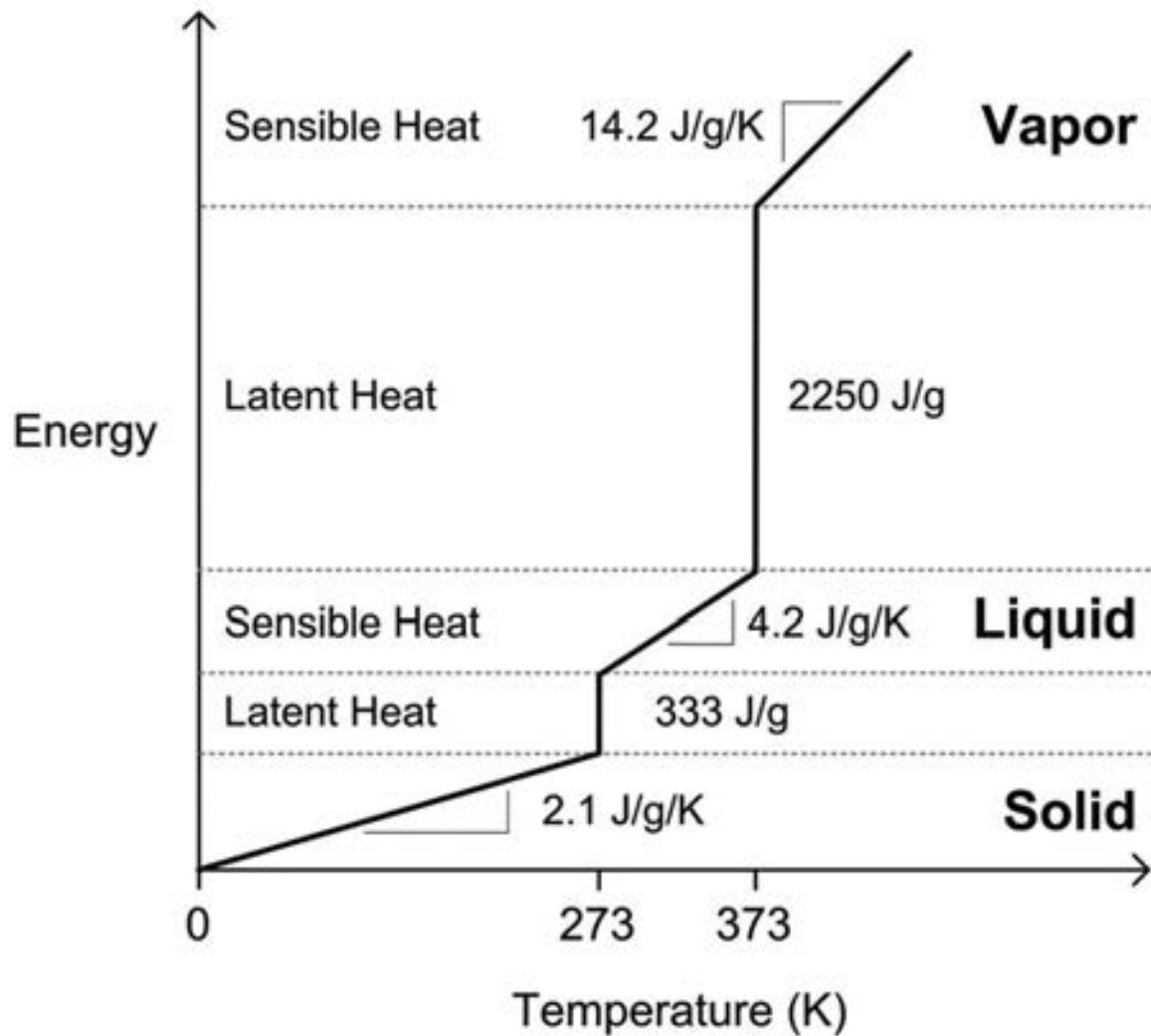

Walls

August 8, 2019





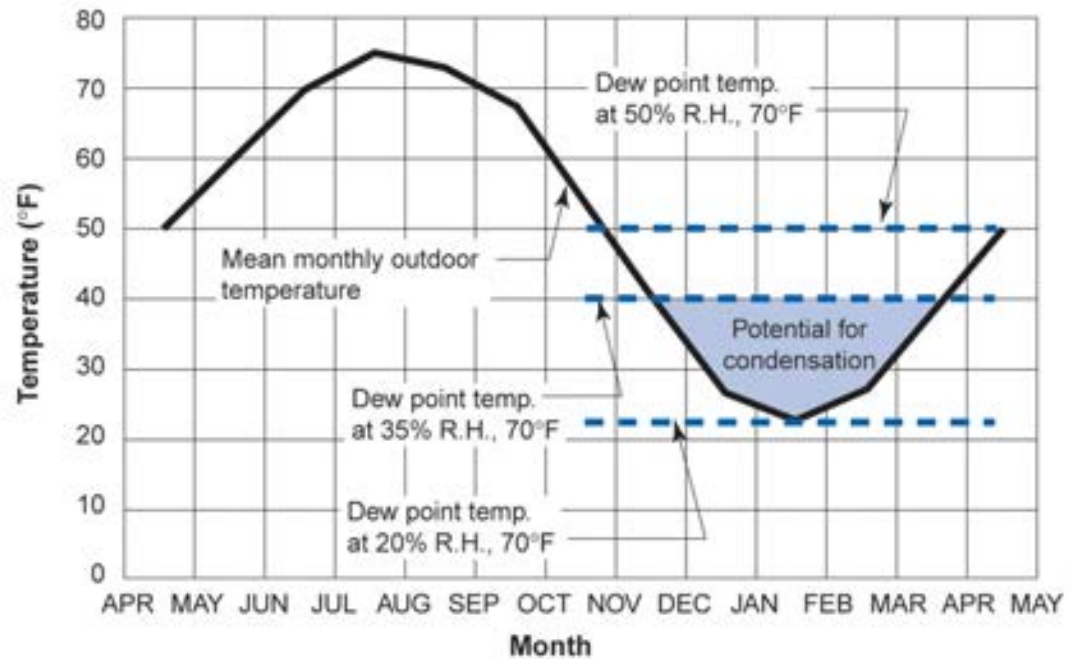
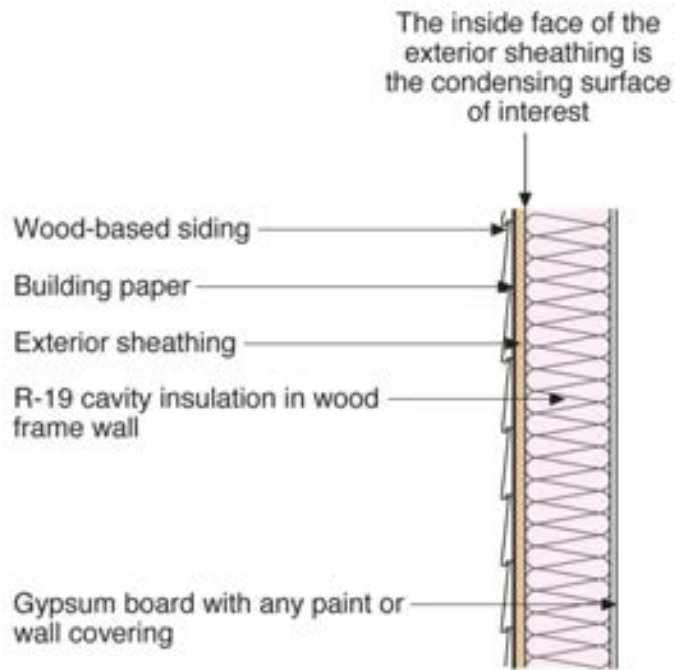


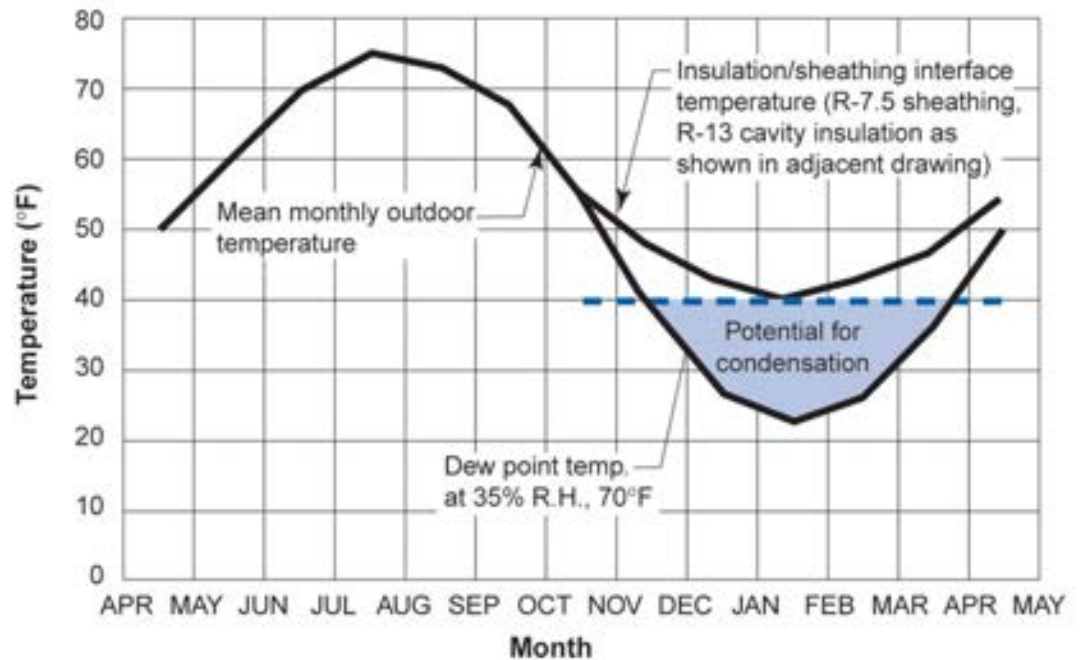
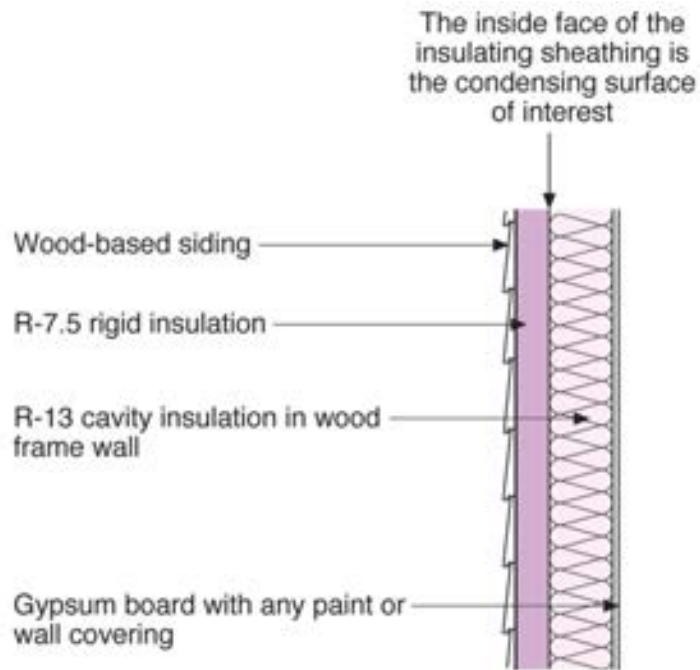


Simple linearized energy-temperature relation for water

From Straube & Burnett, 2005



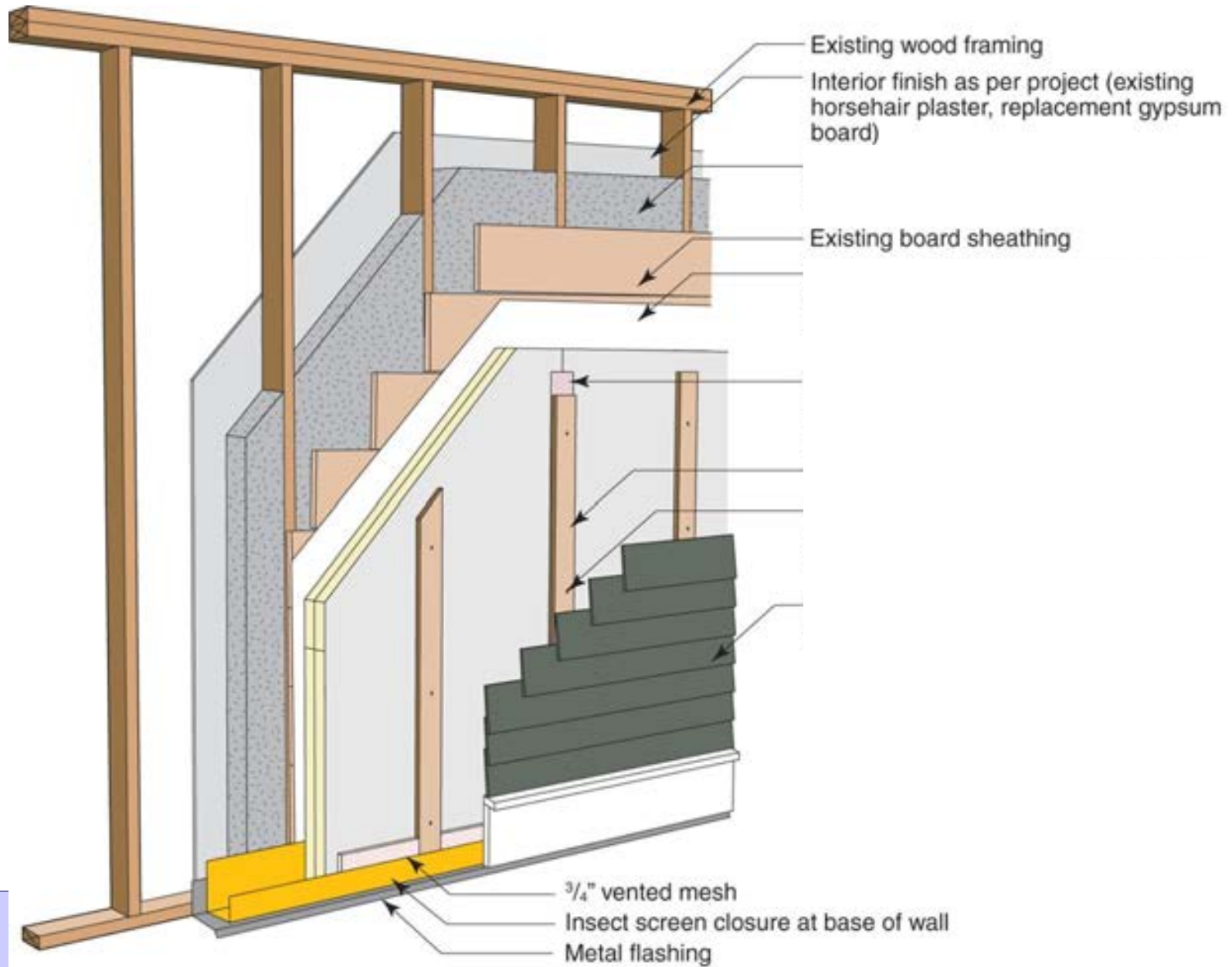




Exterior Insulation Retrofits

- Going beyond nominal R-13/R-19 walls = thicker walls
- Exterior retrofit advantages
 - Insulation outboard of vulnerable structure
 - Interior is habitable during retrofit
 - Retain interior finishes (lose exterior finishes)
 - No loss in interior square footage
 - Can inspect condition of enclosure (during cladding removal)
 - Interior stairwells (code minimum widths)

4" Polyisocyanurate Foam



4" Polyisocyanurate Foam



4" Polyisocyanurate Foam







Foam Sheathing Cladding Attachment

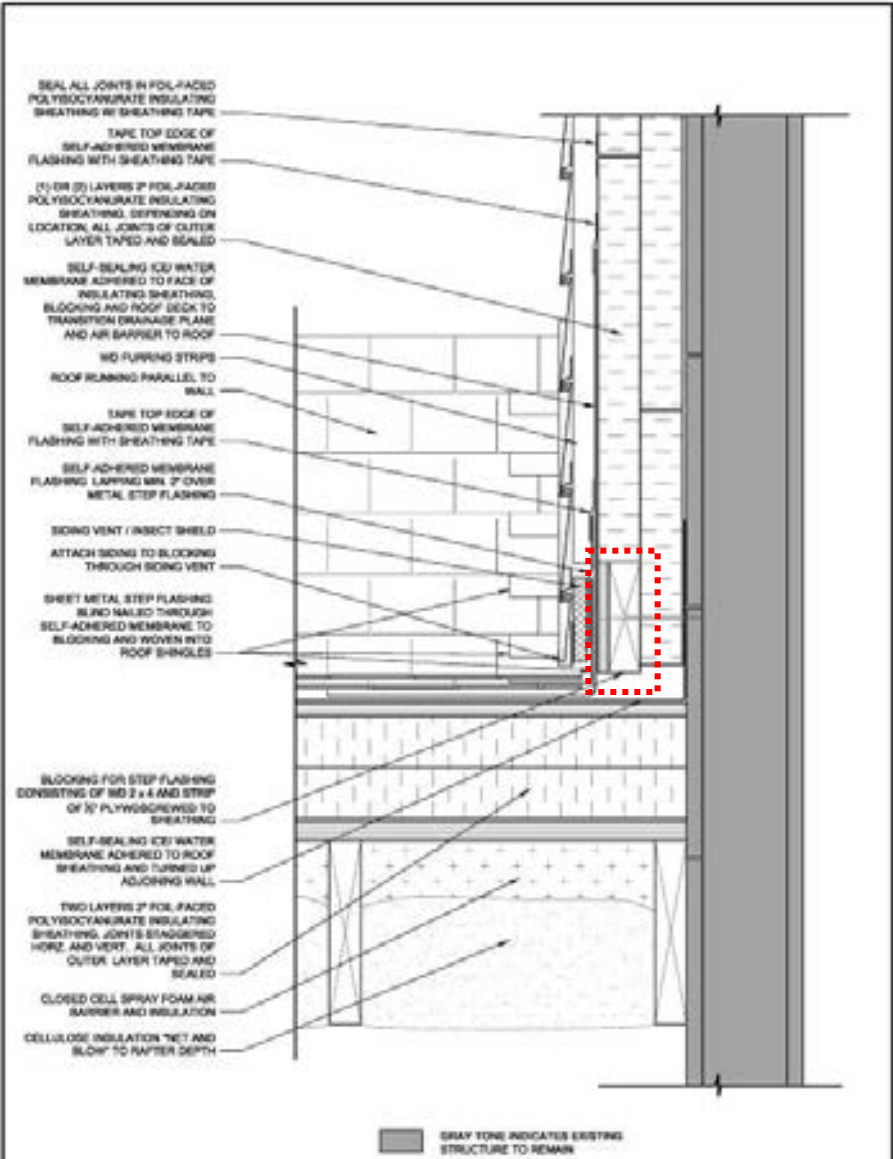


250 lbs/113 kg load (7.8 psf):
<0.003" deflection

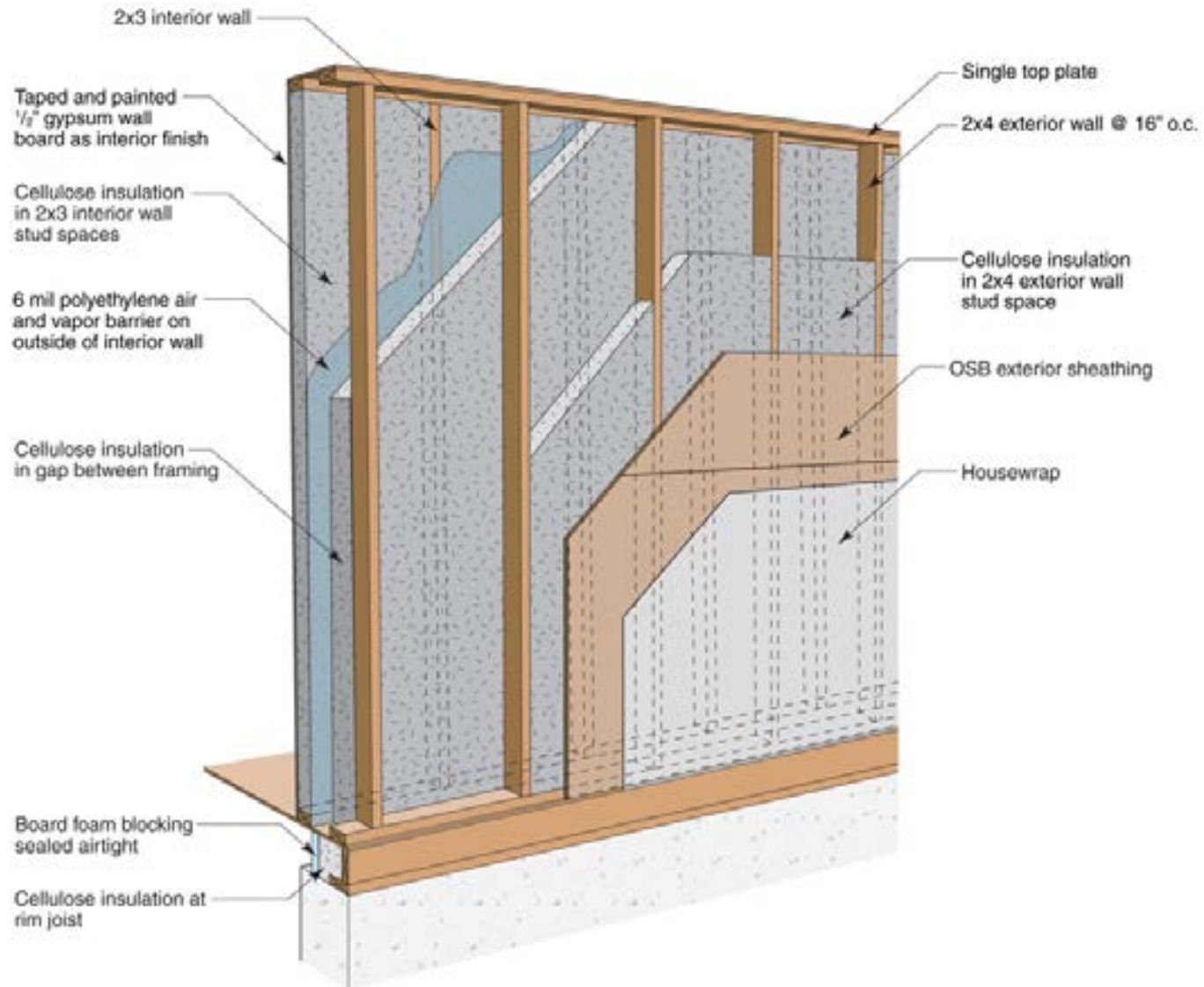
Wood siding ~2 psf
Fiber cement 2-3 psf
Stucco 8-10 psf

Image c/o Petersen Engineering

Exterior Retrofit Complications



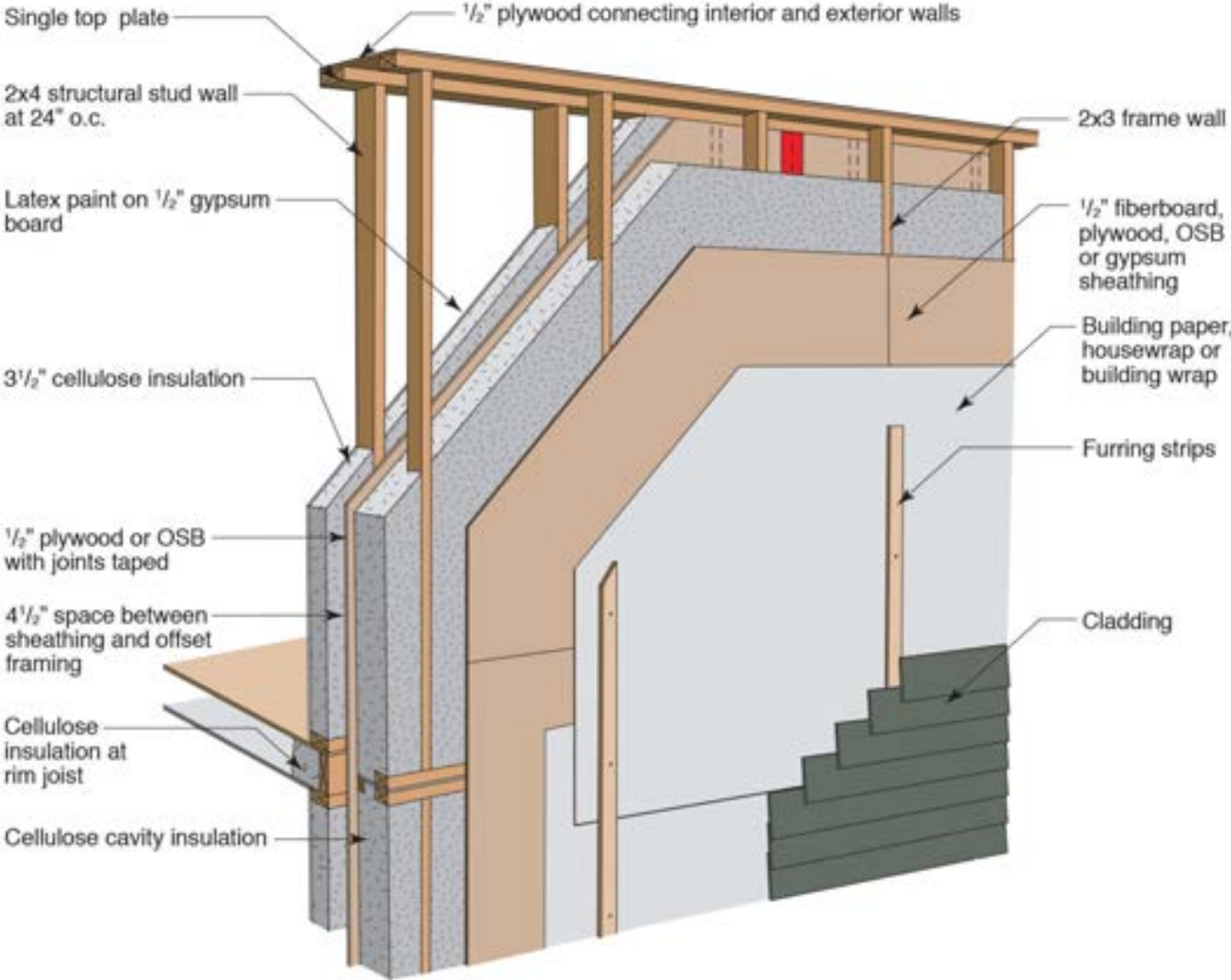
Double Stud Walls (Risky?)



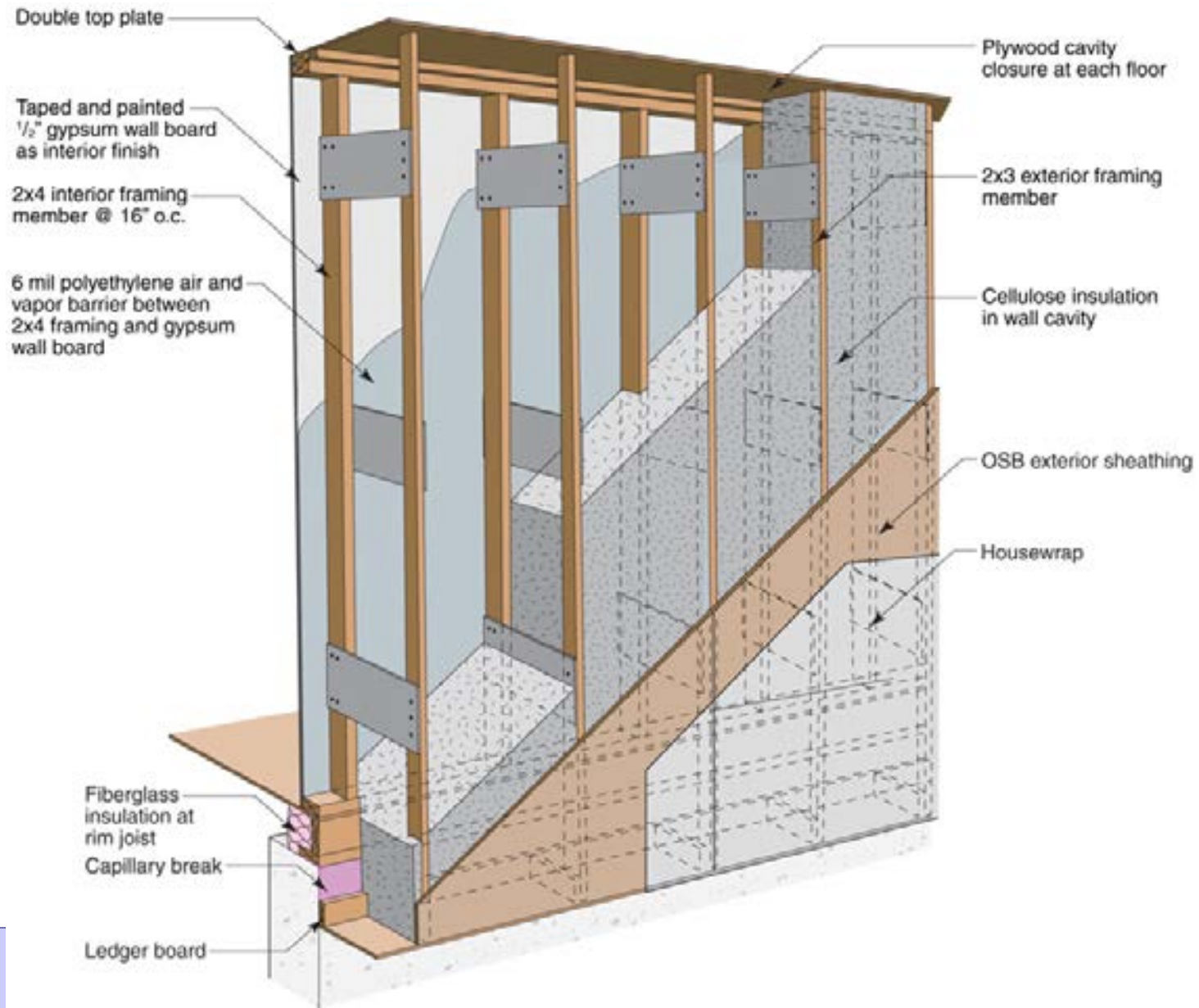
Double Stud Walls

- Double stud wall advantages:
 - High R values
 - Simplifies exterior detailing (few changes to standard practice)
 - Lower cost vs. other high-R walls?
- Moisture risks due to interstitial condensation?
 - Most common failure, after rain control issues
 - Air barrier imperfections—increase risk
 - Air permeable low-density insulations—increase risk (including convective looping)
 - Air impermeable insulations—decrease risk
 - Reduce risk with “skim” of spray foam at sheathing?

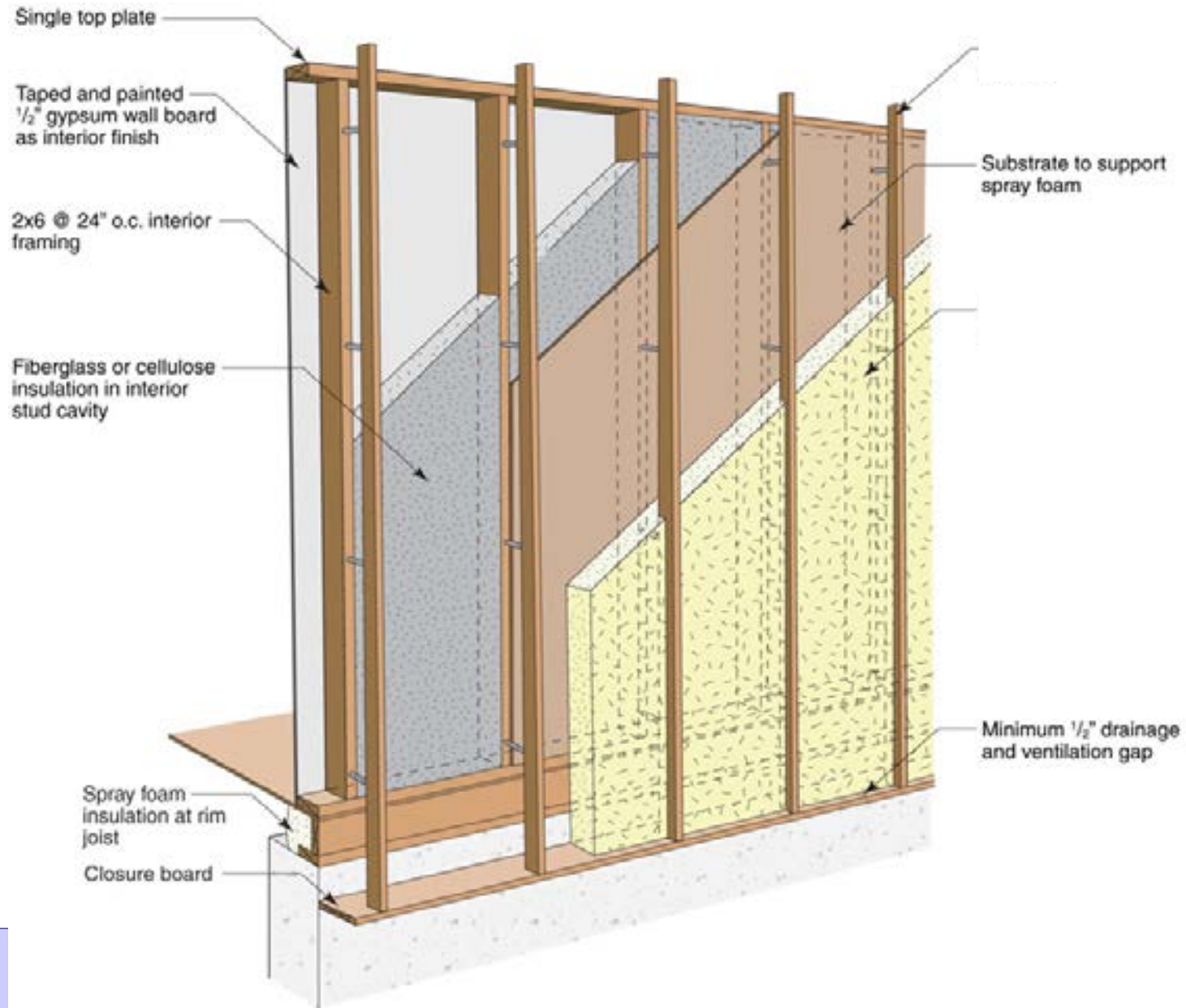
Double Stud Wall w. Robust Air Barrier



Larsen Truss



4-1/2" High Density Spray Foam





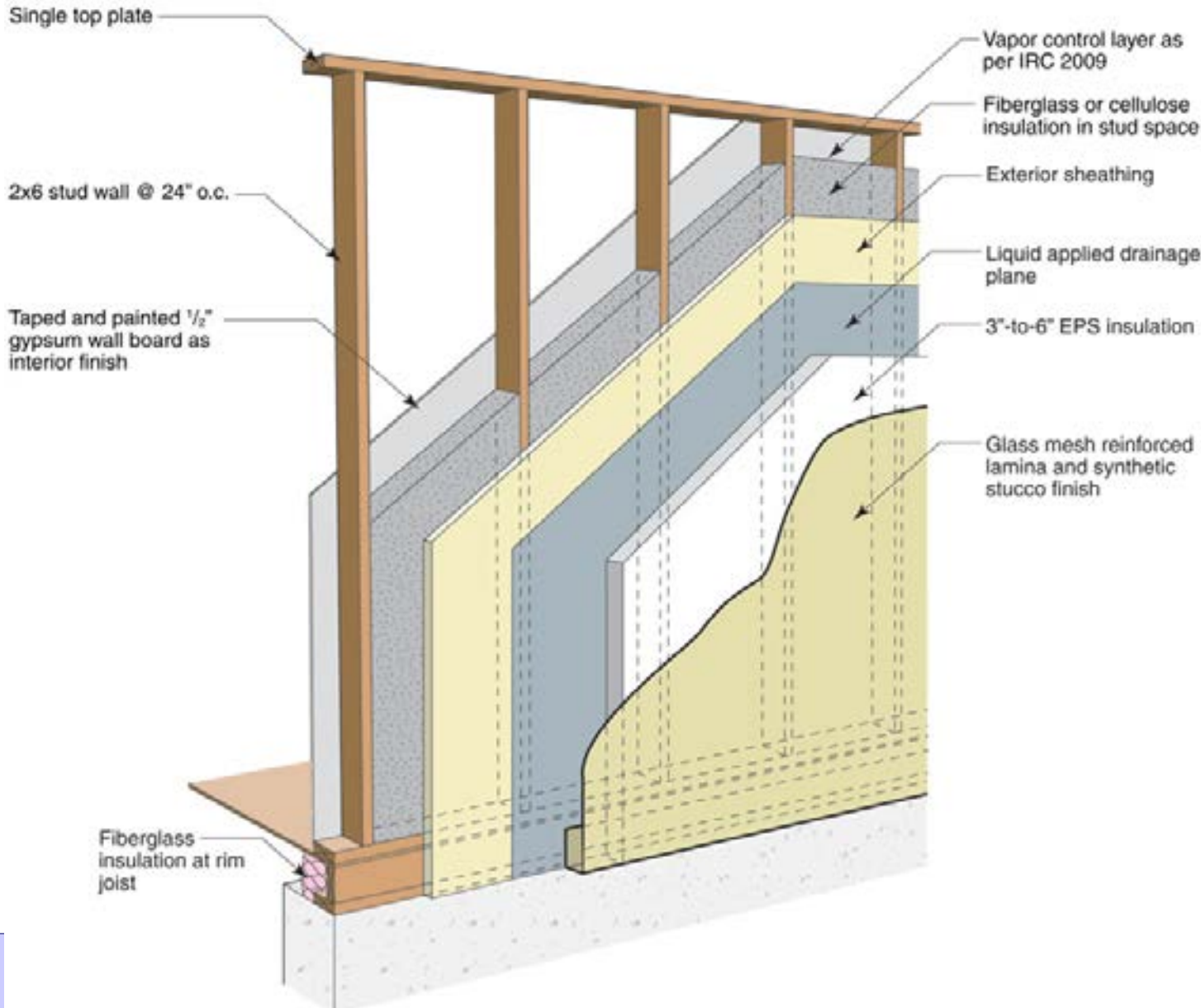








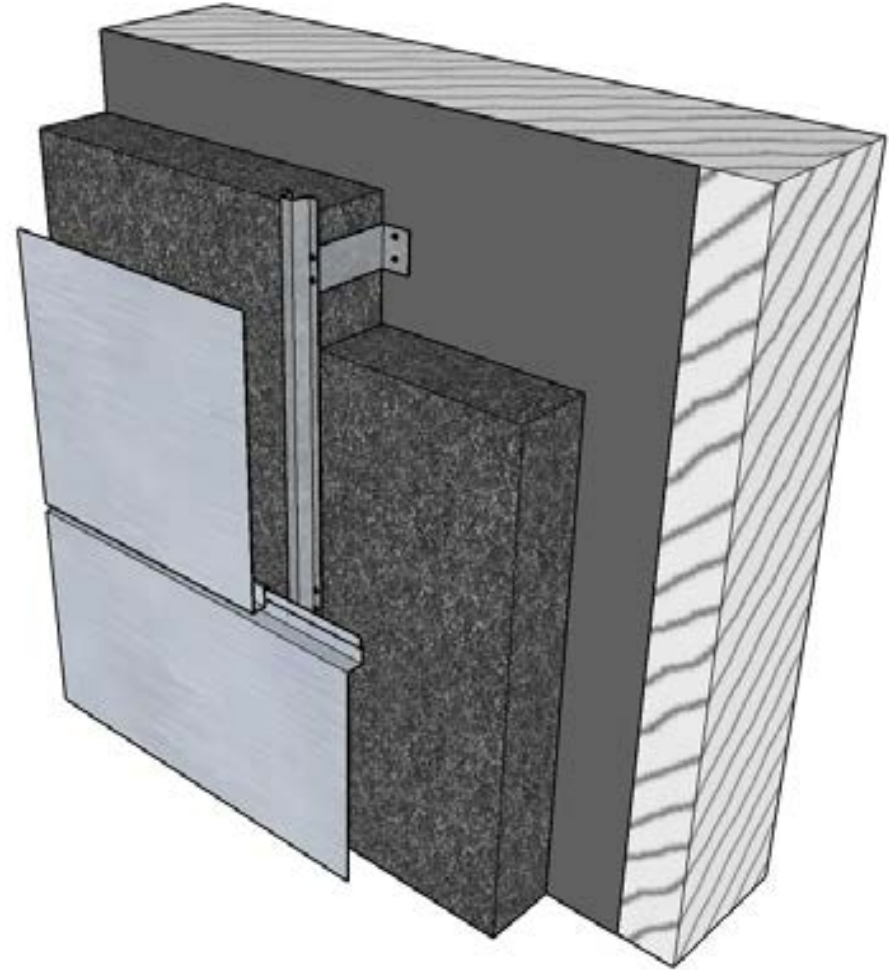
EIFS Overclad



Commercial Exterior Insulation Approaches

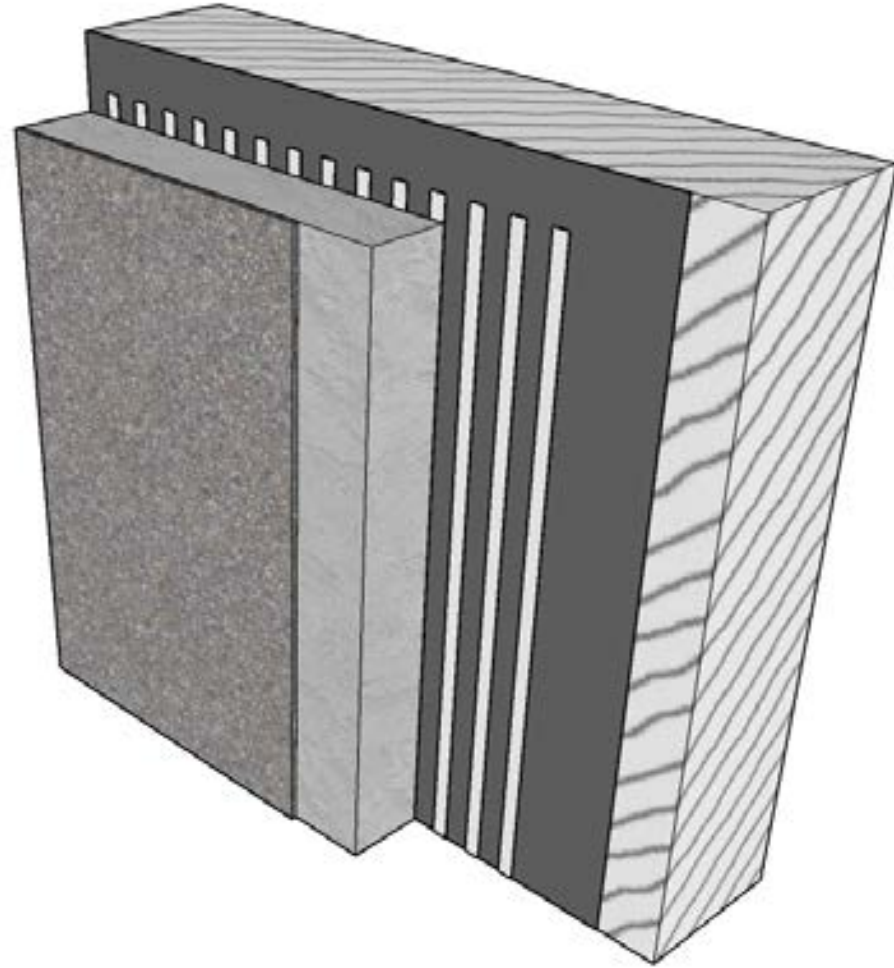
Exterior Insulation Approaches

- Insulation and cladding (discrete components)



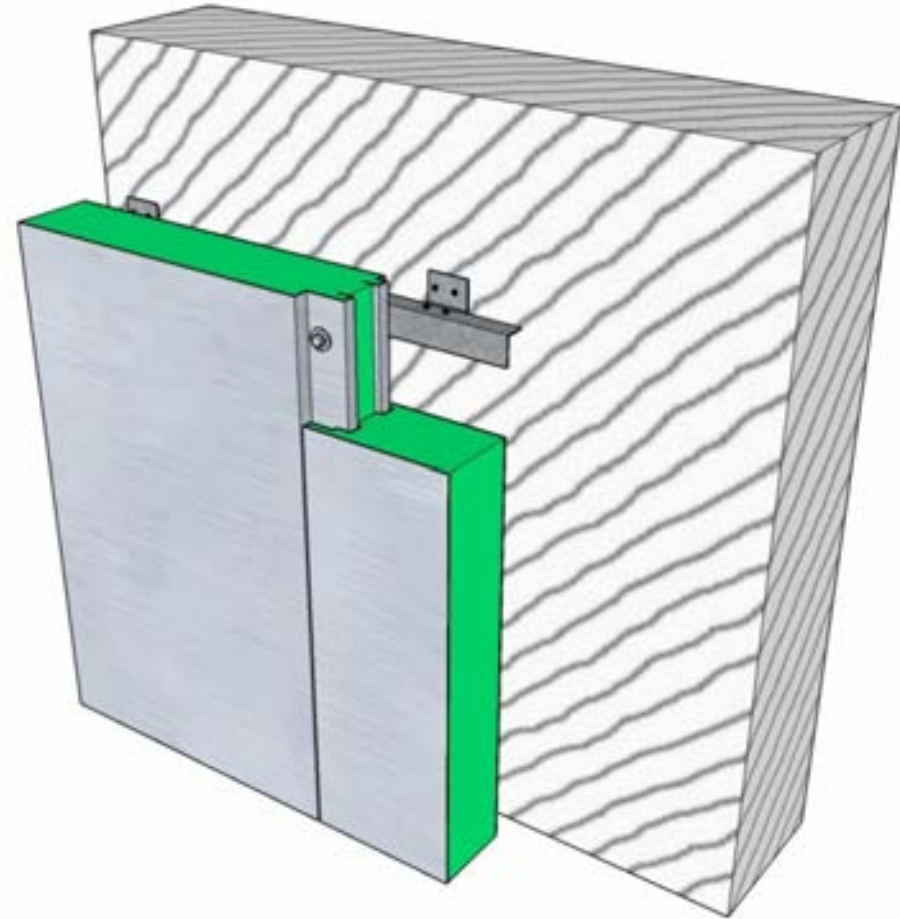
Exterior Insulation Approaches

- Insulation and cladding (discrete components)
- Exterior Insulation and Finish System (EIFS)



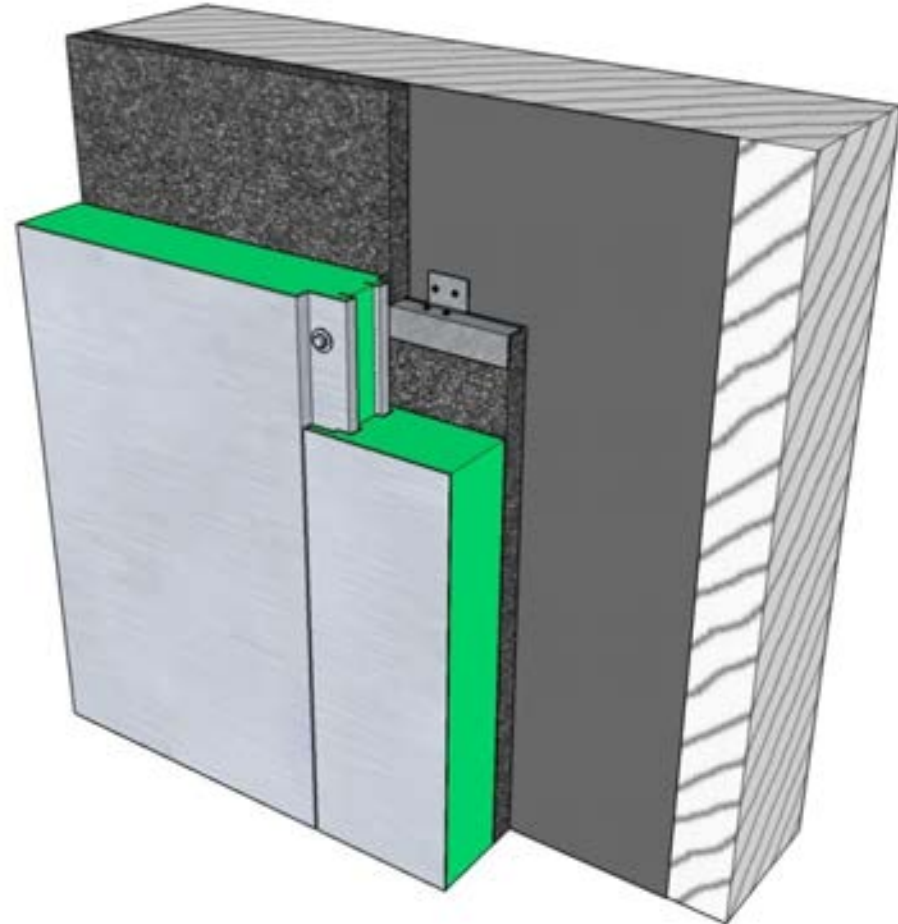
Exterior Insulation Approaches

- Insulation and cladding (discrete components)
- Exterior Insulation and Finish System (EIFS)
- Insulated Metal Panels (IMP)
 - Used as a complete enclosure



Exterior Insulation Approaches

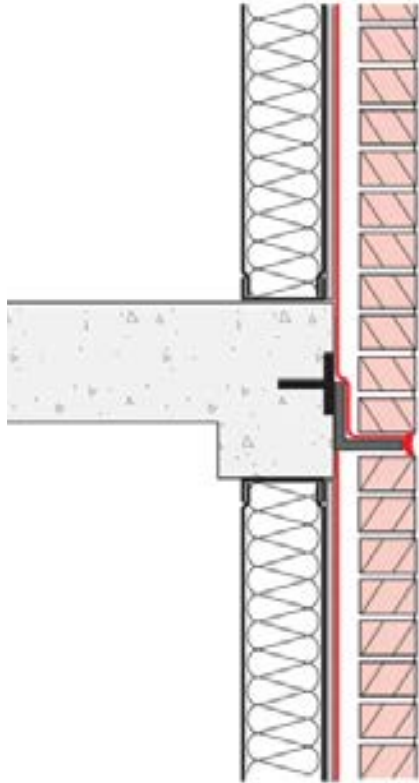
- Insulation and cladding (discrete components)
- Exterior Insulation and Finish System (EIFS)
- Insulated Metal Panels (IMP)
 - Used as a complete enclosure
 - Used as an insulated cladding



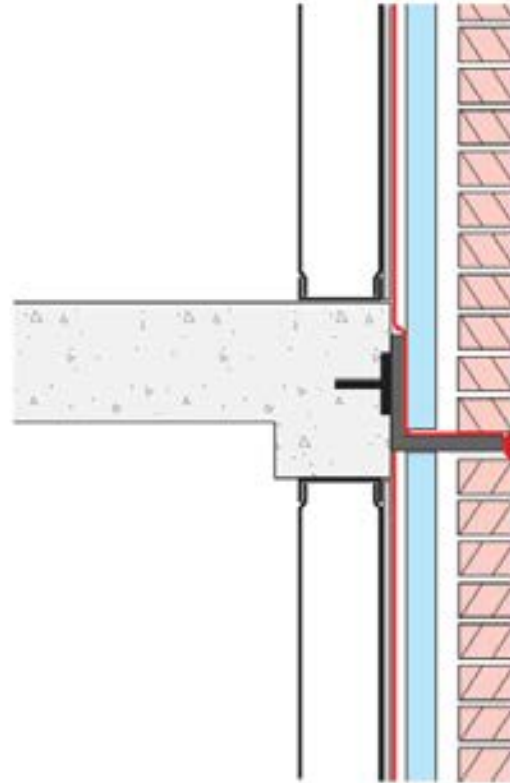
Brick Veneer

- Brick veneer has some of the longest history with exterior insulation
 - Long history = more common
 - More common = less questions
- Not always well done

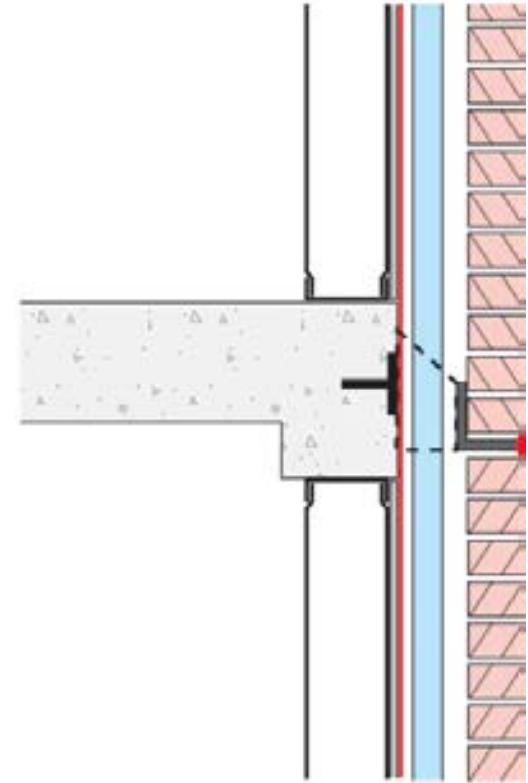
Brick Veneer



"The Ugly"

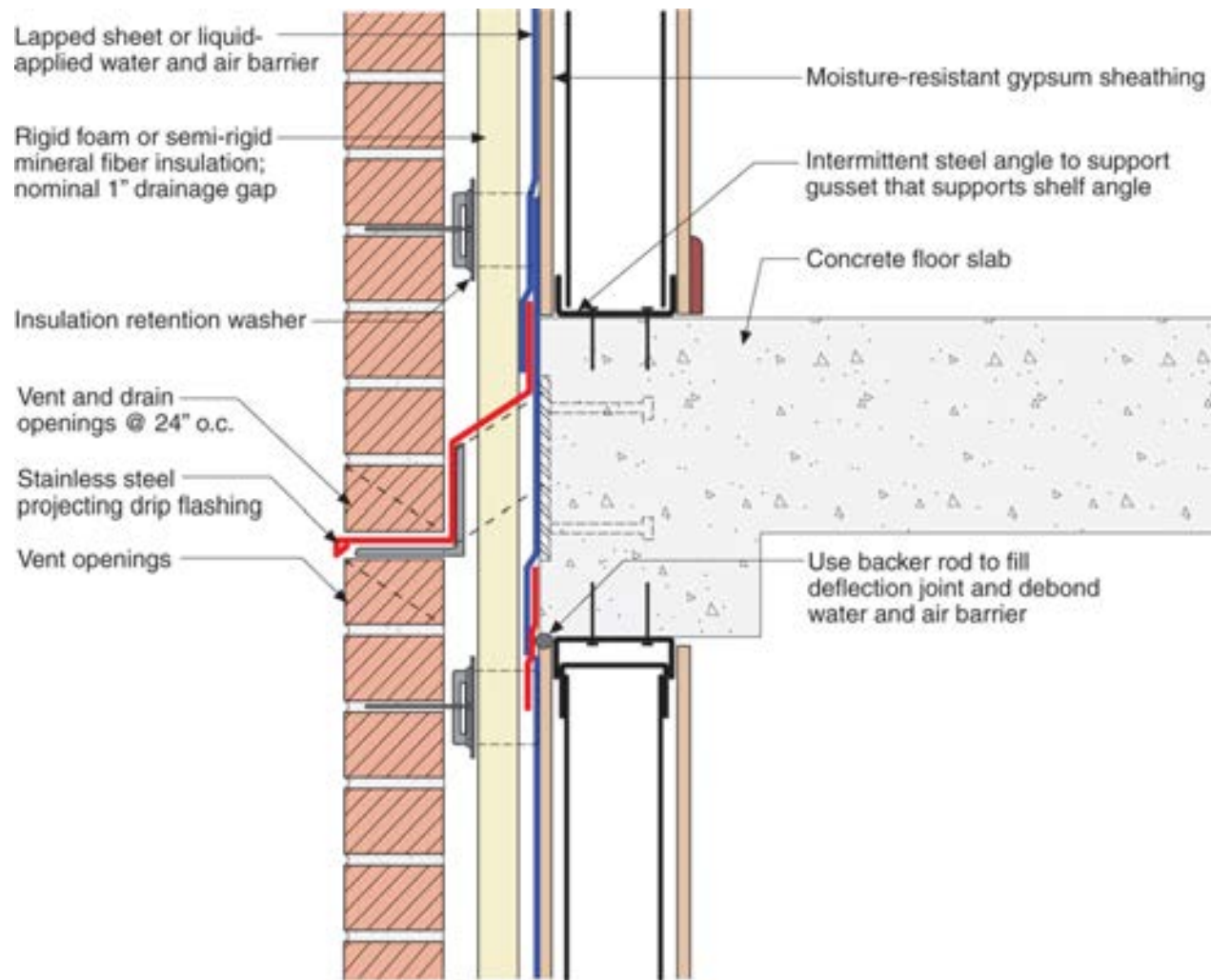


"The Bad"



"The Good"

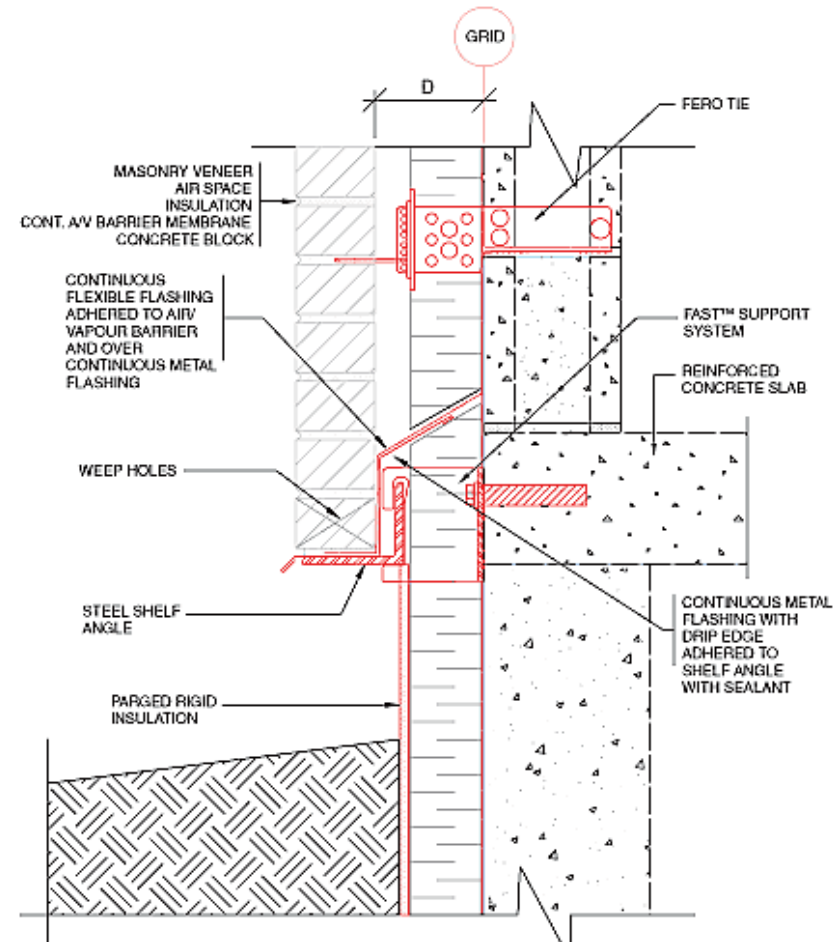
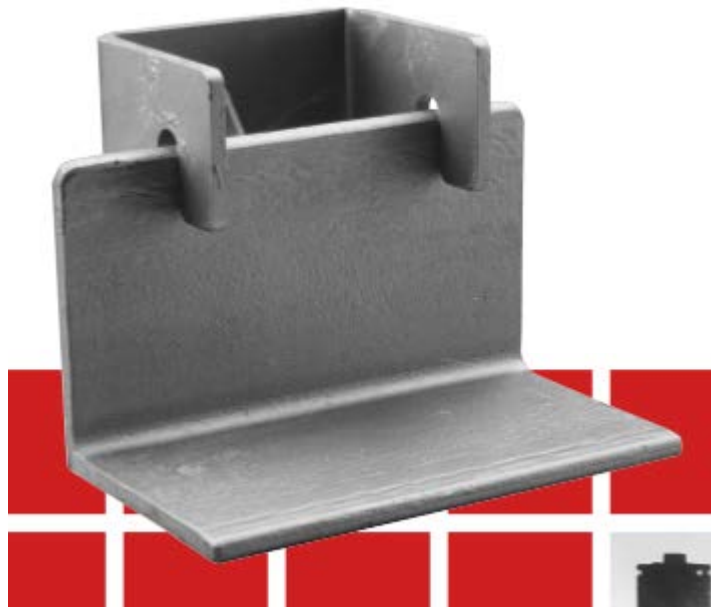
Brick Veneer



Brick Veneer



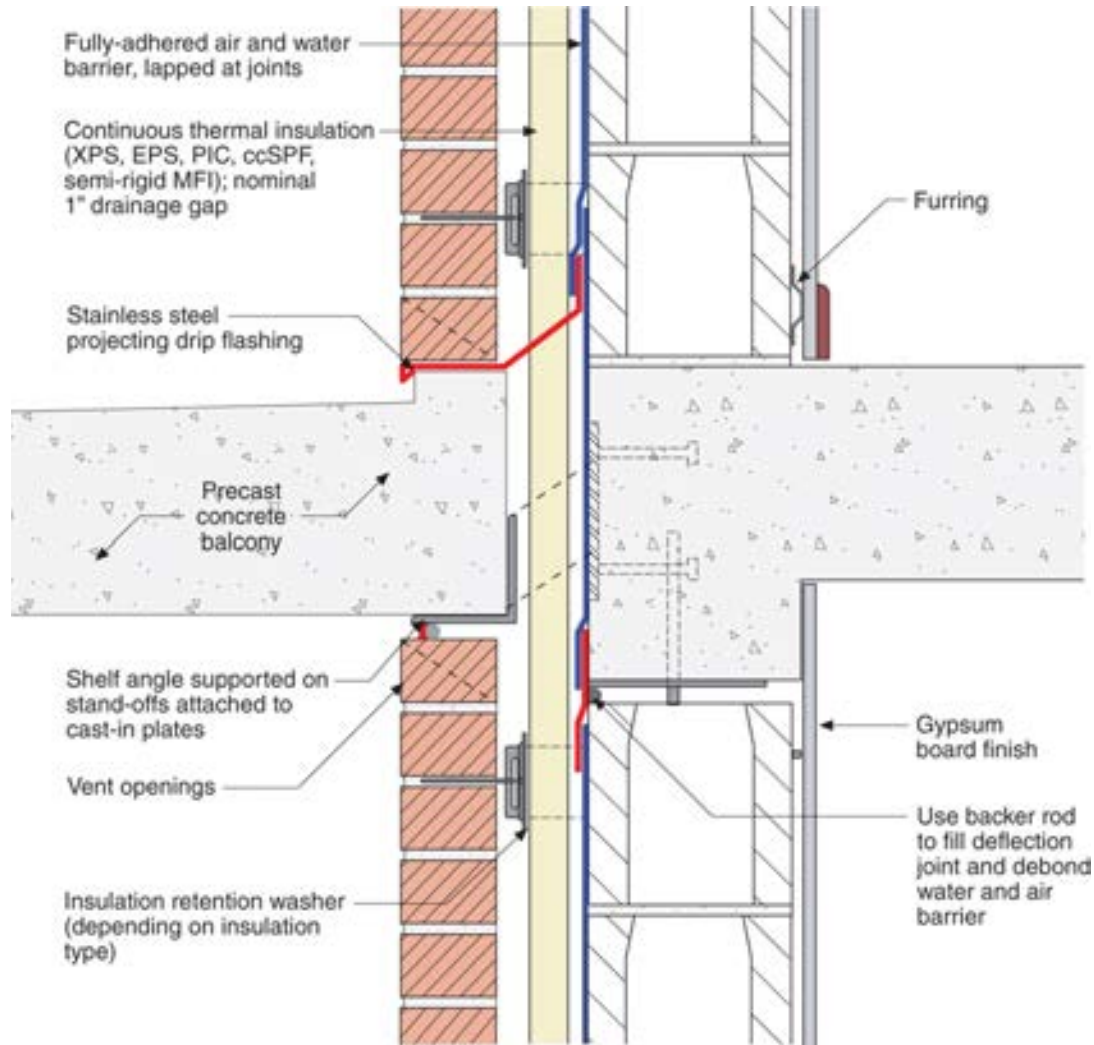
Brick Veneer



Brick Veneer

- Alternate details and support options exist
- Support systems for brick can be modified for other building elements
 - Decks
 - Balconies
 - Canopies
 - Etc.

Brick Veneer



Brick Veneer



Other Claddings

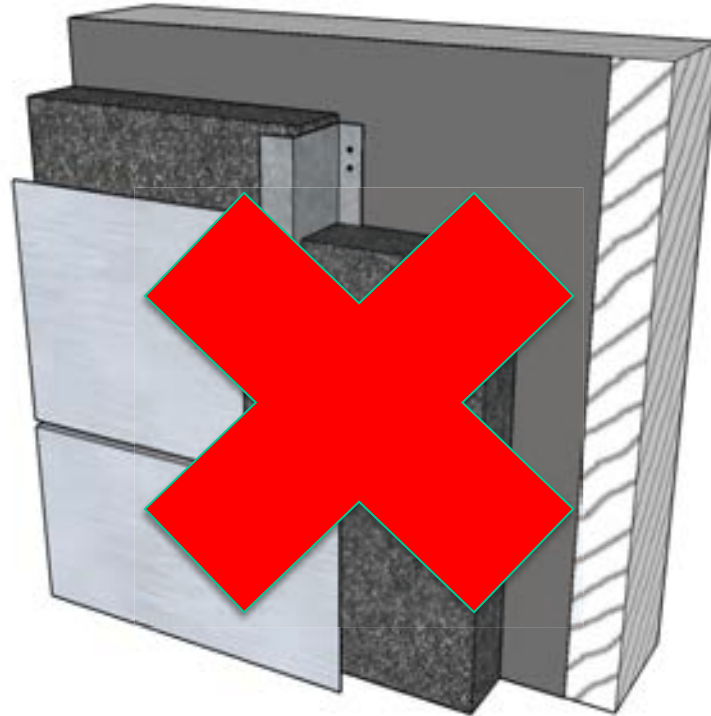
- For insulation less than 1.5” – direct attachment of cladding through insulation back to the structure is practical
- For insulation greater than 2” – a secondary cladding support structure is often needed.

Other Claddings

- Lighter weight claddings
(metal/wood/fiber cement)
 - Less common = less experience
 - Less experience = more questions
- Cladding support systems historically done poorly
- Systems are getting better

Other Claddings

- Single “z-furring”
 - Poor thermal performance (steel stud wall on the exterior – why bother?)



Other Claddings

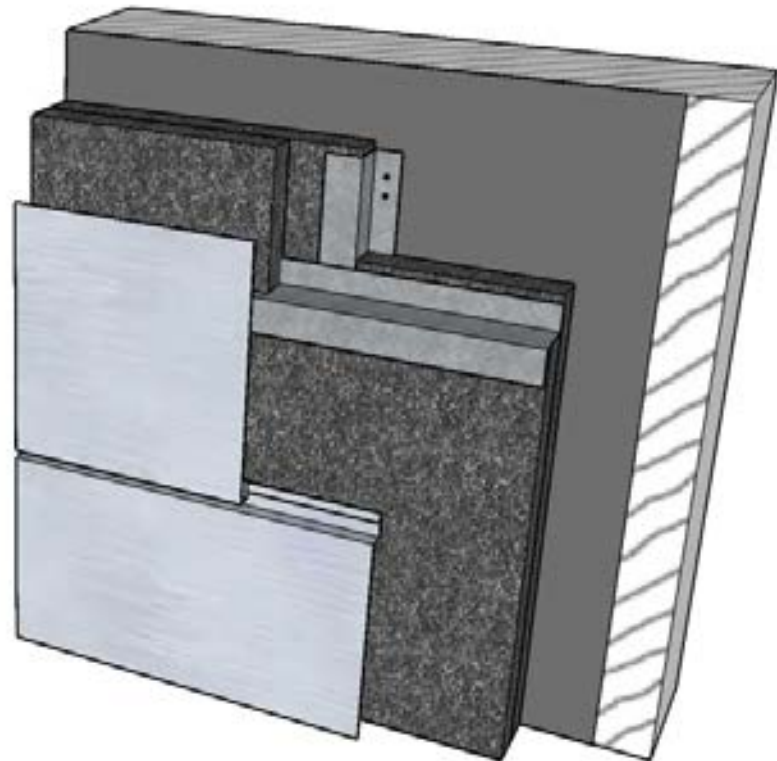
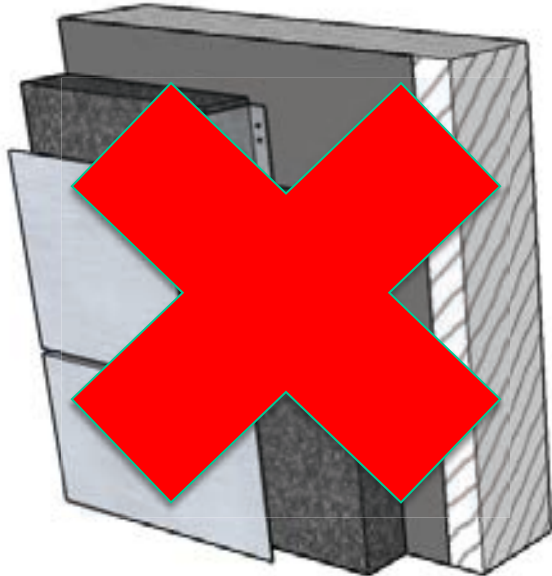


Other Claddings

- Single “z-furring”
- Double “z-furring”
 - Can be made to function reasonably well provided that two layers of insulation are used.
 - Often designed with first layer bridging insulation and second layer creating a gap behind the cladding = single “z-furring”

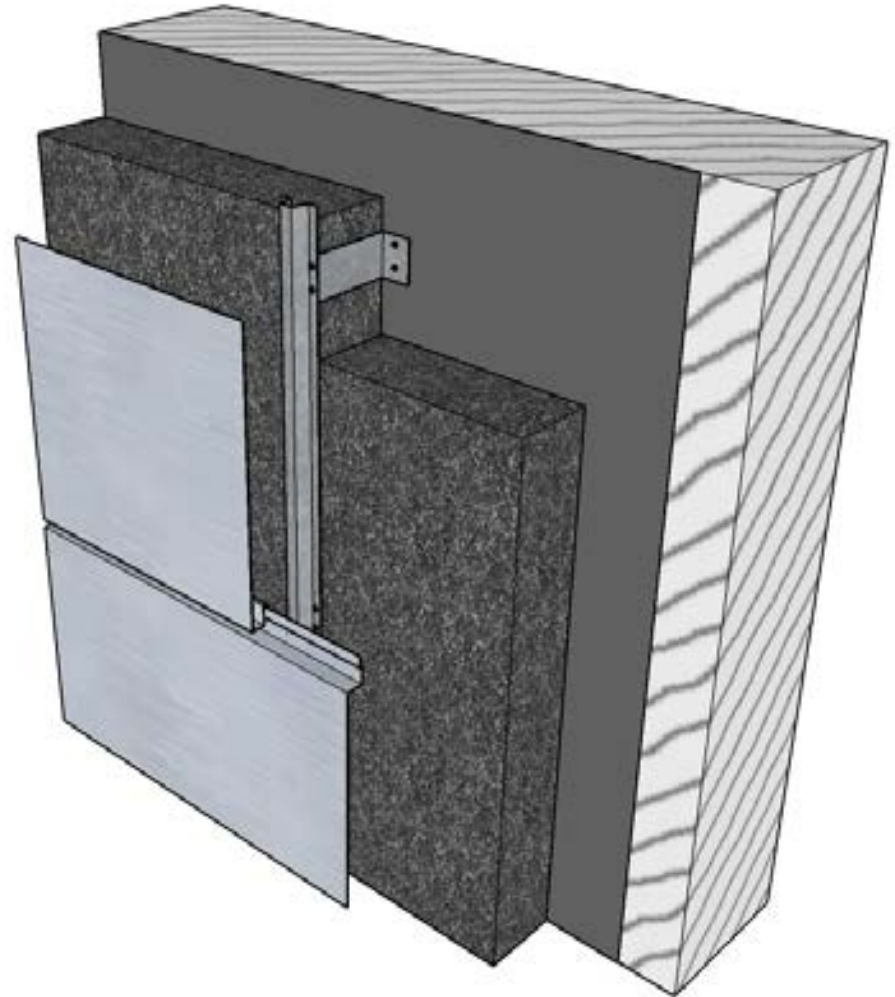
Other Claddings

- Single “z-furring”
- Double “z-furring”

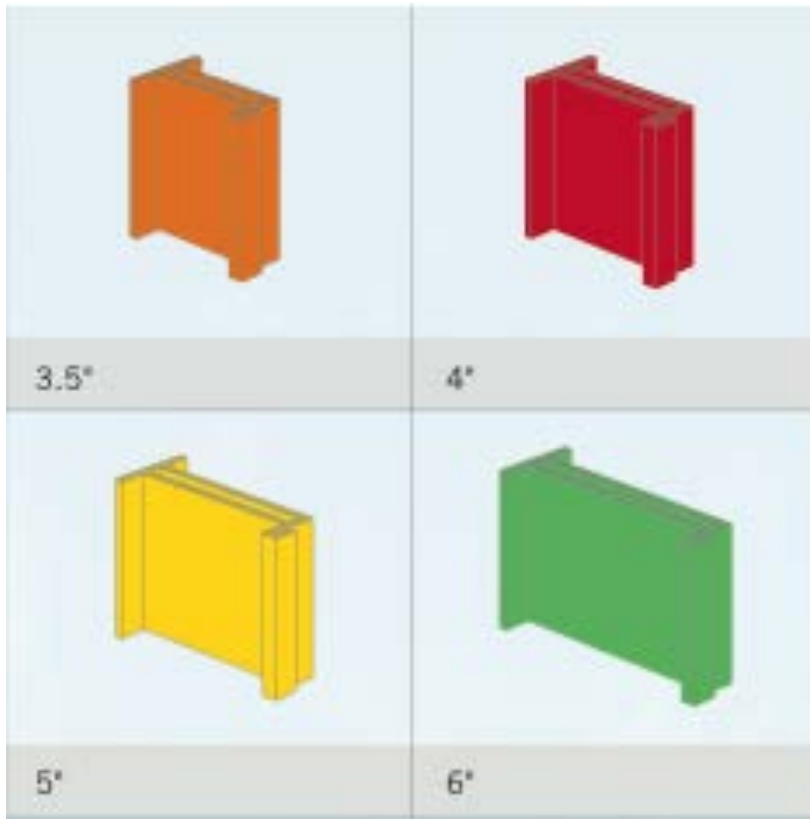


Other Claddings

- Single “z-furring”
- Double “z-furring”
- Clip and “z-furring” or hat channel
 - Metal clip
 - Fiberglass clip

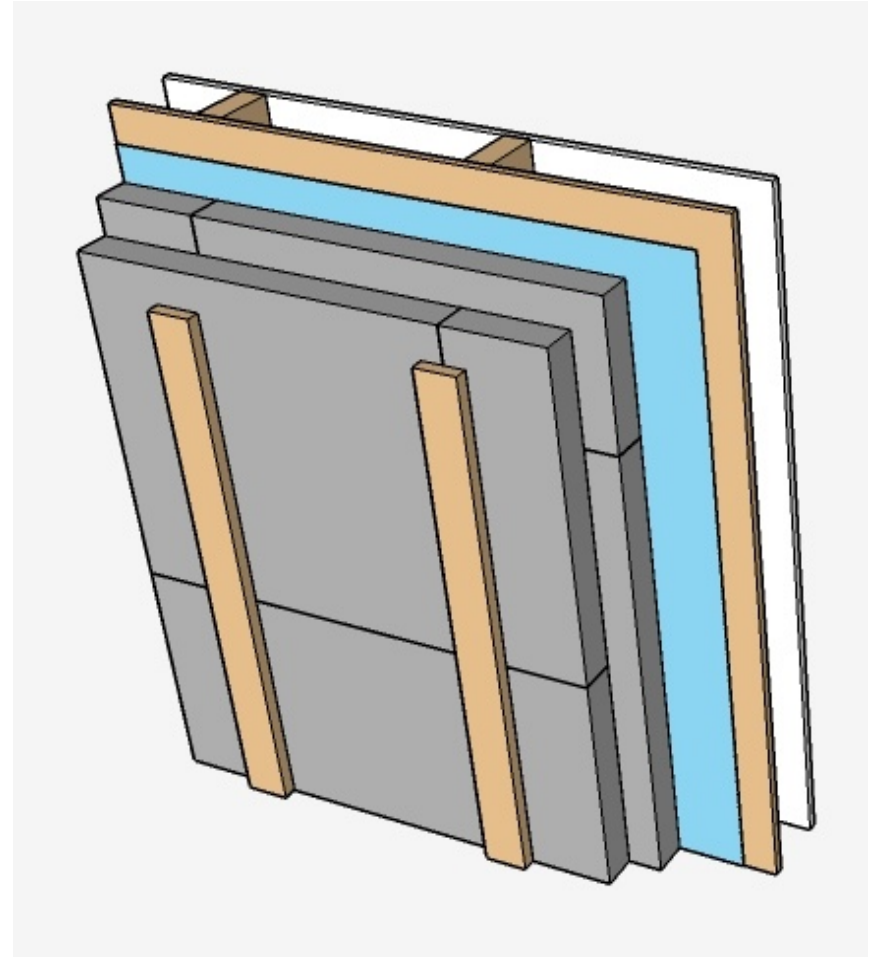


Other Claddings



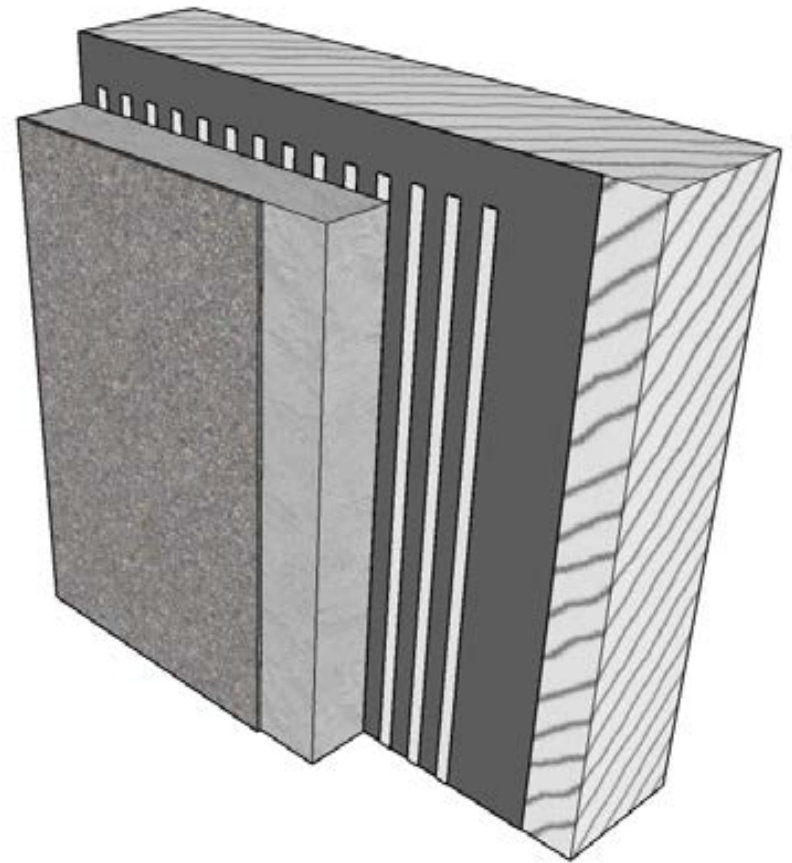
Foam insulating sheathing

- Single “z-furring”
- Double “z-furring”
- Clip and “z-furring” or hat channel
 - Metal clip
 - Fiberglass clip
- Attach furring directly back to structure through insulation



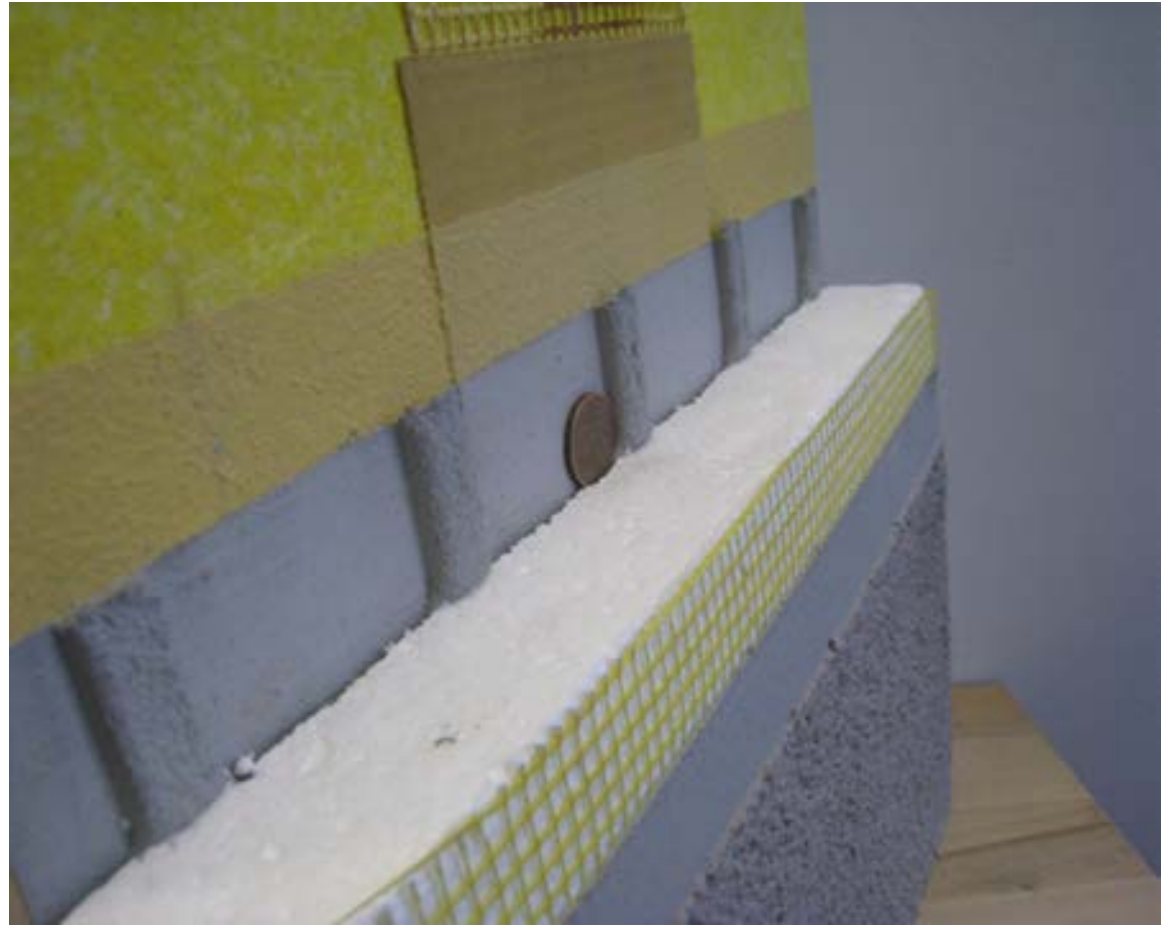
EIFS

- Exterior Insulation and Finish System (EIFS)
 - Lightweight
 - Cost effective
 - Water managed
- Minimal Thermal Bridging
- R-4 per inch
- System has a tainted history



EIFS

- Commonly installed using adhesive
- The adhesive can also form the drainage gap in water managed systems

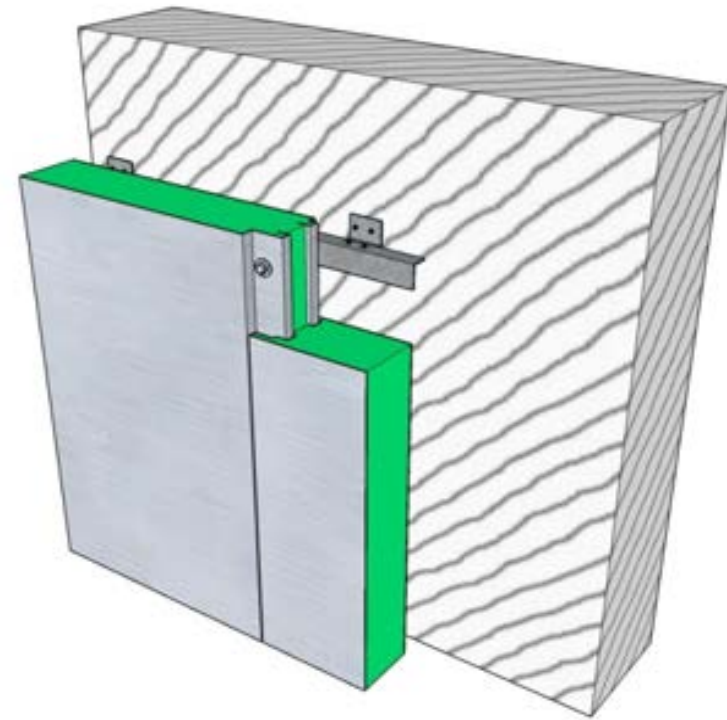


EIFS



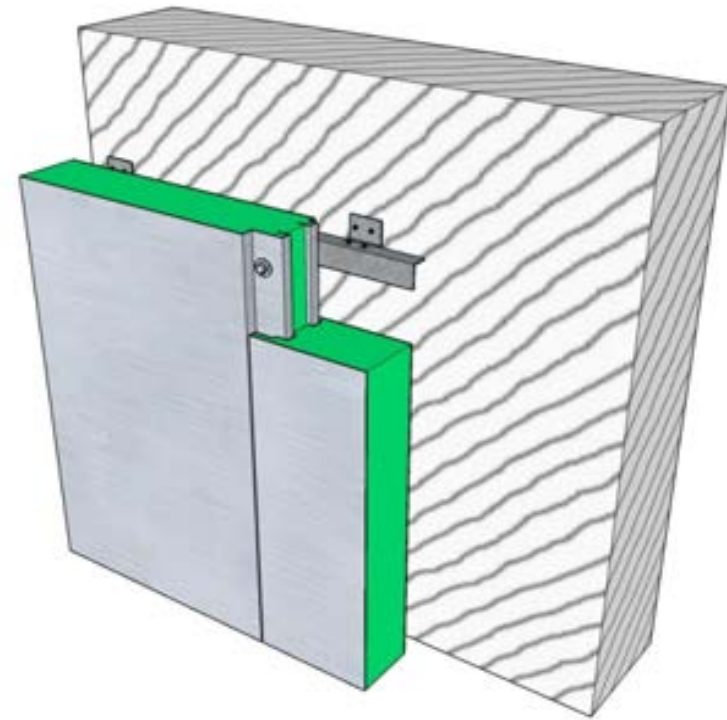
Insulated Metal Panels

- Insulated Metal Panels (IMP)
 - Lightweight
 - Moderate cost
 - Water managed
- Minimal Thermal Bridging
- R-7.5+ per inch
- Can be an excellent enclosure system
- Requires some consideration for retrofit applications



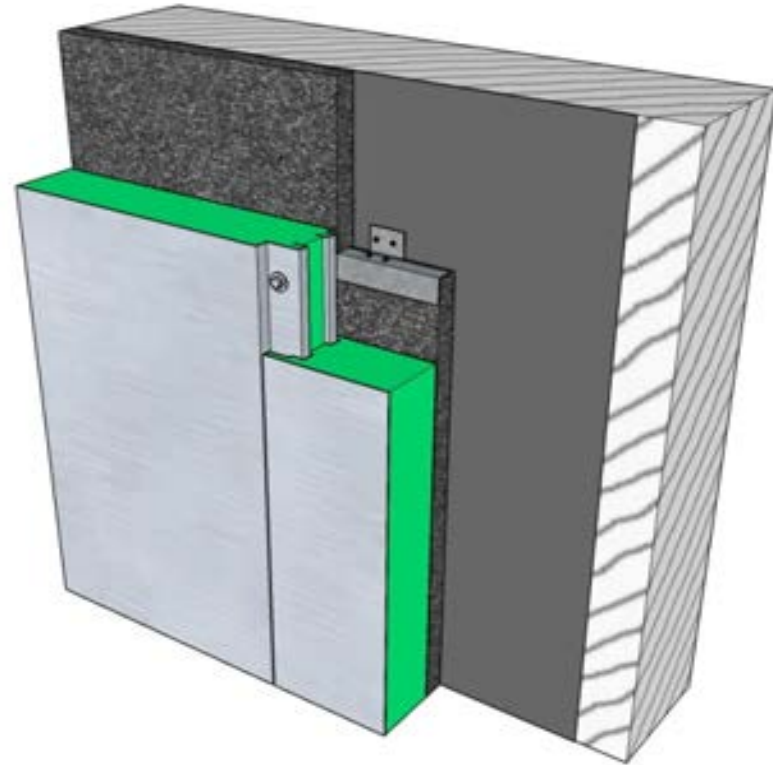
Insulated Metal Panels

- Can be used as both a complete enclosure system



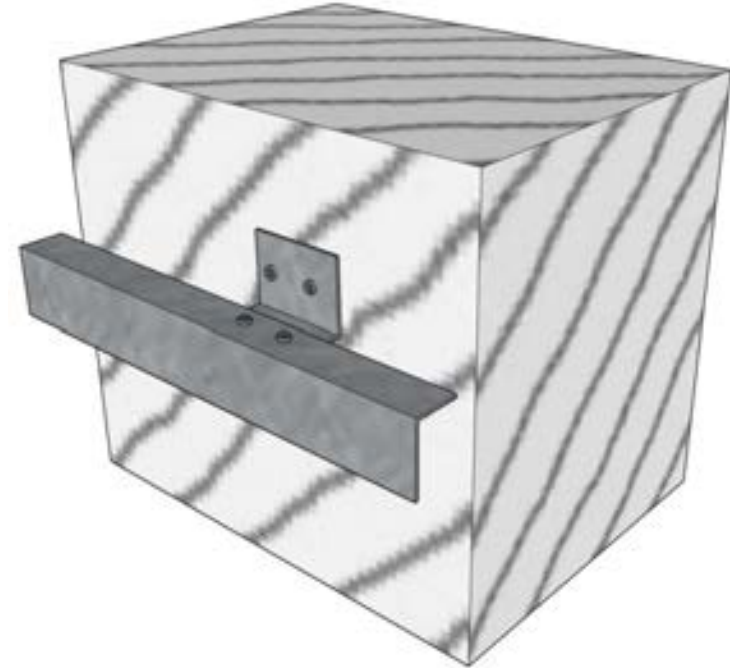
Insulated Metal Panels

- Can be used as both a complete enclosure system
- Can also be used as an insulated cladding system



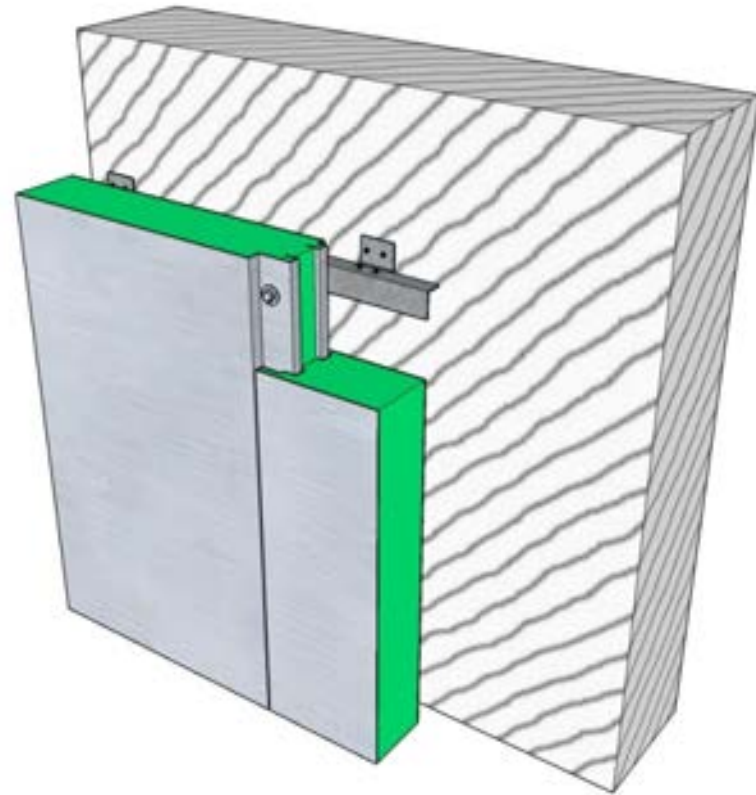
Insulated Metal Panels

- Attachment often to metal hat channel or z-furring
 - In retrofit applications out of plane walls can require special adjustable systems or shims



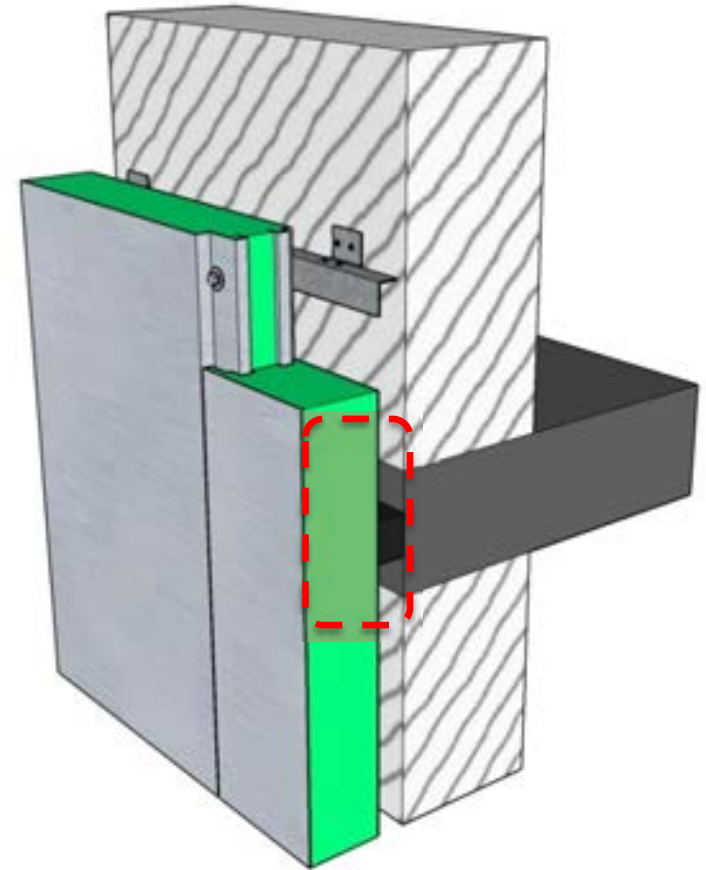
Insulated Metal Panels

- IMP as a complete enclosure system
 - Provides all enclosure functions into a single system
 - System design as intended by panel manufactures



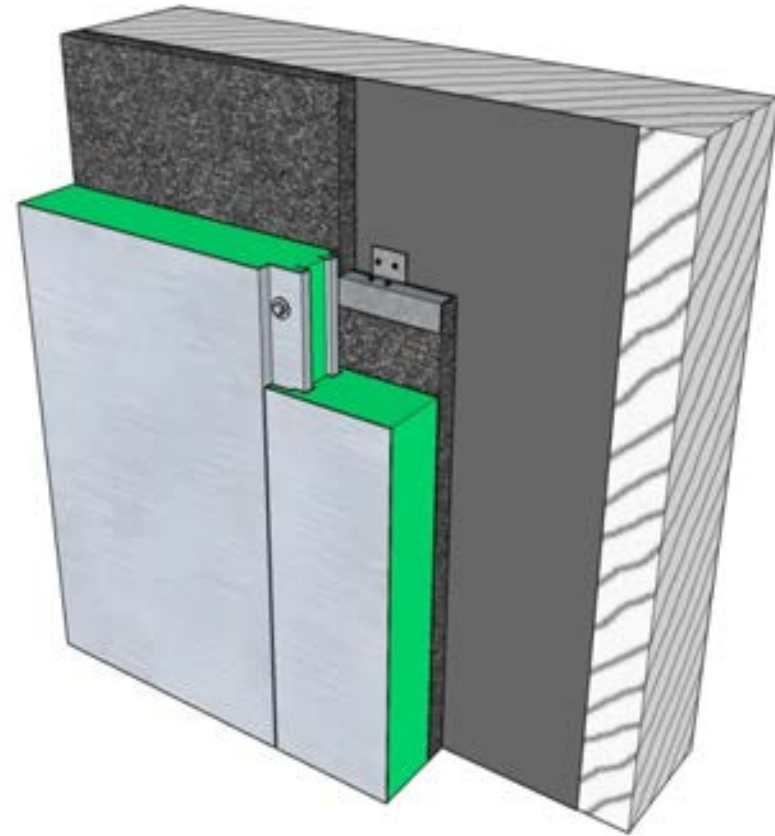
Insulated Metal Panels

- IMP as a complete enclosure system
 - May require special detailing for compartmentalization at floors or partition walls, particularly in retrofit applications



Insulated Metal Panels

- IMP as an insulated cladding system
 - Provides thermal insulation and cladding
 - Rain water management and air tightness are provided by other elements
 - Modification to manufacturers intended design



Insulated Metal Panels (Retrofits)

- IMP as an insulated cladding system
 - Need to fill space between the panel and back up wall to prevent air by-pass of the insulation
 - Can simplify certain details such as interfaces at balconies, lower roofs, and compartmentalization
 - More in line with common construction detailing

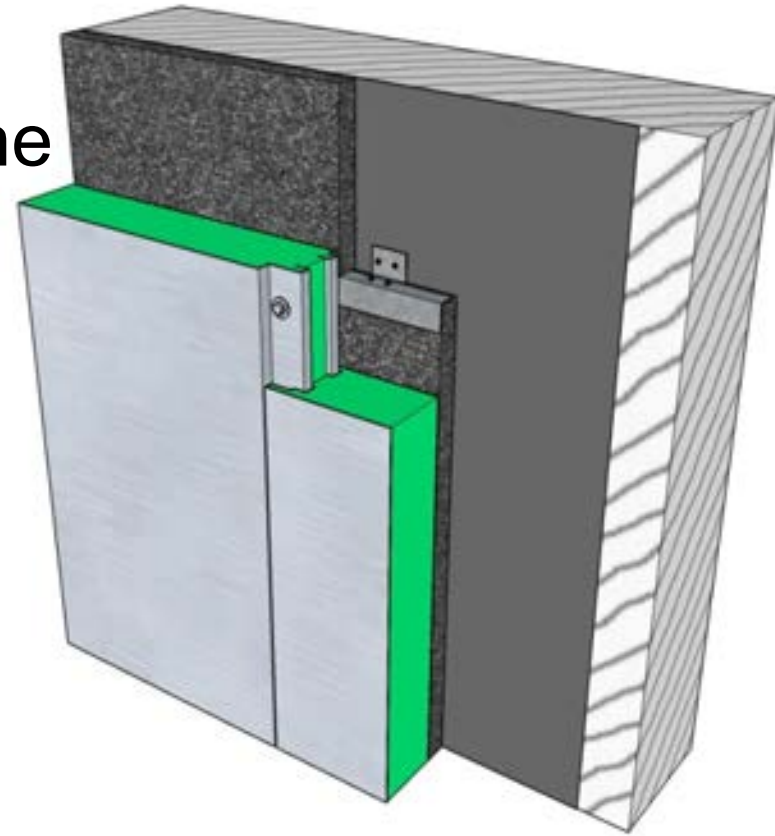




Photo credit: Elton + Hampton
Architects



Photo credit: Elton + Hampton
Architects





