Walls

August 8, 2019
Simple linearized energy-temperature relation for water
From Straube & Burnett, 2005
The inside face of the exterior sheathing is the condensing surface of interest.

- Wood-based siding
- Building paper
- Exterior sheathing
- R-19 cavity insulation in wood frame wall
- Gypsum board with any paint or wall covering

Graph:
- Temperature (°F)
- Mean monthly outdoor temperature
- Dew point temp. at 50% R.H., 70°F
- Dew point temp. at 35% R.H., 70°F
- Dew point temp. at 20% R.H., 70°F
- Potential for condensation
The inside face of the insulating sheathing is the condensing surface of interest.

- Wood-based siding
- R-7.5 rigid insulation
- R-13 cavity insulation in wood frame wall
- Gypsum board with any paint or wall covering

Graph:
- Insulation/sheathing interface temperature (R-7.5 sheathing, R-13 cavity insulation as shown in adjacent drawing)
- Mean monthly outdoor temperature
- Potential for condensation
- Dew point temp. at 35% R.H., 70°F

Month:
- APR
- MAY
- JUN
- JUL
- AUG
- SEP
- OCT
- NOV
- DEC
- JAN
- FEB
- MAR
- APR
- MAY
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
Exterior Retrofit Complications
Double Stud Walls (Risky?)

- 2x3 interior wall
- Taped and painted 1/2" gypsum wall board as interior finish
- Cellulose insulation in 2x3 interior wall stud spaces
- 6 mil polyethylene air and vapor barrier on outside of interior wall
- Cellulose insulation in gap between framing
- Single top plate
- 2x4 exterior wall @ 16" o.c.
- Cellulose insulation in 2x4 exterior wall stud space
- OSB exterior sheathing
- Housewrap
- Board foam blocking sealed airtight
- Cellulose insulation at rim joist
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

- Single top plate
- \(\frac{1}{2}\)" plywood connecting interior and exterior walls
- 2x4 structural stud wall at 24" o.c.
- Latex paint on \(\frac{1}{2}\)" gypsum board
- 3\(\frac{1}{2}\)" cellulose insulation
- \(\frac{1}{2}\)" plywood or OSB with joints taped
- 4\(\frac{1}{2}\)" space between sheathing and offset framing
- Cellulose insulation at rim joist
- Cellulose cavity insulation
- 2x3 frame wall
- \(\frac{1}{2}\)" fiberboard, plywood, OSB or gypsum sheathing
- Building paper, housewrap or building wrap
- Furring strips
- Cladding
Larsen Truss

- Double top plate
- Taped and painted 1/2" gypsum wall board as interior finish
- 2x4 interior framing member @ 16" o.c.
- 6 mil polyethylene air and vapor barrier between 2x4 framing and gypsum wall board
- Plywood cavity closure at each floor
- 2x3 exterior framing member
- Cellulose insulation in wall cavity
- OSB exterior sheathing
- Housewrap
- Fiberglass insulation at rim joist
- Capillary break
- Ledger board
4-½” High Density Spray Foam

- Single top plate
- Taped and painted ½” gypsum wall board as interior finish
- 2x6 @ 24” o.c. interior framing
- Fiberglass or cellulose insulation in interior stud cavity
- Substrate to support spray foam
- Spray foam insulation at rim joist
- Closure board

Minimum ½” drainage and ventilation gap
EIFS Overclad

- Single top plate
- 2x6 stud wall @ 24" o.c.
- Taped and painted 1/2" gypsum wall board as interior finish
- Vapor control layer as per IRC 2009
- Fiberglass or cellulose insulation in stud space
- Exterior sheathing
- Liquid applied drainage plane
- 3"-to-6" EPS insulation
- Glass mesh reinforced lamina and synthetic stucco finish
- Fiberglass insulation at rim joist
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

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

- Fully-adhered air and water barrier, lapped at joints
- Continuous thermal insulation (XPS, EPS, PIC, ccSPF, semi-rigid MFI); nominal 1" drainage gap
- Stainless steel projecting drip flashing
- Precast concrete balcony
- Shelf angle supported on stand-offs attached to cast-in plates
- Vent openings
- Insulation retention washer (depending on insulation type)
- Gypsum board finish
- Use backer rod to fill deflection joint and de-bond water and air barrier
- Furring
Brick Veneer
Other Claddings

- For insulation less than 1.5” – direct attachment of cladding though 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
- 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