Masonry Wall Insulation Background

Mass Walls (Rain Control)
- Moisture is absorbed/safely stored during rain
- Moisture re-evaporates/dries while warmer
- No “drainage plane”
Inside or Outside Insulation?

- Insulating on exterior always preferable (masonry durability, condensation risks)
- Interior insulation → historic preservation reasons
- Interior → potential durability risks

Cold Climate Risks

- Freeze-thaw (colder + reduced drying)
- Air leakage condensation on interior face of masonry
- Rot / corrosion of embedded elements
- Covering interior → less early warning of damage problems in the wall
Cold Climate Risks: Freeze-Thaw
- Below & above freezing cycling (actually ~23 F)
- Soaking wet brick
- Surface “flaking off”
- Brick more/less resistant to freeze-thaw
- $S_{\text{crit}}$ or critical degree of saturation measurement

Cold Climate Risks: Condensation
- Requires perfect workmanship at air barrier—around penetrations, etc.
- Made worse by air gap behind insulation
- **NOT RECOMMENDED**
Do We Need to Insulate Mass Walls?

Climate: Burlington, VT

Case 2 (add 1.5” ccSPF, R-8.7) ≈ 60% reduction in heat flow through walls vs. uninsulated case

Case 3 (add 3” ccSPF, R-17.3) ≈ 75% reduction in heat flow through walls vs. uninsulated case

Mass vs. no mass → Adds ~R-1

The Moisture Balance

- Large storage capacity (mass wall)
- Drying decreases with insulation
  - Less heat flow in winter
  - Inhibited inward drying?
- Reduce/control wetting to compensate

safe storage capacity
Masonry Wall Retrofit Insulation Assemblies

Masonry Interior Insulation Retrofit Assemblies

Closed-cell spray foam

Semi-rigid mineral fiber board

Climate Zone 4 or Warmer
Masonry Interior Insulation Retrofit Assemblies

Cellulose/Batt & GWB

- Climate Zone 4 or Warmer & Humidity Control

Cellulose/Batt, Smart VR, Service Cavity

- Highly workmanship sensitive

Moran Square Retrofit Assemblies

Typical Retrofit Assembly

Max Build-in

Airtightness

High R-Value?

“Thin” Build-in (Wainscoting)

NESEA BE21: Moran Square-Low Carbon Renovation

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Tricky Enclosure Items

Wetting Patterns: What Does the Building Tell Us?

- Where to look at the building (damage, moisture)
- “Where the building touches the ground and the sky”
- And add windows
- Parapets—cold & wet
- Unheated conditions
Wetting Patterns: Grade Contact Conditions

Firehouse

Syndicate

Dampproofing applied to brick below grade, covered with drainage mat (dimple mat).

Evaporation from surface film of water

Capillary flow of salts in solution

Wetting Patterns: Windows

Caulk and backer rod joint, to avoid entry of water into masonry wythes.

Preferred flashing/drip edge: can be wedged into place instead of mechanical fastening. If acceptable. Alternate: improves drainage but is more visible—have drip edge tail from outside edge of sill.
Wetting Patterns: Roof Copings

Roof/Attic: Unvented?

Roof membrane and parapet per previous detail

Right insulation (40% of total minimum) on top of roof deck. Polyiso/Polyslope, Rockwool Comfortboard 80, or Gutex (to be considered if acceptable)

Self-adhered membrane air barrier on existing roof sheathing

Insulation in roof rafter cavities (dense-pack reticulated cellulose, mineral wool, or similar), 60% of total R-value minimum

Wall insulation and air barrier required at attic wall (part of conditioned space)
Roof/Attic: Vented?

No wall insulation or air barrier required at attic wall (outside of conditioned space).

Insulation in ceiling framing cavities and covering tops of members.

Roof membrane and parapet per previous detail. Low and high roof ventilation (doghouse detail) required.

Continuous ceiling air barrier: plywood or ZIP with taped seams or gypsum board with fire taped seams. No electrical penetrations; minimize all other penetrations.

Catwalks for access to attic; minimizes insulation damage.

Insulation in ceiling framing cavities and covering tops of members.

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Masonry Thermal Bridges

- Add tee wall “wrap” for flanking loss

Floor-Ceiling Over Unconditioned @ Existing Building

- Air barrier, insulation 2-hour fire rating
- Taped ZIP-R as air barrier layer
Thermal Bridges at Window Openings

- PHIUS feedback
- Opaque frame and trim limited by historic
- Some are fixable
- Some have limited solutions

Retrofit Building Section (Syndicate)

- Commercial space is outside of the Passive House boundary
- But blower door test requires perfect air seal between commercial & residential
- Not allowing guarded test
- Both spaces operate at room temperature
New Construction
Enclosure Assemblies

New Construction Building Section

Parking garage (unconditioned)
Wall and Floor-over-Garage Assemblies

Questions?

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This presentation will be available at http://buildingscience.com/past-events
### Document Resources

- Building Science Digest 114: Interior Insulation Retrofits of Load-Bearing Masonry Walls In Cold Climates  

- Building Science Insight 047: Thick as a Brick  

- Building Science Insight 080: Tailor Made  

- Building Science Insight 095: How Buildings Age  

- Building Science Insight 105: Avoiding Mass Failures  

- Building America Report 1105: Internal Insulation of Masonry Walls: Final Measure Guideline  

- Building America Report 1307: Interior Insulation of Mass Masonry Walls: Joist Monitoring, Material Test Optimization, Salt Effects  

- Building America Report 1508: Analysis of Joist Masonry Moisture Content Monitoring  

- Green Building Advisor: Insulation Retrofits on Old Masonry Buildings: Building Science Podcast  