McKeesport, PA YMCA Building

- Former YMCA building, circa 1923 construction
- Action Housing Inc. - Downtown Housing facility
- ~65,000 sf; ~75 units (rental, shelter rooms)
McKeesport, PA YMCA Building

- Former YMCA building, circa 1923 construction
- Action Housing Inc. - Downtown Housing facility
- ~65,000 sf; ~75 units (rental, shelter rooms)
- Major energy efficiency retrofit project underway
  - PH target; occupied rehab project
- Thoughtful Balance Inc. (architecture firm)
  - Laura Nettleton, Michael Whartnaby
- BSC acting as sub-consultant
  - Masonry interior insulation retrofit; other energy issues

Masonry 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
- Energy efficiency, preserve exterior, museum-level durability: choose 2 of 3
Cold Climate Risks

1. Freeze-thaw (reduced drying)
2. Air leakage condensation on interior face of masonry
3. Rot / corrosion of embedded elements

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Cold Climate Risks: Condensation

- Requires perfect workmanship at air barrier—around penetrations, etc.
- Made worse by air gap behind insulation
- **NOT RECOMMENDED**

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The Moisture Balance

- Large storage capacity (mass wall)
- Drying decreases with insulation
- Design should reduce/control wetting to compensate

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Do We Need to Insulate Mass Walls?

**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
**Retrofit Approaches**

**Recommended Approaches**
- Spray foam against masonry
- Open cell (0.5 PCF)? Closed cell (2.0 PCF)? Intermediate (1.0 PCF)?
- Air seal at joist pockets
- Montreal experience

**Hybrid Wall Insulation Assembly**
- Remove all lath and plaster over existing masonry walls.
- Bed lath over masonry as usual.
- Air seal at beams

**Non Spray Foams Options**
- Rigid board foams, adhered to wall—air barrier
- Expanded polystyrene/EPS (non-GWP foam)
Non-Foam Options?

- Dense pack cellulose against brick
- High-density mineral fiber/glass fiber & variable permeability vapor retarder
- Requires meticulous workmanship/air barrier—air barrier outboard of framing & services

Site Assessment

Site Assessment: Where is it Wet?

Site Assessment: Brick Condition
Site Assessment: Windows (Terra Cotta)

Drip Edges
- Minimum projection of drip edge

Windows (Potential Rain Entry Point)

Site Assessment: Ground Capillarity?
Brick Testing & F/T Simulations

Measurement of $S_{\text{crit}}$
- Critical Degree of Saturation ($S_{\text{crit}}$)
- European research on stone and masonry
- Below this moisture content: no damage w. F/T
- Above this moisture content: damage occurs quickly
- Cut brick samples; measurements
- Vacuum saturate to range of moisture contents
- Subject to freeze-thaw cycles
- Measure dilation (growth) of samples (very small!)
- “Hook” in graph signifies $S_{\text{crit}}$

Laboratory Measurement of $S_{\text{crit}}$

Dilation (Growth) of Samples
- “Hook” in graph signifies $S_{\text{crit}}$
Hygrothermal Simulations

- Simulate existing (uninsulated) wall
- Simulate retrofitted (insulated) wall
- Vary rain loading—sensitivity analysis

Hygrothermal Simulation Results

- Low risks at low rain exposures—both existing and insulated (below $S_{\text{crit}}$)
- Extreme rain loads:
  - Existing wall medium-to-high risks
  - Insulated wall medium-to-high risks
  - Insulated vs. uninsulated—less effect than rain load
  - Even at high insulation levels (8“ ccSPF)
- Danger of putting wood-based materials on “cold and wet” side of wall
  - Showed rising moisture contents

Thermal Bridging at Slab Floors

- Embedded slabs, hollow metal pans
Thermal Bridging at Slab Floors

- **Typical Insulation Levels**
  - R-14 for 8 foot wall
  - R-3 for 8 inch floor slab
  - R-10.9 overall opaque R value
  - 22% loss from nominal value

- **High Insulation Levels**
  - R-38 for 8 foot wall (6” ccSPF)
  - R-3 for 8 inch floor slab
  - R-19.9 overall opaque R value
  - 47% loss from nominal value

**Questions?**
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This presentation will be available at:
http://www.buildingscienceconsulting.com/presentations/recent.aspx

**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
- RR 1013: Assessing the Freeze-Thaw Resistance of Clay Brick for Interior Insulation Retrofit Projects
- RR 1105: Internal Insulation of Masonry Walls: Final Measure Guideline
- RR-1307: Interior Insulation of Mass Masonry Walls: Joist Monitoring, Material Test Optimization, Salt Effects
- Interior Insulation Retrofit of Mass Masonry Wall Assemblies Workshop
- Canadian Building Digest 2. Efflorescence
- Green Building Advisor: Insulation Retrofits on Old Masonry Buildings: Building Science Podcast