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Embedded Wood Joists in Interior-Insulated Masonry Walls

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BUILDING ENERGY 14
CONFERENCE + TRADE SHOW FOR RENEWABLE ENERGY AND GREEN BUILDING PROFESSIONALS

AIA Best Practice Slide

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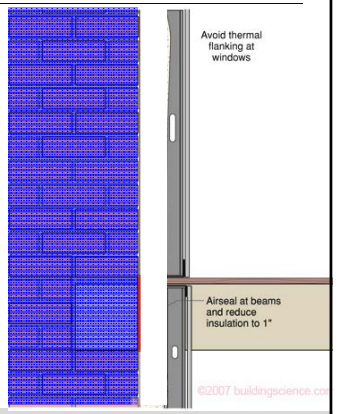
Questions related to specific materials, methods, and services will be addressed at the conclusion of this presentation

Learning Objectives

- Understand the moisture risks associated with embedded wood members in masonry walls retrofitted with interior insulation
- Understand the importance of controlling bulk rainwater in joist end durability
- Explain some of the possible measures that can be taken to reduce risks in these cases, as well as their pros and cons

Embedded Wood Members

- After interior insulation, wall and joist end will be colder
- Less energy flow, higher RHs, wetter conditions
- Wood can mold/rot
- How big is the risk?



Terminology-“Beams” and “Joists”

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2005 Monitoring Research (Canada)

- In SK, joists stayed dry (10-15% MC)
- In ON, sometimes up to 20% MC
  - Capillarity from foundation?
  - Rainwater absorption through face of masonry?

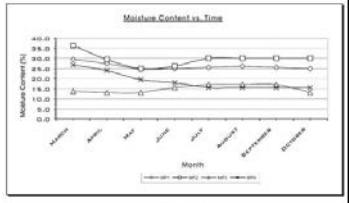

Figure 1

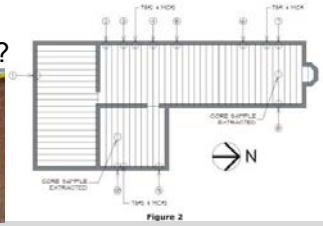

Figure 2

2009-2012 Previous Work

- Interior-sourced moisture risk (condensation)
- Historic methods of beam end preservation
  - Charring, ventilation
- “Gapped” insulation at beams (uninsulated)
- Wind-driven rain a huge factor in wetting vs. drying patterns
- Other literature:
  - Typically found few problems in the field
  - Cracked facades → problems
  - Adding heating to beam ends? Expensive

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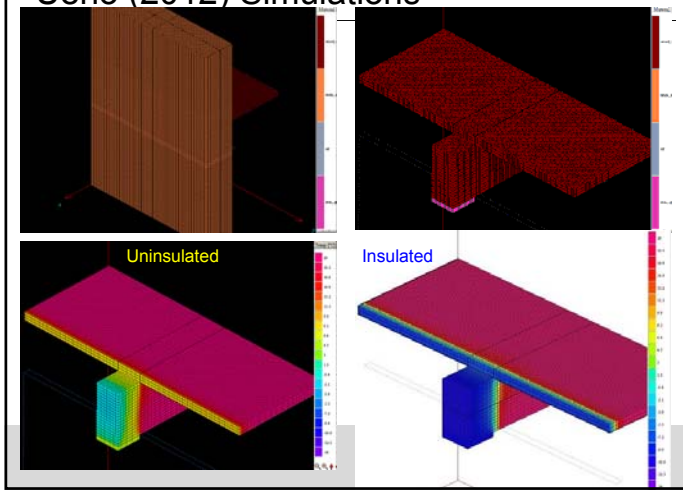
Ueno (2012) Simulations



Ueno (2012) Simulations

- Also looked at joists vs. beams
- Added heat flow using passive “spreader” plates

- 1D hygrothermal simulations (WUFI) with boundary conditions from 3D HEAT runs
- Inconclusive results
- Monitoring!

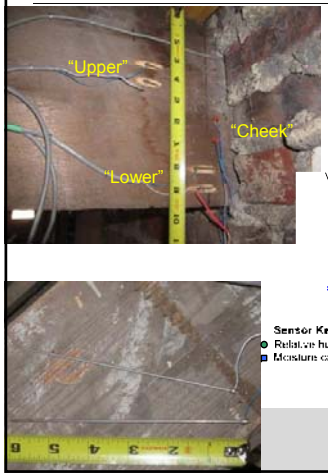
Embedded Joist Monitoring

- HfH Lawrence renovation
- Ongoing interior retrofit
- Joist moisture content:
  - 3 measurements/joist
  - 10 joists
- Variables
  - Orientation/exposure
  - Wall type
  - Insulated/non-insulated
  - Air sealed

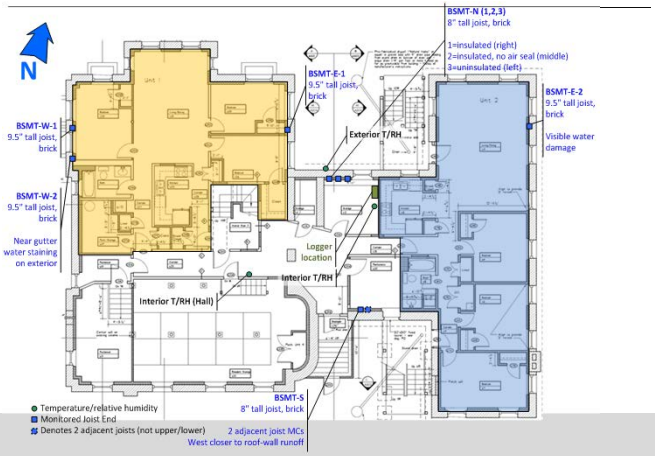
Interior Insulation Details

- 3x 2” (6” total) layers extruded polystyrene, adhered to masonry walls
- Joist pockets insulated with XPS blocks, air sealed with spray foam kits

Joist Monitoring Package



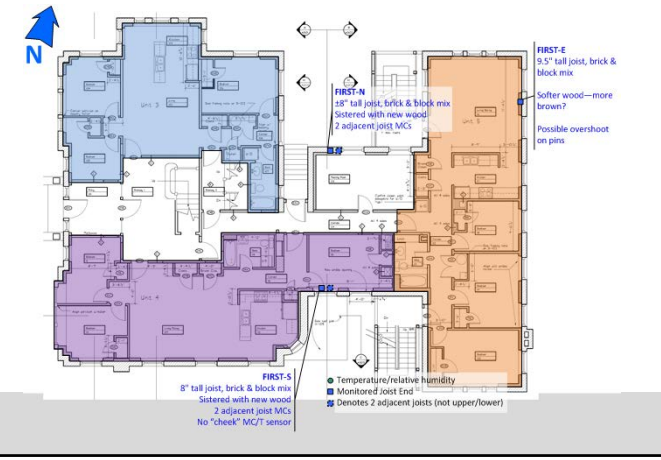
Joist Monitoring Locations (Basement)



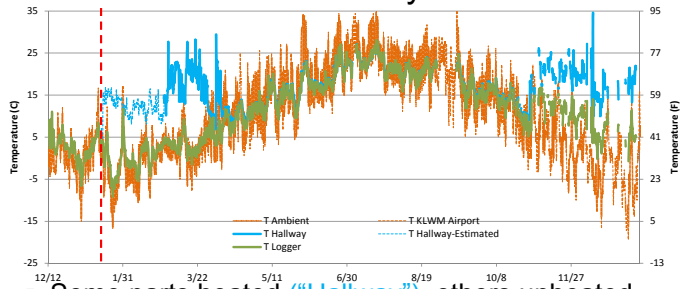
Insulation Option Comparison (North)

- Same orientation, 3 different insulation techniques
- Fiberglass = insulated but no air leakage control

Joist Monitoring Locations (First)

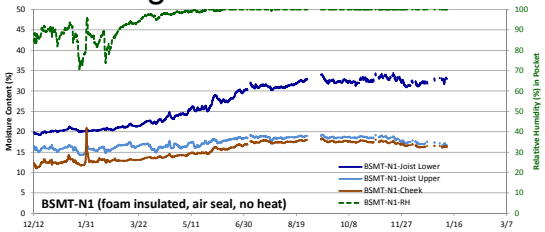


Exterior/Interior Boundary Conditions



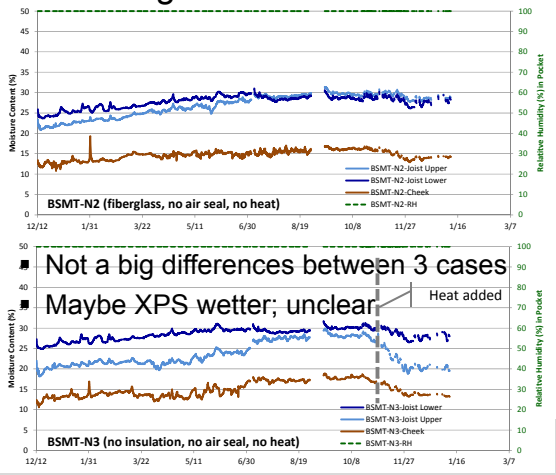
- Some parts heated ("Hallway"), others unheated ("Logger") → not very representative; being built
- Construction heating added January 2013
- Interior dewpoints ~identical to exterior dewpoints
- Many joists still uninsulated/unsealed

North-Facing Basement Joists



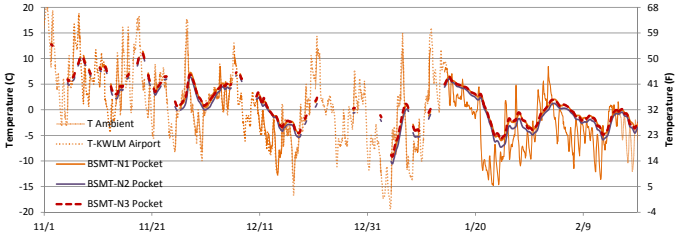
- "Lower" vs. "Upper" & "Cheek" MCs
- RH tracking to moisture contents
- All pretty high MCs, especially "lower"
- "Mothballed" condition of building
- Rise in RH moving into summer, not winter

North-Facing Basement Joists



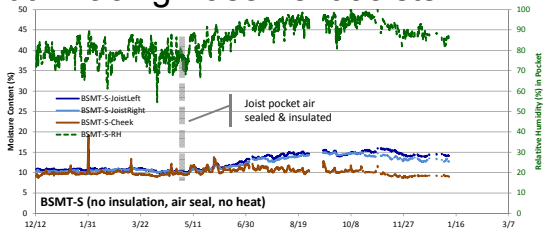
- Not a big differences between 3 cases
- Maybe XPS wetter; unclear

Results: Joist Pocket Temperatures



- Minimal interior heating in winter 2014
- Small temperature differences
  - N2 coldest (fiberglass)
  - N3 (uninsulated) and N1 (XPS) almost identical

South-Facing Basement Joists



- Left/right pairing (not upper/lower)
- Much drier MCs than north-facing (warmer)
- Lower RHs in joist pocket
- Sealed/insulated in spring 2013

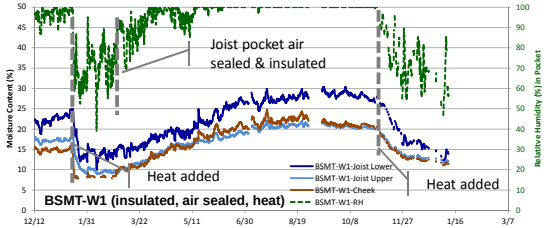
First Floor Joists

- All unheated, uninsulated, unsealed
- All in hollow clay tile walls

- FIRST-N: 20-30% MCs, 100% RH pocket
- FIRST-E: 10-15% MCs 60-90% RH pocket (seasonal cycle)
- FIRST-S: 9-12% MCs—very safe

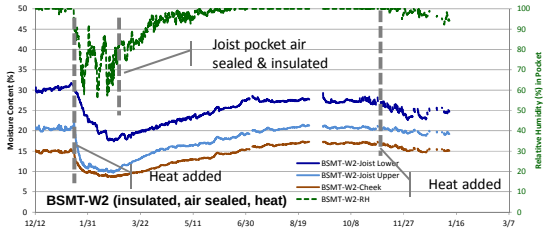
- Huge effect of orientation/exposure
- Basement East vs. First East

Heated Basement Joists



- Adding heat drops MCs/RH
- Highest MCs/RHs in summer—inward T gradient

Heated Basement Joists



- BSMT W1 vs. W2—wetted by gutter?
- No noticeable difference

Monitoring Conclusions

- All high MCs—20% recommended. But do they operate this way already?
- Mothballed conditions—started at high MCs?
- Higher MCs/RHs in summer—inward drive?
- “Normal” in-service response not clear yet
- Orientation very large effect
  - South-facing joists in the safe range
  - North-facing joists among the wettest
- Continued monitoring (2014 construction completion target, 10 units)

Takeaway Information/Recommendations

- Keep bulk water (rainwater) away from joist ends
  - Pointing, reglets, sheltering details
- Keep capillary water away (see BSI-011 “Small Sacrifices”)—near grade conditions, reglet?
- Additional risk mitigation methods
  - No risk: cut off end, support from masonry (steel ledgers) or interior bearing wall or replace structure
  - Leave uninsulated? → Condensation risks? Heat loss
  - Borate “sticks” in joist ends?
  - Heat spreader plates? → Passive ones not effective?
  - Encapsulate embedded end in sealant? → Imperfections have big risks

Questions?

This concludes the American Institute of Architects Continuing Education Systems Program

This temporarily suspends the AIA CEU content

Questions?

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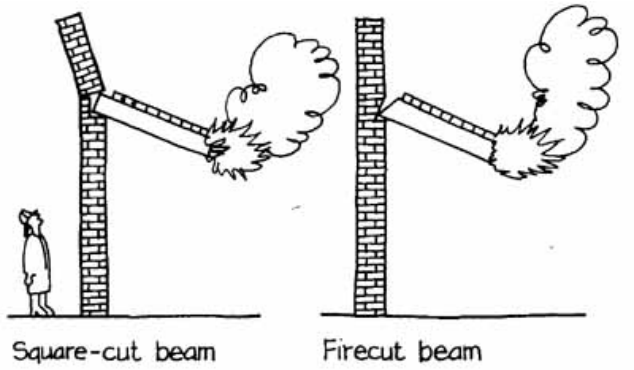
Questions?

AIA CEU content is now resumed

Firecut Beams



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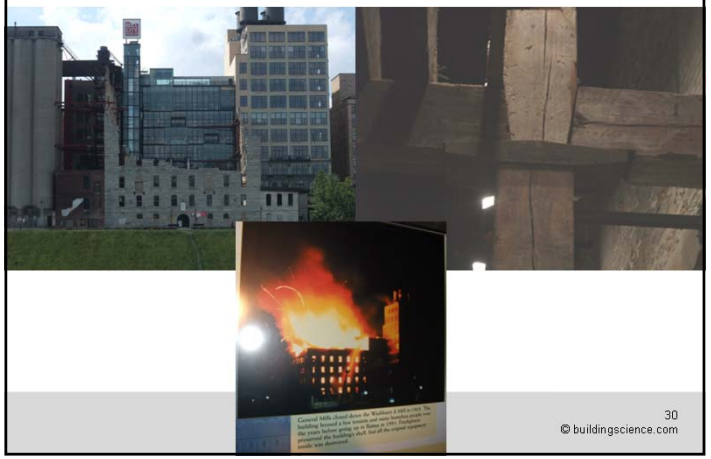
Firecut Beams



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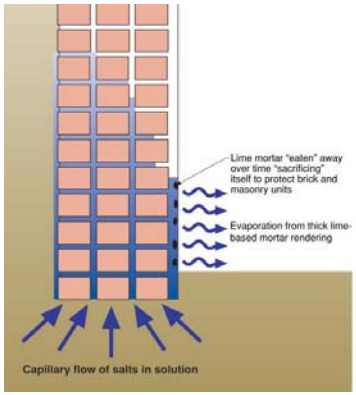
BSI-011 “Small Sacrifices”



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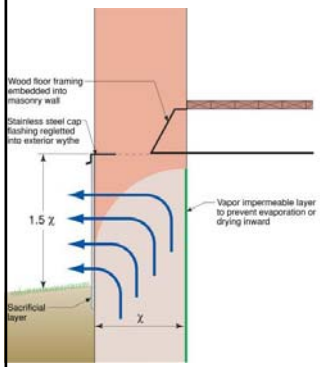
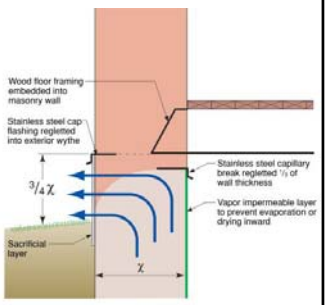
BSI-011 “Small Sacrifices”





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