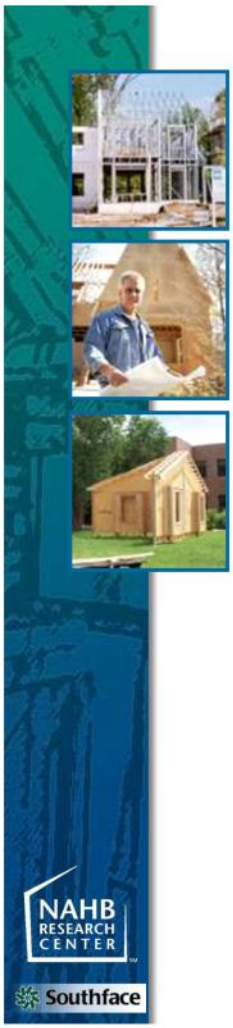


# Field Moisture Monitoring to Support the Design of Durable Energy Efficient Wall Systems

NAHB Research Center

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Building AMERICA
U.S. Department of Energy


# Purpose

- Document the moisture performance of EE wall systems in a variety of climate zones that meet or exceed the minimum insulation levels and air tightness requirements of the 2012 IECC
- Support the design of durable energy efficient wall systems
- Funding: NAHB, FPL, Building America


# Energy Efficiency Features Impact Wall's Durability

- Reduced building infiltration rates
- Lower wall air leakage
- Changes in wall layer permeance
- Increased wall insulation
- Different location of R-value relative to cavity


# Building Codes

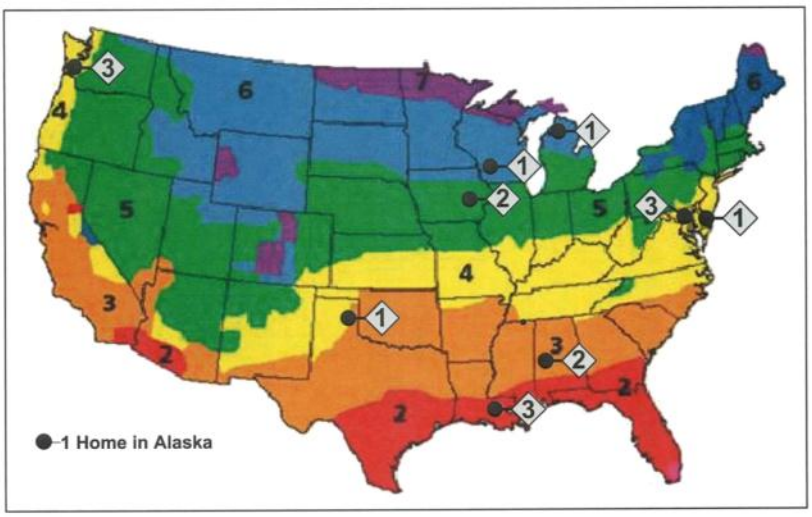
- Energy codes provide min insulation requirements, not wall design solutions
- IECC prescriptive insulation in CZ 6-8: R20+5
  - Durability? - IRC, IBC
- Vapor Retarders (IRC Chapter 7)
  - CZ 6: +R11.25 for 2x6 walls with Class III
  - CZ 7-8: +R15 for 2x6 walls Class III
  - R20+5: Class I or II


# Vapor Retarder in CZ 7 for R20+5

- Best practices from the strictly moisture management standpoint
  - Warm cavity: +R10 or more exterior
  - Significant change for builders – constructability
- Incremental change
  - More common in residential market
  - One inch of exterior insulation +R4-R5
    - EPS, XPS, other rigid insulation board
  - Vapor retarder
    - Kraft paper (is it enough?)
    - Poly, smart vapor retarder, spray foam - also air barrier

# Technical Approach 1

- Cataloguing and monitoring EE wall designs used by builders in various climates



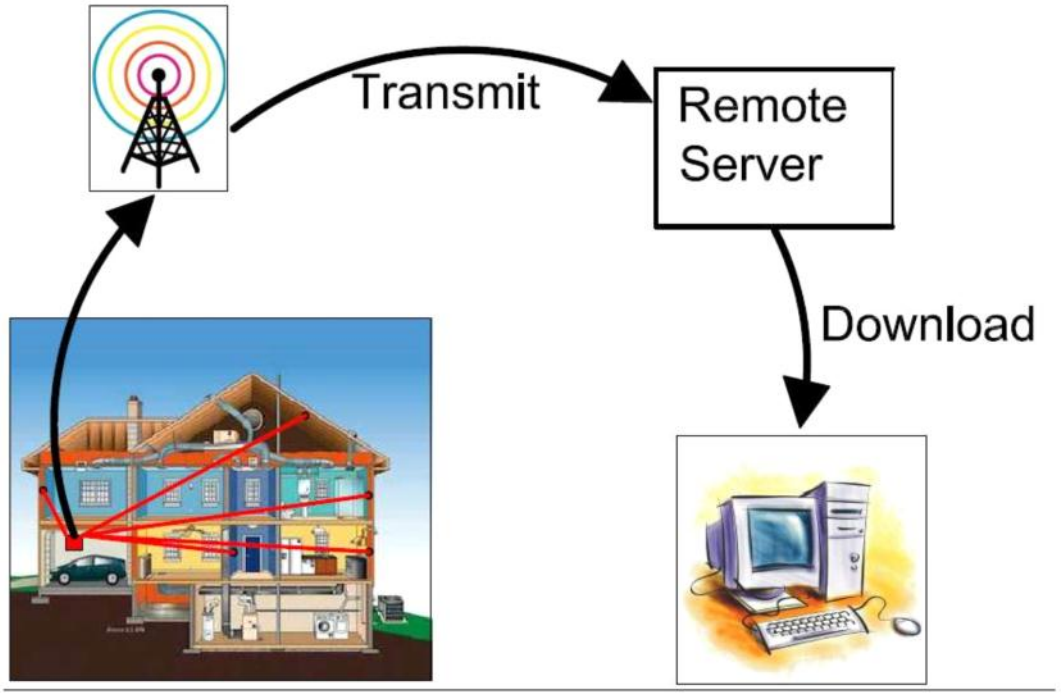

# Wall Configurations

- Systems and Materials
  - 2x4, 2x6, 2x6 with offset 2x4 studs
  - R13-R24 cavity
  - Open cell spray foam
  - Closed cell spray foam
  - Flash & batt
  - 1-inch XPS
  - 2-inch XPS
- 17 unique wall configurations

# Technical Approach 2

- **Test Huts in Climate Zone 4 to evaluate the performance of various EE wall designs**
  - 2x4, 2x6
  - Vapor retarders
  - 1-inch XPS exterior insulation
  - Quarterly water injections
  - Indoor RH (ASHRAE 160 simplified method)

# Monitor cavity T & RH and MC of Sheathing and Framing

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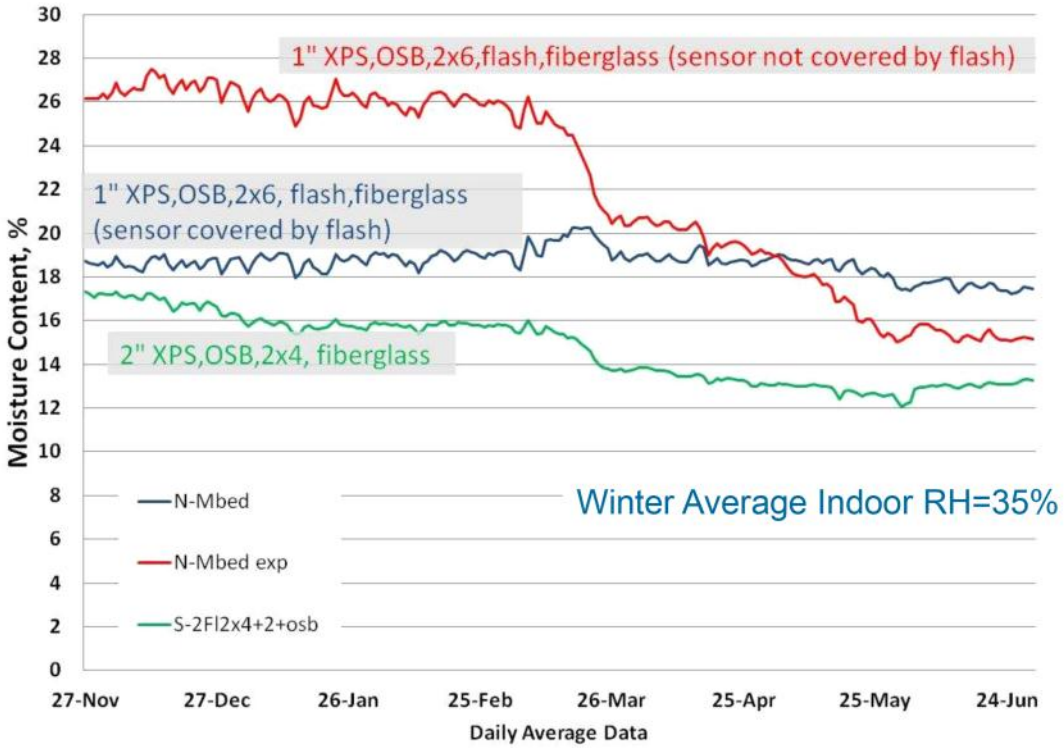
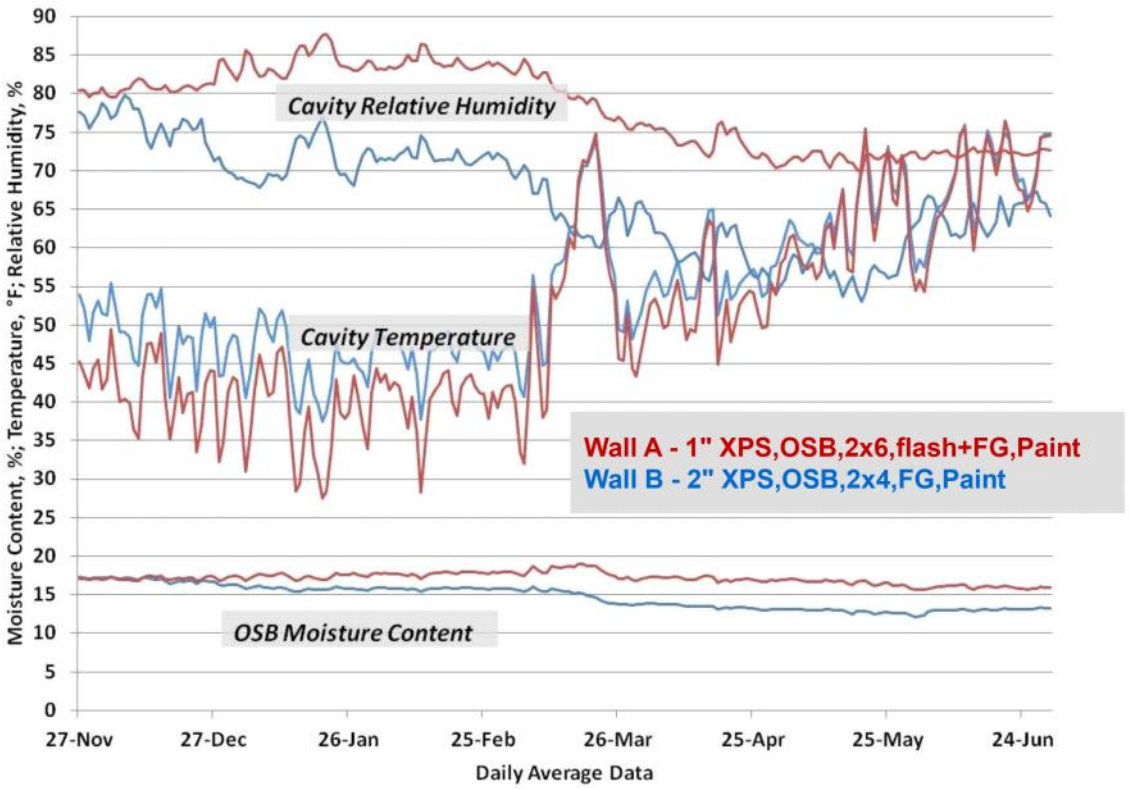
# Preliminary Results of Monitoring for Selected Test Sites

- Site in Climate Zone 6A
- Site in Climate Zone 4A

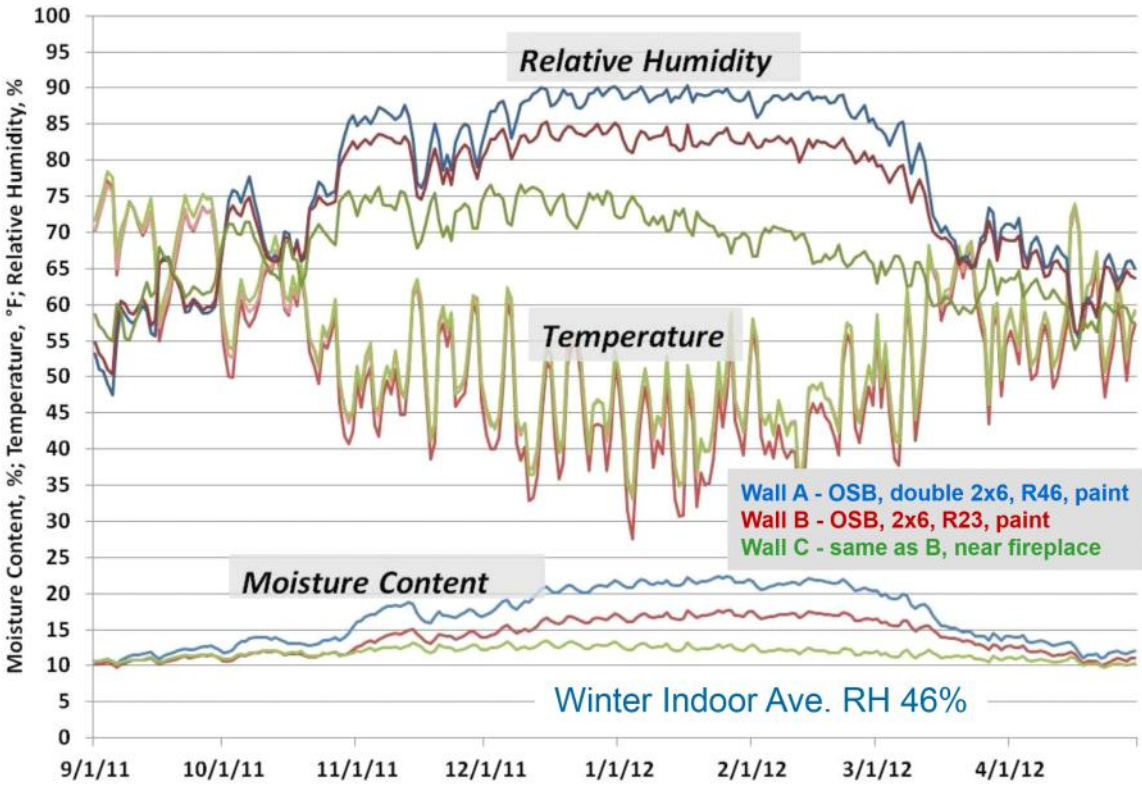
# Climate Zone 6A – OSB MC



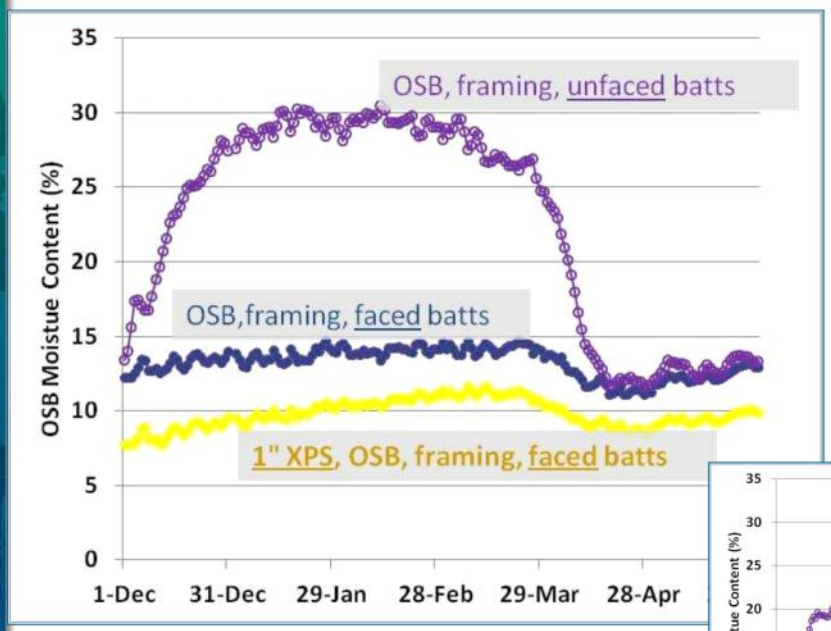
# CZ 6A, South Exposure Wall

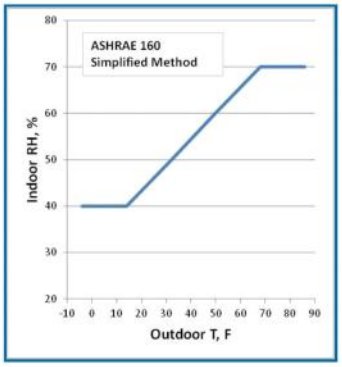


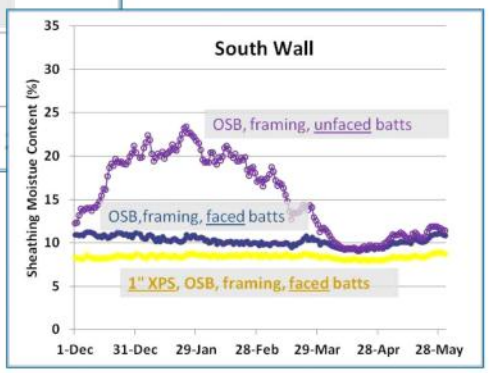
# CZ 4A, NW orientation, model home, humidifier



# CZ 4A, Test Huts, North orientation




Winter Indoor Ave. RH 55%

Interior paint – measured permeance ≈40


# Preliminary Field Results

- Significantly reduced drying rates for OSB sandwiched between low perm exterior insulation and low perm flash
- OSB moisture content is lower for wall with higher levels of exterior insulation but the drying rate is reduced
- Construction moisture appears to influence the OSB MC for walls without interior vapor retarder


# Preliminary Field Results

- In CZ 6, wall systems with 2” exterior foam w/o flash and wall systems with 1” with flash have reasonable OSB MC levels in a tight house with lower interior RH and no vapor retarder
- In CZ 4, walls with R20+ cavity insulation have reasonable OSB MC levels in a tight house with moderate interior RH and no vapor retarder


# Preliminary Field Results

- Based on controlled field testing with interior RH level >50%, the winter OSB MC is significantly lower for walls with kraft paper vapor retarder
- In summary, incremental improvements to walls systems is less prone to elevated MC levels when interior RH is maintained at lower levels and drying to either exterior or interior is provided


# Value

- Align wall configuration with the moisture performance in a specific climate zone
- Validate the field performance of design features
- Identify potential design issues
- Document the indoor conditions for energy efficient homes


# Market Readiness

- The performance data will be immediately relevant to the construction materials and systems available in the market today
- Design recommendations will be also relevant to the construction of durable energy efficient walls
- The solutions will be available to builders for immediate implementation