Project Overcoat:
Moving Exterior Insulation to Existing Homes

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Project Overcoat: Moving Exterior Insulation to Existing Homes

• The benefits of exterior thermal insulation over a single water, air, and vapor control layer.

• The challenges of the 1-1/2 story home in cold climates.

• An overview of an exterior retrofit roof insulation strategy that we are researching.
Introduction to Building America

- Focus is to reduce energy use by 50% in new houses and 30% in existing residential buildings.
- Promote building science using a systems engineering and integrated design approach.
- “Do no harm” => we must ensure that safety, health, and durability are maintained or improved.
- Accelerate the adoption of high-performance technologies.
Building America
U.S. Department of Energy

Industry Research Teams

BA-PIRC

BARA
Building America Retrofit Alliance

ARIES
Collaborative

BA-PIRC

ARCI
Alliance for Residential Building Innovation

NorthernSTAR

CARB
Consortium for Advanced Residential Buildings

IBACOS
Home Quality + Performance

NAHB
Research Center

PARR
The Partnership for Advanced Residential Retrofit
Building America Innovations

This research is paving the way for key innovations:

• 1. Building Science Solutions
  • Building on existing research on exterior insulation systems
  • Evaluating methods for insulating 1-1/2 story homes
  • Searching for alternative approaches & materials
NorthernSTAR’s Builder Resources

• This presentation is based on the benefits of exterior insulation systems
  – focus on 1-1/2 story homes in cold climates
  – with history of ice dams and comfort issues.

• Key technical references:
  – Project Overcoat for 1-1/2 Story Homes
  – BSC Building Insights: Ice Dams & Over-Roofing
  – Link to DOE resources: www.buildingamerica.gov
High-Performance Homes: Making the Case for Robust

• We must ensure our high-performance houses meet our expectations today and into the future?
• High-performance houses will push the envelope (mechanical systems, occupants, etc).
  – This will require more robust designs.
  – It will demand systems with forgiveness/tolerance.
  – We must have a more predictable delivery system.
  – The owners/occupants will need to be in the loop.
High-Performance Homes: Making the Case for Robust

• Robust
  – Strong, healthy, and hardy in constitution
  – Built, constructed, or designed to be sturdy, durable, or hard-wearing
  – A system that is able to recover from unexpected conditions during operation

• Thing that simply seem to work regardless what your subs, nature, or client throw at them!
High-Performance Homes: Making the Case for Robust

• Fragile
  – Easily broken; not having a strong structure
  – Unlikely to withstand severe stresses and strains

• Things that make perfect sense on paper, but seem to be “too fickle” to handle the real life situations they encounter.
High-Performance Homes: Making the Case for Robust

• When push comes to shove, will your home’s response be one of robustness or fragility?
  – Climate extremes
  – Abnormal interior conditions
  – Execution errors
  – Unusual operations
  – Neglected maintenance
Thinking Outside the Box

• Intro to “Exterior Thermal & Moisture Management System” (ETMMS)

• Examples in new construction

• Applications to existing homes
Where do the structural components belong?

• You have 5 choices
  – Outside
  – Both sides
  – Middle
  – In-between
  – Inside

• What if your structural materials
  – Change dimensionally with temperature / humidity and
  – Are subject to deterioration, if kept moist over time?
Where do the moisture control layers belong?

• In a heated and air-conditioned building with air and vapor permeable cavity insulation, where do the moisture control layers belong?

• You have 4 choices
  – Outside
  – Inside
  – Both sides
  – Middle
Two sided vs. one sided walls

• Is it possible to use a single material in a single plane as the air barrier, vapor retarder, and moisture barrier (or WRB)?
  – Absolutely

• And with the right material selections, it can be a universal wall for hot and cold climates.
A Better Way to Build

• Step 1: Put the structure on the inside
  – Light-frame construction
  – Timber frame
  – Concrete masonry
  – SEP = Structural Engineered Panel (studless construction)
A Better Way to Build

• Step 2: Put the thermal and moisture control layers on the outside.
  – PERSIST (Makepeace)
  – REMOTE (Alaskans)
  – PERFORM (Texans)
  – Out-sulation (???)
  – Perfect Wall (Lstiburek, w/ credit to the CBD)
New Technology – Old Look
ETMMS: Foundation, Walls, & Roof

• Build the entire structure;
  – foundation, floor systems, walls, and roof
• Wrap the entire envelope with a membrane properly integrated with openings / penetrations
• Add rigid foam insulation
  – 2 to 3” on foundation
  – 4 to 5” on walls
  – 6 to 8” on the roof
• Add furring strips, overhangs, etc.
• Install trim; siding; roof sheathing and roofing
House 3
House 4
## House Tightness Testing @ 50 PA

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<th>cfm</th>
<th>ACH</th>
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<tr>
<td><strong>House Two:</strong></td>
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<td><strong>House Three:</strong></td>
<td>145</td>
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<td><strong>House Four:</strong></td>
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</table>
Project Overcoat

• Bringing ETMMS to Existing Homes
  – Potential application to existing homes
  – Challenges & opportunities
  – Current focus on 1-1/2 story houses
New vs. Existing Homes

• It is apples and tofu!

• While the technologies may look similar, they are fundamentally ...
  – Different problems
  – Different strategies
  – Different delivery systems
  – Different economics
  – Different market interface
ETTMS: Application to Retrofit

• Performance Potential is Clearly There!
  – You can have your cake and eat it, too
    • increase energy efficiency
    • while enhancing building durability

• Most work can be completed from the outside

• However, you must take care of mechanicals
  – Sealed combustion
  – Mechanical ventilation
  – Pressure management
ETTMS: Application to Retrofit

• Sizing up the potential
  – What fraction of our existing homes with limited wall insulation are good candidates?
  – What fraction of those homes will have good access around the entire exterior perimeter?
    • stoops, garages, patios, decks, meters, etc.
ETTMS: Application to Retrofit

• Low Hanging Fruit
  – Simple house shapes with limited overhangs
  – Homes with good exterior access
    • detached garages with limited patios and decks
  – Homes with nice interior finishes
  – Homes in need of
    • siding, roof, and windows
ETTMS: Application to Retrofit

• Poor Candidates
  – Exterior is too complex
  – Pre-existing moisture has caused serious mold issues in structural cavities
  – Bad attic conditions
  – Wet foundation (especially crawl space)
    • unless that can be fixed a the same time
ETTMS: Application to Retrofit

- Walls versus Walls + Roof
  - Walls-only is seductive
    - Connection at top is not easy
    - House becomes a better chimney, so you must address attic air seal

  - For many homes the attic/roof is just as big a problem as the walls
    - 1-1/2 story walk-up attics (especially finished)
Building America NorthernSTAR Research

• ETTMS: Application to Retrofit
  – Roof only
  – Focus on 1-1/2 story homes
  – Particularly those with recurring ice dam issues
Anatomy of an Ice Dam
Market Potential
Roof Geometry
Exterior Insulation Strategies
Project Overcoat:
1-1/2 Story Roof Application
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• Blower Door Results
  – Pre = 2925 cfm @ 50Pa
  – Mid 1 = 2774 cfm @ 50Pa
  – Mid 2 = 1607 cfm @ 50 Pa
  – Final = ???
World Class Research…

… at Your Fingertips

Building America Solution Center

COMING IN JANUARY
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• Questions?

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