Systematic Air Sealing and Insulation Retrofit – Three Case Study Homes

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Topics

• Research Objectives
• Grand Rapids, MI, Case Study
  ▪ Two houses, air-sealing only
• Midland, MI, Case Study
  ▪ Air sealing and insulation energy retrofit
• Conclusions and Key Learnings
Answer Questions about Air Sealing

Which retrofit measures are most beneficial?

Can air sealing alone reach the same airtightness as a more comprehensive energy retrofit?

Is it repeatable?

Can this be done by DIYer?
Why focus on air leaks?

Estimated Energy Loss of Residential Home Components

- Ceiling: 5%
- Windows/Doors: 17%
- Frame Walls: 17%
- Air Infiltration: 38%
- Basement Floor: 1%
- Basement Walls: 22%
DIY and Pro Products

- Retrofit products exist today for either DIYers or professional installers

One-Component PU (DIY/Pro)  Two-Component PU (Pro Only)
Grand Rapids Case Study

- One story (900 sq ft) w/basement
- Archetype in high concentration within housing stock
- Post war ranch, 1950’s
- 2x4 walls, un-insulated
- 8 inch block basement walls, un-insulated
- Single glazed windows
- 5 ½ inch cellulose in attic
- Older furnace
Air Leakage Measurement

- Record fan flow over progressive range of induced test pressures
- Report CFM at induced delta pressure of 50 Pascals
# Systemic Approach

## Start with basement
- Often full access to band joist area
- Can generally reach from floor

## Move to attic
- Access is harder
- Insulation may be in the way

## Finish with above grade walls
- May have to remove trim
- Protect interior

- Accessible band joist
- Remove ceiling, do remainder
- Bulkheads, chimney
- Exterior walls then Interior walls
- Lights/Hatch
- Windows and doors
- Outlets, penetrations
- Base molding

*A most effective measure would be one with low labor/material costs and large CFM50 reduction*
Band Joist Example
Attic Example
Above Grade Wall Example
TH1 Air Leakage Reduction

- Ounces of Air Sealing Material
- Labor Hours

- Below Grade
- Attic
- Walls

CFM

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TH2 Air Leakage Reduction

![Graph showing CFM vs. Ounces of Air Sealing Material for Below Grade, Attic, and Walls.]

![Graph showing CFM vs. Labor Hours for Below Grade, Attic, and Walls.]
Midland, MI, Case Study

- Ranch style
- 750 sq feet
- Full unfinished basement – 750 sf
- Minimal insulation
  - R -11 in walls, 6” batt in ceiling
- No efficiency improvements
- Built in 1960
- Climate Zone 5
Air Sealing Results

Air Leakage Rate (CFM 50 Pa)

Radon: Before 1.1 pCi/L, After 2.6 pCi/L
Overall Results

- 35% improvement on energy efficiency score (HERs rating)
- 30% savings on monthly energy costs
- 33% reduction in CO2 emissions per year, significantly lowering the environmental footprint

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Energy Performance Results

Modeled Annual Savings

<table>
<thead>
<tr>
<th>Location</th>
<th>Savings</th>
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<tbody>
<tr>
<td>Basement</td>
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<tr>
<td>Above Grade Wall</td>
<td>$92</td>
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<tr>
<td>Attic</td>
<td>$231</td>
</tr>
<tr>
<td>Combined</td>
<td>$628</td>
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Conclusions and Key Learnings

- Similar pattern of air leakage in similar archetypes
- Air Leakage reduction can be dramatic
  - Very tight enclosures can be achieved in retrofit applications
- Attic interior wall sealing had the largest CFM change for a single measure where exterior walls showed limited effectiveness
  - Partition Walls
  - Bulkheads
  - Chimney from kitchen exhaust hood
- Air sealing walls (after basement and attic air sealing) was not effective at reducing the air leakage
- Air sealing results are similar for air seal only and full energy retrofit
- Easiest to access areas have the best result
Acknowledgements

A McIntyre

T Mrozowski
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