Energy Efficient Building Envelopes in Schools

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High Performance Building Solutions
Learning Objectives

1. Overview of Existing Building Envelope Inspection and Specifications for Schools
2. Project Development: Scope, Funding and Contracting Challenges
3. Working with Energy Performance Contractors
4. Key Envelope Improvement Opportunities for Schools
Existing Building Envelope Inspections

- Air Barrier
- Thermal Barrier
- Moisture Barrier
  - Vapor
  - Liquid
- Invasive vs Non-Invasive Inspections
Project Development

- Initial Site Inspection
- Scope of Work Development
- Funding Source
- Project Implementation
Key Inspection Areas for Schools

- Roof Exhaust/Intakes
- Vented Attic with No Lid
- Exterior Wall to Roof Transition
- Environmental Separators
- Soffits
- Additions/Renovations
Sewanee: University of the South

- Original Construction 1900
- Renovated in 1980
  - Added Vented Crawlspace
  - Replaced Original Windows
  - Added Air Conditioning
- Problem: IAQ Problems
Sewanee: University of the South

- Inspection Found:
  - Bulk Water Intrusion
  - Moisture Vapor Intrusion
  - Excessive Air Infiltration
  - Structural Issues
Sewanee: University of the South
Sewanee: University of the South

- Repairs:
  - Added Air Barrier & Thermal Barrier
  - Replaced Windows
- Challenges:
  - Historic Building
  - Subcontractors
- Completed 2016
Sewanee: University of the South
East Carolina University

- Original Construction 1994
- Added onto in 2004
- Problem:
  - IAQ Problems
  - Moisture Intrusion Concerns
  - Comfort Complaints
East Carolina University

- Inspection Found:
  - Incomplete Air Barrier
  - Vented Attic Directly Connected to Conditioned Space
  - Back Drafting Water Heaters
  - HVAC Service Issues
Air Leakage Rate Comparison

- USACE: 0.25 CFM/SF
- ASHRAE 189.1: 0.40 CFM/SF
- ECU Neurology: 1.69 CFM/SF
East Carolina University

- Repairs:
  - Attic Air Sealing
  - Soffit Air Sealing
  - Roof Replacement

- Challenges:
  - Hurricane Florence
  - Nights & Weekends
East Carolina University
Johnston Community College

- 16 Campus Buildings
- Totaling 405,000 SF
- Multiple Additions/Renovations
- Problem: Performance Contracting (ESCO)
  - 9 Buildings on List
  - 10 year or less payback
  - Eliminated Buildings Based on EUI
Johnston Community College

- Inspection Found:
  - Only 5 out of the 9 buildings <10 year Payback
  - Other buildings required repair but did not meet the payback requirements
  - Incomplete Air Barrier
  - Bulk Water Intrusion
  - Duct Leakage
Results Compared to Commercial Standards

<table>
<thead>
<tr>
<th></th>
<th>CFM/SF Surface Area @ 75 Pascals</th>
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<tbody>
<tr>
<td>Britt</td>
<td>0.46</td>
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<tr>
<td>Old Health</td>
<td>0.57</td>
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<tr>
<td>Steam</td>
<td>0.49</td>
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<tr>
<td>IECC</td>
<td>0.40</td>
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<tr>
<td>USACE</td>
<td>0.25</td>
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Johnston Community College
## Johnston Community College

<table>
<thead>
<tr>
<th>Building</th>
<th>Leakage Area (Sq. Ft.)</th>
<th>CFM of Leakage</th>
<th>Weatherization Cost</th>
<th>Energy Cost Savings</th>
<th>Simple Pay Back (Yrs)</th>
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<tbody>
<tr>
<td>Britt</td>
<td>6.70</td>
<td>1,037</td>
<td>$27,804</td>
<td>$3,116</td>
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<td>Elsee</td>
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<td>STEAM</td>
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<td>1,632</td>
<td>$32,470</td>
<td>$4,870</td>
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<td>Wilson</td>
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<td>$27,725</td>
<td>$4,277</td>
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<td><strong>Total</strong></td>
<td><strong>43.45</strong></td>
<td><strong>6,146</strong></td>
<td><strong>$128,691</strong></td>
<td><strong>$18,492</strong></td>
<td><strong>7.0</strong></td>
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</table>
Florence County

- Original Scope of Work
  Included 4 Buildings
- Original Construction 1975
- 32,784 SF, Single Story
- Problem: ESCO (Performance Contracting)
  - IAQ
  - Pressure Balance
  - Comfort Issues
Florence County

- Inspection Found:
  - Vented Soffits Open to Conditioned Space
  - Passive Attic Ventilation
  - All Equipment and Duct Work in Unconditioned Space
Florence County

Air Leakage Standards Comparison

- US Army Corps: 0.25
- ASHRAE 189: 0.40
- Pre Weatherization: 1.16
- Post Weatherization: 0.56