

# 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

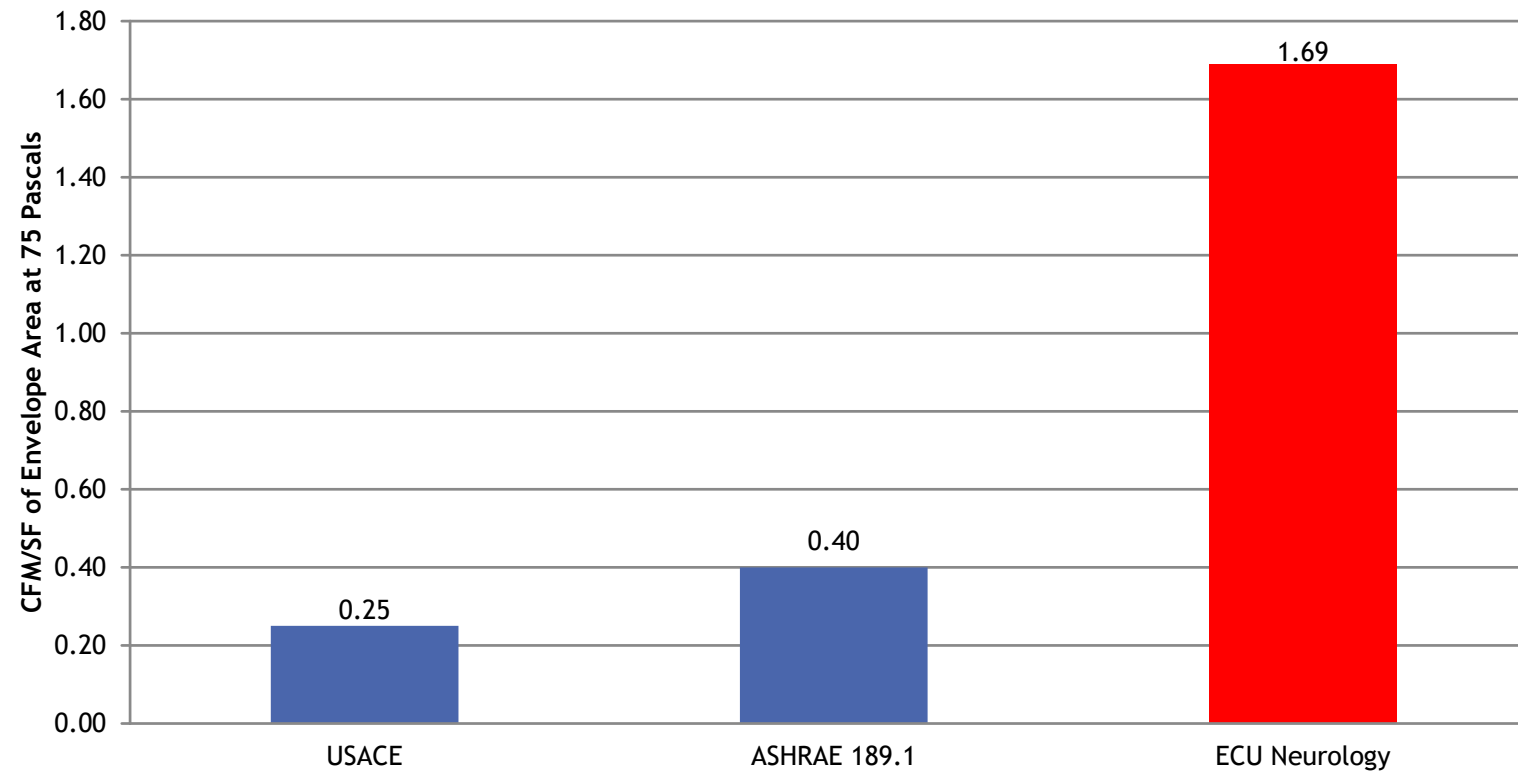


# East Carolina University



# East Carolina University

## Air Leakage Rate Comparison



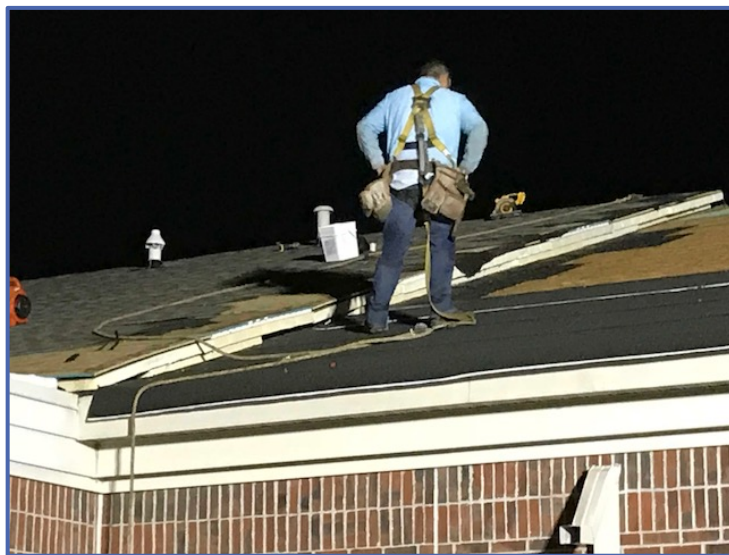


# East Carolina University

- ▶ 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





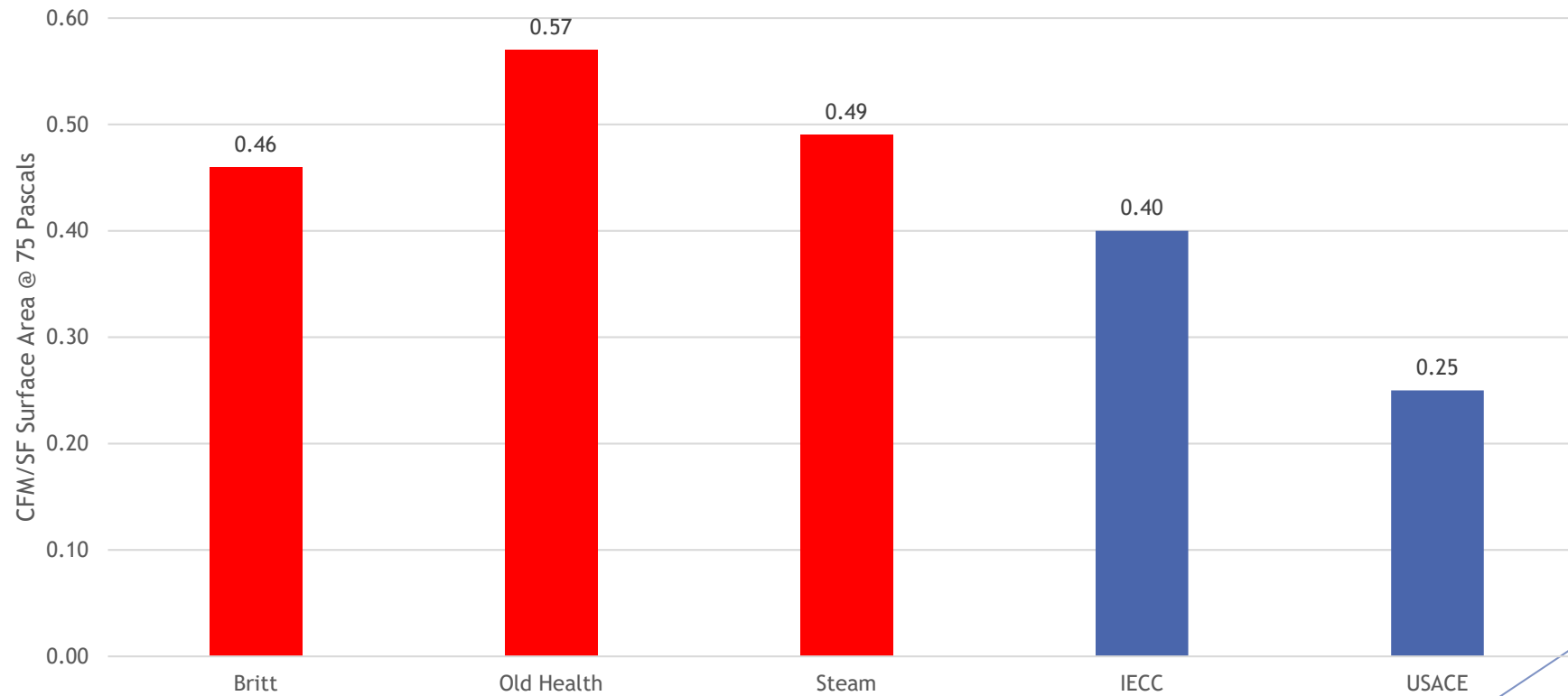
# Johnston Community College

- ▶ 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

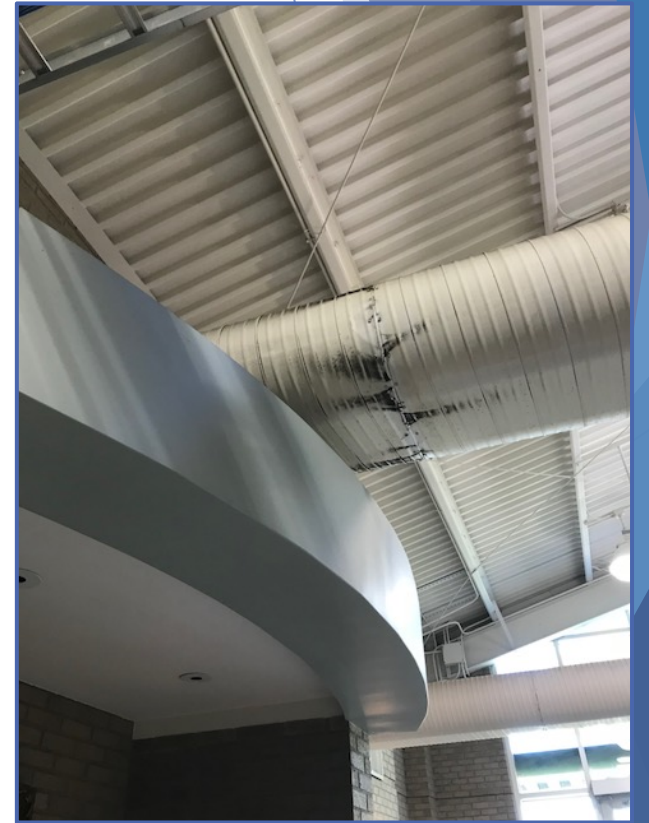


# Johnston Community College

Results Compared to Commercial Standards



# Johnston Community College





# Johnston Community College

<u>Building</u>	<u>Leakage Area (Sq. Ft.)</u>	<u>CFM of Leakage</u>	<u>Weatherization Cost</u>	<u>Energy Cost Savings</u>	<u>Simple Pay Back (Yrs)</u>
Britt	6.70	1,037	\$27,804	\$3,116	8.9
Elsee	3.22	498	\$11,900	\$1,504	7.9
Health	10.12	1,566	\$28,792	\$4,725	6.1
STEAM	14.28	1,632	\$32,470	\$4,870	6.6
Wilson	9.13	1,413	\$27,725	\$4,277	6.4
<b>Total</b>	<b>43.45</b>	<b>6,146</b>	<b>\$128,691</b>	<b>\$18,492</b>	<b>7.0</b>

# 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

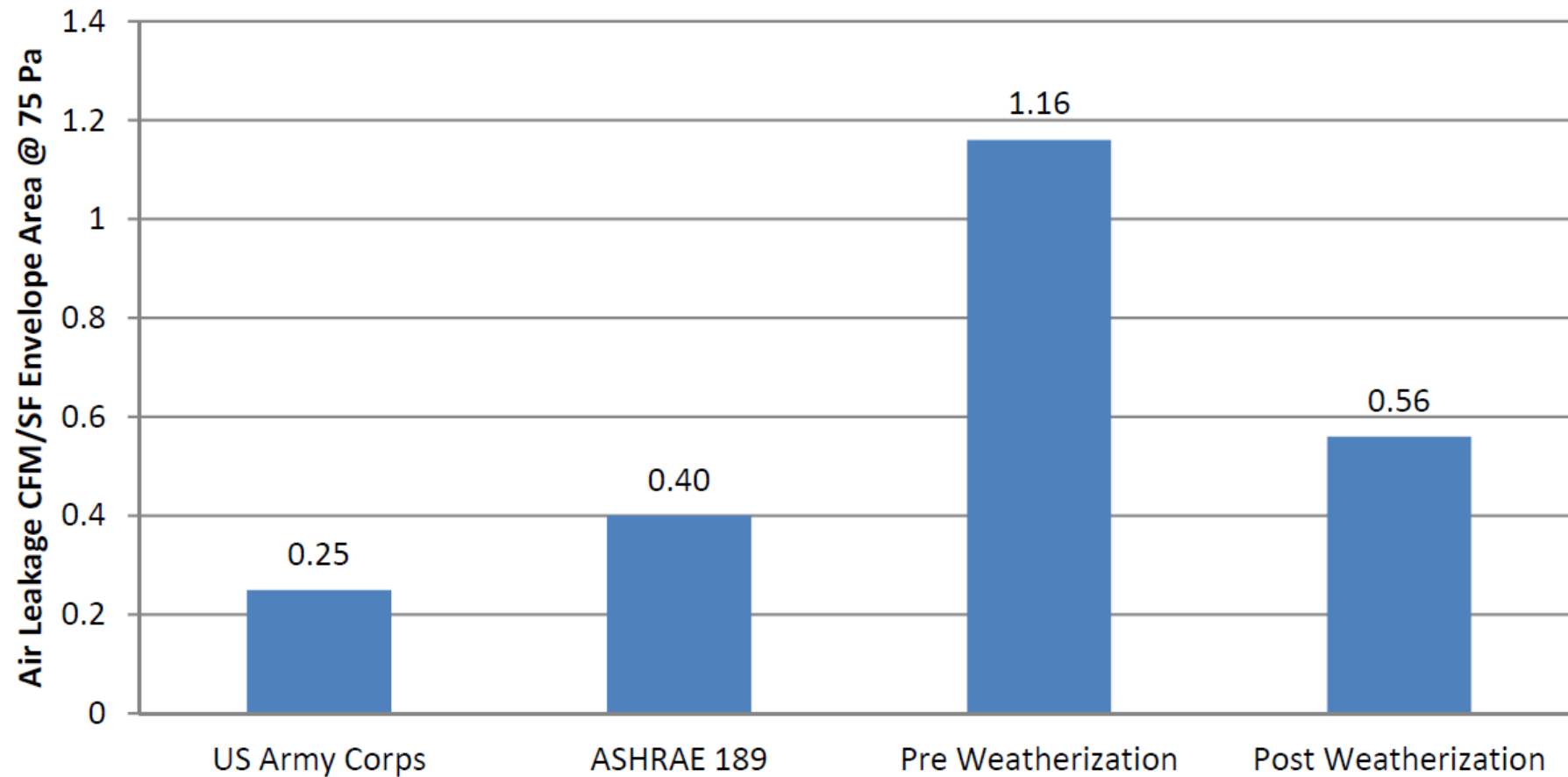
- ▶ Inspection Found:
  - ▶ Vented Soffits Open to Conditioned Space
  - ▶ Passive Attic Ventilation
  - ▶ All Equipment and Duct Work in Unconditioned Space






# Florence County

## Air Leakage Standards Comparison





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