Envelope Team: Virtual Technology Showcase

Envelope Technology Research Team Meeting

May 17, 2018
2 to 3pm ET
Envelope Technology Showcase Agenda

- Welcome, Introductions
- Get Attached: Efficient Window Solutions for Better Buildings
  - Mike Hatten, Solarc Energy Group
- Addressing Air Leakage: Air Barrier Technologies
  - Laverne Dalgleish, Air Barriers Association of America
- Building Enclosure Commissioning: Getting Performance
  - Dr. Simon Pallin, ORNL
- Q&A
Poll Question 1

Which type of organization best describes you or the work you do?

- Building Owner/Manager
- Architect/Engineer
- Manufacturer
- Energy Service Providers
- Researcher/Academia

If your organization type isn’t listed, please type into your Questions Window the kind of organization you represent.
Collaboration: the Envelope Tech Team

Engage and support Members in efforts to accelerate adoption of building envelope technologies

- **Build awareness** with guidance and information on envelope technology solutions
- Conduct envelope technology verification studies
- Offer **technical assistance** for envelope projects
Check out the Envelope Tech Team Web Resources

- **Topic Areas**
  - Windows
  - Walls
  - Roofs

- **Resources**
  - Case Studies
  - Calculators
  - Design Guides
  - Fact Sheets
  - Toolkits
  - …and more…

https://betterbuildingsinitiative.energy.gov/alliance/technology-solution/building-envelope
Get Attached: Efficient Window Solutions for Better Buildings

Mike Hatten, Solarc Energy Group
Get Attached: Efficient Window Solutions for Better Buildings

Mike Hatten, P.E.
SOLARC Energy Group
May 17, 2018
What are window attachments?

- Secondary glazing systems
- Cellular shades
- Blinds
- Storm windows
- Roller shades
What are the performance benefits?

- Energy cost savings
- Reduced cooling and heating loads
- Improved thermal and visual comfort
- Enhanced occupant health and wellness
- Reduced UV deterioration of furnishings
What is AERC?

AERC is a DOE-funded, independent, public interest organization whose mission is to rate, label and certify the energy performance of window attachments.
Secondary Glazing Systems (SGS)

50% the cost of existing window replacement

Low-E Storm Window Attachments

- Low-emissivity (low-e)
- Attach to interior or exterior
- Fully operable
Lower costs and energy use

- Lower upfront costs
- Lower monthly operating costs
- Reduce heating and cooling peak demand
### Lower energy use

#### SIMPLIFIED ENERGY SAVINGS CALCULATOR

Ver. 3.0 beta 5/7/2018

<table>
<thead>
<tr>
<th>Information About Your Building Location</th>
<th>Information About Your Building</th>
<th>Information About Your Proposed SGS Project</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Location (State)</td>
<td>Building Area, Sq. Ft.</td>
<td>Type of SGS Analyzed</td>
</tr>
<tr>
<td>Washington</td>
<td>278102</td>
<td>Double</td>
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<tr>
<td>Project Location (City)</td>
<td>No. of Floors</td>
<td>Sq. ft. of SGS Installed</td>
</tr>
<tr>
<td>Seattle</td>
<td>12</td>
<td>45504</td>
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<tr>
<td>Electric Utility</td>
<td>HVAC System Type</td>
<td>SGS Sq. Ft Limit (Max.)</td>
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<tr>
<td>SCL</td>
<td>Built-up VAV with hydronic reheat</td>
<td>109,608</td>
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<tr>
<td>Natural Gas Utility</td>
<td>Dominant Heating Fuel</td>
<td></td>
</tr>
<tr>
<td>PSE</td>
<td>Natural Gas</td>
<td></td>
</tr>
<tr>
<td>Location HDD (Base 65)</td>
<td>Annual Heating Fuel</td>
<td></td>
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<tr>
<td>4,800</td>
<td>5500</td>
<td></td>
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<tr>
<td>Location CDD (Base 65)</td>
<td>Annual Operating Hours</td>
<td></td>
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<tr>
<td>116</td>
<td>5500</td>
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</table>

#### Energy Savings Output

<table>
<thead>
<tr>
<th>Savings Output</th>
<th></th>
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<tbody>
<tr>
<td>Heating, kWh/SF</td>
<td></td>
</tr>
<tr>
<td>Cost Savings, $/yr</td>
<td>$42,938</td>
</tr>
<tr>
<td>Heating, therms/SF</td>
<td></td>
</tr>
<tr>
<td>Cost Savings, $/yr</td>
<td>$42,885</td>
</tr>
<tr>
<td>Cooling &amp; Fans, kWh/SF</td>
<td>11.80</td>
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<tr>
<td>Electric Savings, kWh/yr</td>
<td>536,721</td>
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<tr>
<td>Gas Savings, therms/yr</td>
<td>57,180</td>
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<tr>
<td>Electric Cost Savings, $/yr</td>
<td>$42,938</td>
</tr>
<tr>
<td>Gas Cost Savings, $/yr</td>
<td>$42,885</td>
</tr>
<tr>
<td>Total Savings, kBtu/SF-yr</td>
<td>27.15</td>
</tr>
<tr>
<td>Total Savings, $/yr</td>
<td>$85,822</td>
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</tbody>
</table>

#### Total Annual Energy Use Intensity Comparison

<table>
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<tr>
<th>Year</th>
<th>Baseline</th>
<th>SGS</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>200</td>
<td>175</td>
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<tr>
<td>40</td>
<td>160</td>
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<td>120</td>
<td>120</td>
<td>90</td>
</tr>
<tr>
<td>140</td>
<td>110</td>
<td>80</td>
</tr>
</tbody>
</table>

#### Annual Percentage Total Energy Savings

- Baseline: 100%
- SGS: 77.62%

- **Total Annual Energy Use Intensity Comparison:** 22.38%
Lower peak heating and cooling demand

- Translates to an average of 17% first cost savings on HVAC upgrade project
Improve comfort, health and wellness
Improve comfort, health and wellness

- Minimize drafts and increase comfort
- Reduce glare and noise
- Improve health and wellness
Applications and case studies

• Bullitt Center / Seattle: Exterior motorized shades

- 6 story office / 50,000 SF / Built in 2013
- Exterior motorized blinds on floors 3, 4, & 5 to control solar heat gain and glare
- Integral to passive cooling design strategy / limits mechanical cooling needs
- World’s “most efficient” office building with EUI at about 12 kBtu/SF-year
- Net positive energy
Applications and case studies

- Kiln Apartments / Portland: Applied Window Films

- 4 story multi-family residential building / Passive House design / Built in 2015
- Perimeter apartments on S, E, W: Overheating (90 to 100 deg. F on summer afternoons)
- Window films applied to reduce solar heat gain coefficient
- Dropped temperature extremes into the mid-80’s
Applications and case studies

• 195 Church Street / New Haven: Secondary Glazing

  18 story office / 224,000 SF / Built in 1974
  Energy retrofit project: Secondary glazing and LED lighting upgrade
  29% energy savings / $203,000 per year
  System type: VAV with electric reheat
  Increase in number of hours when windows are predominantly open: 21%
  SGS calculator indicates about 19% of 29% saved is due to SGS units.
Learn more.

For information, case studies, resources and more:

**Northwest Energy Efficiency Alliance (NEEA):** BetterBricks.com/solutions/windows

**Attachments Energy Rating Council (AERC):** aercnet.org/resources/window-attachments

**195 Church Street case study:** betterbricks.com/case-studies/

**Bullitt Center case study:** casestudies.uli.org/bullitt-center/
Addressing Air Leakage: Air Barrier Technologies

Laverne Dalgleish, ABAA
Air Barrier Technology
Mr. Laverne Dalgleish
LEARNING OBJECTIVES

- Why install an air barrier
- How tight can you make a building
- Can you make a building too tight – buildings need to breathe
- Air barriers - vapor permeable or impermeable?
- Installation issues with air barriers
Air Barriers

Six Sides of the Building

roof – walls – foundation

Twelve intersections
Penetrations, terminations and connections are where the building leaks air.
AIR BARRIERS

Reasons for an air barrier

- Energy savings
- Moisture issues★★
- Sound
- Smell
- Insects
- Equipment efficiency
- Reduce drafts
AIR BARRIERS

Air Barriers Impact

- Thermal insulation performance
- Windows performance
- HVAC efficiency
- Occupant behavior

which all impact the energy use and moisture issues in a building
ENERGY SAVINGS CALCULATOR

In conjunction with Oak Ridge National Laboratories (ORNL) and the National Institute of Science and Technology (NIST), we are very excited to provide this new resource to the industry to help quantify energy savings based on the use of air barriers and increasing the airtightness of buildings.

LEARN MORE
ENERGY SAVINGS CALCULATOR

Infiltration Calculator

Location: Canada

Building Type: Standalone Retail

Floor Area (ft²): 24692

Leakage Rates (L/s.m² at 75 Pa)

Base case: 5.4
Retrofitted building: 2.0

Energy Costs

Electricity (C$/kWh): 0.14
Natural Gas (C$/m³): 0.16

Calculate >>

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To report issues with the site please contact site administrator.
• 52 cities in the US, 5 cities in Canada, and 5 cities in China.

• Selection of cities based on trying to obtain a reasonable distribution of major metropolitan areas

• If specific city does not appear, select a city that has similar meteorological conditions (wind, temperature, solar radiation, and rain).
Results

HVAC energy cost for a prototype standalone retail building in Chicago

\[ y = 96.5x^2 + 139.99x + 8878.2 \]
\[ R^2 = 0.9997 \]

HVAC energy cost for a prototype standalone retail building in Chicago
AIR BARRIERS
AIR LEAKAGE IMPACTS ON THERMAL INSULATION

- Increase moisture with building enclosure

Moisture transfer into space due to air leakage

- Miami: 18 lb/ft².year
- Chicago: 12 lb/ft².year
- Winnipeg: 10 lb/ft².year

Base and 0.25 L/s.m² comparison.
# AIR BARRIERS

## AIR LEAKAGE IN BUILDINGS

How airtight can you make buildings?

<table>
<thead>
<tr>
<th></th>
<th>CFM/ft² @ 1.57 lbs/ft²</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>IECC</strong></td>
<td></td>
<td>0.40</td>
</tr>
<tr>
<td><strong>Original USACE</strong></td>
<td></td>
<td>0.25</td>
</tr>
<tr>
<td><strong>Updated USACE</strong></td>
<td></td>
<td>0.15</td>
</tr>
<tr>
<td><strong>Now producing</strong></td>
<td></td>
<td>0.03</td>
</tr>
</tbody>
</table>
AIR BARRIERS
AIR LEAKAGE IN BUILDINGS

Can you make a building too tight?

Do not confuse air for ventilation from air leakage in a building
Natural ventilation is not air leakage in a building

Build tight – Ventilate right
AIR BARRIERS
AIR LEAKAGE IN BUILDINGS

Misconception of having a building breathing
It depends
Does it really matter?
No matter what you do, at some time during the year, it is wrong
This is Air Leakage!

You cannot see air leakage!
You cannot see air leakage!

Installation is key to an airtight building
Experience equals better quality installations
Test on site to confirm during construction
Whole building test to prove installation correct
Thank you for your time!

Question and Answer Period

Laverne Dalgleish
Air Barrier Association of America
Idalgleish@airbarrier.org
Ph. 866-956-5888
Building Enclosure Commissioning: Getting Performance

Dr. Simon Pallin, ORNL
Current R&D Efforts

- Building Enclosure Commissioning
  - Benefits and Costs Study
  - Exploration of new enclosure performance metric

- Examination of Airtightness Requirements
  - Landscape Study
  - Sampling of air leakage rates
Why conduct Building Enclosure Commissioning?

Benefits

- Improve the design process
- Built as designed
- Reduce building energy loads
- Address human health and safety needs
- Prevent moisture from compromising building
- Maintain thermal comfort
- Maintain air quality
- Improve overall quality of building
- Comply with building codes

Credit: Anica Landreneau, HOK, ETRT presentation
Why conduct Building Enclosure Commissioning?

Costs

- Planning
- Testing
- Consultants
- Time
- Addressing findings
- Other
Where’s the Value in BECx?

- Higher level of quality assurance = improved performance = reduced risk.
- Potential for risk reduction increases with complexity of building enclosure systems and materials.

Source Credit: Paul Totten, WSP, ETRT presentation, 6/13/17
BECx 101 - Standards, Guidelines, and Resources

- ASHRAE Guideline 0-2013
  - NIBS Guideline 3-2012
  - ASTM 2947

- ASTM 2813
  - NIBS Guideline 3-2012

Process

Technical

Laboratory

Field
BECx 101 - Standards, Guidelines, and Resources

Additional reading…
In progress: New performance metric

**Thermal Resistance**
- R-value
  - Walls
  - Roof
  - Foundation
  - Fenestration
- Thermal Bridges

**Air Infiltration**
- Thermal Resistance
  - Airtightness (ACH75)
  - Building Type
  - Exposure

**Indoor Climate**
- Thermostat Setpoints
- HVAC Characteristics
- User Behavior

**Weather Conditions**
- Temperature
- Wind Loads

**Building Enclosure Performance (BEP-value)**
Questions and Answers

Mike Hatten
Laverne Dalgleish
Simon Pallin
Poll Questions 2 & 3

Please type in your thoughts...

- How will you use the information shared today?

- Which enclosure technologies or topics would you like to hear about next?

Use your Questions Window to type in your suggestions and ideas
Join the Envelope Tech Research Team!

Email: lapsamv@ornl.gov

- Building Managers
- Architects and Engineers
- Subject Matter Experts
- Building Owners
- Installers/Builders
- Trade Associations
- Manufacturers
- Researchers
- Energy Service Providers

Engage in R&D:
- Addressing airtightness requirements
- Investigating Building Enclosure Performance Metric
- Featured Enclosure Technology Sessions
  - Thursday Panel Session, Aug 23rd
  - Improving Building Performance with Envelope Technologies
  - Showcasing advanced technologies & case study examples

- Friday Workshop, Aug. 24th
  - Going Deep on Building Enclosure Commissioning (BECx)
  - 4 hour interactive session on BECx on best practices, member experiences and development of BECx implementation resources

For more information and to register:
2018energyexchange.com