Sustainable Preservation

Transforming Historic Buildings to High Performance Buildings

Bourke Reeve
Three Points
This Session:

- What is Sustainable Preservation?
- What is green building all about?
- What lessons have been learned about creating high performance historic buildings?
- What does the future hold?
About me...

- MHP Georgia State University 2004
- GA Trust Design Assistance Program Intern 2003
- Main Street Manager 2006 - 2007
- Southface 2008 - 2018
- Three Points Planning 2008 - Present
Energy Use and Historic Buildings

► The “greenest” building is the one already built.
  ► Thoughts?

► Energy cost can be an issue for some older buildings.
  ► Yes or No?

► The idea of the “energy hog” is bad for the perception of historic buildings.
  ► Yes or No?

► Do you think it is in our best interest to find energy & performance solutions for historic buildings?
  ► Yes or No?
Historic Buildings = Lots Of Challenges

- Often historic buildings have features not common to today’s structures?
  - Passive solar design
  - Exterior window shading devices or structure
  - Natural ventilation (operable windows / Interior transoms)
  - Vented assemblies

- Lack of familiarity with these features can lead to misdiagnosis of problems and inappropriate actions.
  - You need new windows
  - You need a bigger system
  - You need a smart thermostat

- Many of the performance issues in historic buildings come from adding in mismatched technology over time.
  - Oversized AC systems
  - Misaligned thermal envelopes
  - Inappropriate vapor barriers

- The Sustainable Preservation approach allows us to identify appropriate solutions and maximize building performance.
  - Based on building science
  - Incorporates preservation practices
Sustainable Preservation Approach

- Identify the benefits reusing a historic building provides
- Identify opportunities to make the building more efficient, comfortable and durable
- Respect and incorporate preservation best practices
THE SECRETARY OF THE INTERIOR’S STANDARDS FOR REHABILITATION & ILLUSTRATED GUIDELINES ON SUSTAINABILITY FOR REHABILITATING HISTORIC BUILDINGS
Sustainability

Before implementing any energy conservation measures to enhance the sustainability of a historic building, the existing energy-efficient characteristics of the building should be assessed. Buildings are more than their individual components. The design, materials, type of construction, size, shape, site orientation, surrounding landscape and climate all play a role in how buildings perform. Historic building construction methods and materials often maximize natural sources of heating, lighting and ventilation to respond to local climatic conditions. The key to a successful rehabilitation project is to identify and understand any lost original and existing energy-efficient aspects of the historic building, as well as to identify and understand its character-defining features to ensure they are preserved. The most sustainable building may be one that already exists. Thus, good preservation practice is often synonymous with sustainability. There are numerous treatments—traditional as well as new technological innovations—that may be used to upgrade a historic building to help it operate even more efficiently. Increasingly stricter energy standards and code requirements may dictate that at least some of these treatments be implemented as part of a rehabilitation project of any size or type of building. Whether a historic building is rehabilitated for a new or a continuing use, it is important to utilize the building’s inherently-sustainable qualities as they were intended. It is equally important that they function effectively together with any new measures undertaken to further improve energy efficiency.
**Guidelines / Windows**

<table>
<thead>
<tr>
<th>RECOMMENDED</th>
<th>NOT RECOMMENDED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Installing compatible and energy-efficient replacement windows that match the appearance, size, design, proportion and profile of the existing historic windows and that are also durable, repairable and recyclable, when existing windows are too deteriorated to repair.</td>
<td>Installing incompatible or inefficient replacement window units that are not durable, recyclable or repairable when existing windows are deteriorated beyond repair or missing.</td>
</tr>
</tbody>
</table>
Energy Code

Residential:
- New construction
- 1 and 2 family (R3)
- Multi-family, 3 stories and less (R2 and R4) – IECC 2009

Commercial:
- New construction
- Nonresidential
- Multi-family, 3 stories or more
- Additions, Alterations, Repairs

Exempt Buildings
- No conditioning
- Historical
Building Science
“The house as a system”

- Building Thermal Envelope
  - Continuous air barrier
  - Complete insulation coverage
- Properly Sized Heating and Cooling Systems
- Controlled Ventilation

The building envelope separates conditioned space from unconditioned (or outside) and consists of two elements: an air barrier & insulation that must be continuous and touching.
High Performance (Green) Building Programs

LEED Certification Levels:
- Certified: 40-49 points earned
- Silver: 50-59 points earned
- Gold: 60-79 points earned
- Platinum: 80+ points earned

EarthCraft: A Program of Southface

A Practical Approach to Green Building
EarthCraft Sustainable Preservation Program: The Nation’s First Green Building Certification Program for Historic Buildings
EarthCraft Sustainable Preservation

- Program Mission-
- *Expand the use of preservation best practices within the framework of green building and meet the need for a sustainability roadmap for historic buildings*

- Supports Southface’s mission *and* the mission of The Georgia Trust for Historic Preservation
Research and Development
Hot/humid attic air leaking down an interior wall
Energy Audit Case Study
Audit Data

So what is happening in the building?

<table>
<thead>
<tr>
<th>Equipment Type</th>
<th>Demand (kW )</th>
<th>Avg Monthly Cost</th>
<th>Avg Annual Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lighting</td>
<td>10</td>
<td>$224</td>
<td>$2,683</td>
</tr>
<tr>
<td>Air Conditioning</td>
<td>7</td>
<td>$63</td>
<td>$753</td>
</tr>
<tr>
<td>General Electrical</td>
<td>5</td>
<td>$9</td>
<td>$113</td>
</tr>
<tr>
<td>Air Handlers</td>
<td>1</td>
<td>$25</td>
<td>$303</td>
</tr>
<tr>
<td><strong>Total Model</strong></td>
<td><strong>23</strong></td>
<td><strong>$321</strong></td>
<td><strong>$3,852</strong></td>
</tr>
<tr>
<td><strong>Total from Bills</strong></td>
<td><strong>16</strong></td>
<td><strong>$347</strong></td>
<td><strong>$4,164</strong></td>
</tr>
<tr>
<td>Name</td>
<td>Annual Savings ($)</td>
<td>Estimated Cost</td>
<td>Estimated Payback</td>
</tr>
<tr>
<td>--------------------------------------------------------</td>
<td>--------------------</td>
<td>----------------</td>
<td>-------------------</td>
</tr>
<tr>
<td>1 Compact Fluorescents</td>
<td>$1,669</td>
<td>$512</td>
<td>4 Months</td>
</tr>
<tr>
<td>2 Upgrade to high efficiency AC when they fail</td>
<td>$231</td>
<td>$6,000</td>
<td>26.0 Years</td>
</tr>
<tr>
<td>3 Seal duct connections, boots to floor</td>
<td>$175</td>
<td>$250</td>
<td>1.4 Years</td>
</tr>
<tr>
<td>4 Use Point of Use tankless water heaters</td>
<td>$91</td>
<td>$400</td>
<td>4.4 Years</td>
</tr>
<tr>
<td>5 Air Curtain for front door</td>
<td>$68</td>
<td>$500</td>
<td>7.4 Years</td>
</tr>
<tr>
<td>6 Add insulation to AC refrigerant lines</td>
<td>$60</td>
<td>$30</td>
<td>6 Months</td>
</tr>
<tr>
<td>7 Low flow faucets (0.5 GPM)</td>
<td>$19</td>
<td>$10</td>
<td>6 Months</td>
</tr>
</tbody>
</table>

$2,313 $7,702 3.3 Yrs (27,607 lbs)
## Thermal Envelope Upgrades

<table>
<thead>
<tr>
<th>Envelope Component</th>
<th>Upgrade</th>
<th>Estimated Cost</th>
<th>Annual Cost Savings</th>
<th>Payback</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roof Insulation</td>
<td>4” rigid foam insulation above deck, white TPO roof</td>
<td>$7,500</td>
<td>$125</td>
<td>60 years</td>
</tr>
<tr>
<td>Wall Insulation</td>
<td>3.5” wood furred out walls with batt insulation</td>
<td>$8,000</td>
<td>$129</td>
<td>62 years</td>
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<tr>
<td>Double pane windows</td>
<td></td>
<td>$2,500</td>
<td>$42</td>
<td>59 years</td>
</tr>
</tbody>
</table>
ECSP Development Advisors:

- Stacie Monroe  re:FORM Architects
- Jesse Erbel  The Sustainability Institute
- Pratt Cassity  University of Georgia
- Susan Kidd  Agnes Scott College
- Mark McDonald  Georgia Trust for Historic Preservation
Testing the Program

Figure 4. Fan Set-up at the side porch entry.
Evaluated Building Options

- Equipment upgrade opportunities
  - Lighting
  - Water Heating
  - HVAC

- Envelope improvements
  - Complete air barrier
  - Insulation quality & coverage

- Assess Cost Effectiveness and Priority
  - Basic ROI
  - Required Maintenance
  - High Priority Items
Benchmark
Energy Star Data

![Energy Benchmark](image)

**Figure 6**

- Wren's Nest
- Average Museum
What Did We Do
Vapor Barrier In Crawlspace
Water Heater Replacement
Appropriate Attic Insulation
Lighting

Not @ Wren’s Nest...
Testing
Flow Hood Testing

- Measured ~160 CFM of OA
- ASHRAE Compliance
- Better IAQ
- Greater Comfort
Testing

- Blower Door Testing
  - Measured ~30% less air leakage
  - Reduce energy costs
  - Improve air quality
How Did We Do

“16 years of being cold in the winter and now it’s warm in the morning when I get here...”
## Energy performance data

$1376$ total: July & August 2015

$480$ total: June & July 2016
(post improvements)

Total 2 “summer” month savings $896

### Basic Information

<table>
<thead>
<tr>
<th>Month</th>
<th>Start</th>
<th>Meter Read</th>
<th>Billing Days</th>
<th>Total kWh</th>
<th>Peak KW Demand</th>
<th>Electric Service Total</th>
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</thead>
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<tr>
<td>Jul 2015</td>
<td>7/1/2015</td>
<td>07/12/2015</td>
<td>31</td>
<td>3,660</td>
<td>0</td>
<td>$688</td>
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<tr>
<td>Aug 2015</td>
<td>08/11/2015</td>
<td>08/12/2015</td>
<td>31</td>
<td>3,660</td>
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<td>$688</td>
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<tr>
<td>Sep 2015</td>
<td>09/10/2015</td>
<td>09/10/2015</td>
<td>30</td>
<td>2,640</td>
<td>0</td>
<td>$502</td>
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<tr>
<td>Oct 2015</td>
<td>10/11/2015</td>
<td>10/11/2015</td>
<td>31</td>
<td>600</td>
<td>0</td>
<td>$126</td>
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<tr>
<td>Dec 2015</td>
<td>12/10/2015</td>
<td>12/10/2015</td>
<td>31</td>
<td>600</td>
<td>0</td>
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<tr>
<td>Jan 2016</td>
<td>01/11/2016</td>
<td>01/11/2016</td>
<td>32</td>
<td>780</td>
<td>0</td>
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<tr>
<td>Feb 2016</td>
<td>02/10/2016</td>
<td>02/10/2016</td>
<td>30</td>
<td>960</td>
<td>0</td>
<td>$190</td>
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<tr>
<td>Mar 2016</td>
<td>03/10/2016</td>
<td>03/10/2016</td>
<td>29</td>
<td>840</td>
<td>0</td>
<td>$169</td>
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<tr>
<td>Apr 2016</td>
<td>04/11/2016</td>
<td>04/11/2016</td>
<td>32</td>
<td>600</td>
<td>0</td>
<td>$122</td>
</tr>
<tr>
<td>May 2016</td>
<td>05/10/2016</td>
<td>05/10/2016</td>
<td>32</td>
<td>780</td>
<td>0</td>
<td>$158</td>
</tr>
<tr>
<td>Jun 2016</td>
<td>06/09/2016</td>
<td>06/09/2016</td>
<td>30</td>
<td>1,020</td>
<td>0</td>
<td>$198</td>
</tr>
<tr>
<td>Jul 2016</td>
<td>07/11/2016</td>
<td>07/11/2016</td>
<td>32</td>
<td>1,500</td>
<td>0</td>
<td>$282</td>
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</tbody>
</table>
Madison Morgan Center
Key Energy Improvements

Spray applied foam insulation-
Window Rehabilitation
New Equipment & Controls
Energy Savings

20% energy and cost savings
Rhodes Hall Performance

- Spray foam insulation in attic
- HVAC Upgrade
- Water Heater Replacement
- Lighting Upgrade to all LED
- Storm windows
Rhodes Hall Performance

- In 2009 Rhodes Hall had an Energy Star score of 46
  - 50 = average

- Today, Rhodes Hall has an Energy Star score of 84 and is an Energy Star Labeled building.

- Rhodes Hall has achieved:
  - 27 percent reduction in greenhouse gas emissions
  - 29 percent reduction in utility costs
  - Maintained historic materials

- This success demonstrates that historic buildings can also be high performance buildings!
Energy Improvement Priorities

- HVAC equipment upgrades:
  - Right sizing
    - matching the new load
  - Installation
    - duct leakage/location
  - Distribution
    - effective zoning
  - Ventilation
    - OA and how much
Energy Improvement Priorities

- Lighting -
  - LED
    - Cost is down
    - Rebates may be available
    - ROI is good
  - Controls
    - Be wary of complex controls
    - Verification and retro-CX are valuable
  - Daylight
    - Find it, use it
Energy Improvement Priorities

- Building Envelope:
  - Windows
    - Repair
    - Protect
    - Replace
  - Insulation
    - Foam
    - Fiberglass
    - Other

- Air sealing
  - Basic weatherization
  - Complete thermal boundary
Future Program - Historic Homes

- Lessons Learned
- Streamline priorities
- Focus on the biggest impacts
- Create supporting tools and resources
- Broad market impact by engaging home owners and industry
Questions?

Contact:
404-247-2986
Bourke.reeve@threepointsplanning.com

Thank You!