SUSTAINABILITY

"...development that meets the needs of the present without compromising the ability of future generations to meet their own needs."

Brundtland Commission (1988)

HISTORIC PRESERVATION WORKSHOP:
SUSTAINABILITY OF PRESERVATION AND ADAPTIVE USE

SUSTAINABILITY

Are we on the right track?

“THREE LEGGED STOOL”

SEE

Social
Environment
Economics

STEWARDSHIP OF THE BUILT ENVIRONMENT

Stewardship of the built environment balances the needs of contemporary society and their impact on the built environment with their ultimate effects on the natural environment.

IMPORTANT POINTS TO PONDER

*The greenest building is one that has already been built.*

—Carl Elefante

“Much of the world has begun to recognize the inter-relationship and interdependency between sustainability and historic preservation...but much less so in the United States... We have not broadly connected the dots.” —Donovan Rypkema

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“THE GREENEST BUILDING...”

HOW CAN OLDER BUILDINGS BE GREEN?

Older and historic buildings possess inherent green qualities that are often underestimated, overlooked, or undervalued with regards to:

- Energy Utilization Index (EUI)
- Embodied energy
- Impacts of demolition/replacement
- Regional/climate-based design
- Low technology comfort mechanisms
- Original walkable communities
- Life Cycle Assessment

Energy Utilization Index (EUI)

Many historic buildings are already energy efficient

<table>
<thead>
<tr>
<th>Year Range</th>
<th>EUI (Btu/ft²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before 1920</td>
<td>85.127</td>
</tr>
<tr>
<td>1920 – 1945</td>
<td>90.353</td>
</tr>
<tr>
<td>1946 – 1959</td>
<td>80.138</td>
</tr>
<tr>
<td>1960 – 1969</td>
<td>90.976</td>
</tr>
<tr>
<td>1970 – 1979</td>
<td>94.568</td>
</tr>
<tr>
<td>1980 – 1989</td>
<td>100.077</td>
</tr>
<tr>
<td>1990 – 1999</td>
<td>88.534</td>
</tr>
<tr>
<td>2000 – 2003</td>
<td>79.703</td>
</tr>
</tbody>
</table>

Source: Commercial Building Energy Consumption Survey, 2003
U.S. Department of Energy

Energy Utilization Index (EUI)

Many older homes are not as energy efficient

<table>
<thead>
<tr>
<th>Year Range</th>
<th>EUI (Btu/ft²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before 1939</td>
<td>56</td>
</tr>
<tr>
<td>1940 – 1949</td>
<td>54</td>
</tr>
<tr>
<td>1950 – 1959</td>
<td>49</td>
</tr>
<tr>
<td>1960 – 1969</td>
<td>47</td>
</tr>
<tr>
<td>1970 – 1979</td>
<td>46</td>
</tr>
<tr>
<td>1980 – 1989</td>
<td>41</td>
</tr>
<tr>
<td>1990 – 1999</td>
<td>39</td>
</tr>
<tr>
<td>2000 – 2001</td>
<td>37</td>
</tr>
</tbody>
</table>

Source: Commercial Building Energy Consumption Survey, 2003
U.S. Department of Energy

EMBODIED ENERGY

First discussed by the National Trust for Historic Preservation in the late 1970s and still a mainstay in their sustainability initiative today:

“The sum total of all the energy used to acquire raw materials, transform them into building materials, transport them to the building site, and construct the building.”

<table>
<thead>
<tr>
<th>Material</th>
<th>BTU/lb</th>
<th>BTU/ft²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stone</td>
<td>340</td>
<td>54,485</td>
</tr>
<tr>
<td>Concrete</td>
<td>559</td>
<td>85,351</td>
</tr>
<tr>
<td>Lumber</td>
<td>1,075</td>
<td>37,039</td>
</tr>
<tr>
<td>Brick</td>
<td>1,075</td>
<td>138,763</td>
</tr>
<tr>
<td>Aluminum (recycled)</td>
<td>3,483</td>
<td>586,991</td>
</tr>
<tr>
<td>Steel (recycled)</td>
<td>3,087</td>
<td>998,716</td>
</tr>
<tr>
<td>Glass</td>
<td>6,837</td>
<td>1,007,842</td>
</tr>
<tr>
<td>Steel</td>
<td>13,760</td>
<td>6,742,208</td>
</tr>
<tr>
<td>Plastic (PVC)</td>
<td>30,100</td>
<td>2,512,761</td>
</tr>
<tr>
<td>Aluminum</td>
<td>97,610</td>
<td>13,841,388</td>
</tr>
</tbody>
</table>

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Stewardship of the Built Environment  September 30, 2010

**IMPACT OF DEMOLITION/REPLACEMENT**
- Actual recovery time of embodied energy costs
- Demolition energy
- Materials flows

**EMBODIED ENERGY RECOVERY CALCULATION**

**Scenario 1:** Do nothing to the existing building and build a new building. The existing building will be reused by someone else.
- Embodied energy for new building: 1,200 kBTU/sf
- Existing annual operating energy: 70 kBTU/sf
- New annual operating energy: 35 kBTU/sf
- Annual Energy Recovery Rate: 35 kBTU/sf

Energy Recovery Period = Initial Embodied Energy ÷ Annual Energy Recovery Rate = 1,200 ÷ 35 = 34.2 years.

**Scenario 2:** Demolish the existing building and build a new building in its place.
- Embodied energy for new building: 1,200 kBTU/sf
- Lost embodied energy from existing building: 800 kBTU/sf
- Total change in embodied energy: 2,000 kBTU/sf
- Existing annual operating energy: 70 kBTU/sf
- New annual operating energy: 35 kBTU/sf
- Annual Energy Recovery Rate: 35 kBTU/sf

Energy Recovery Period = Initial Embodied Energy + Annual Energy Recovery Rate = 2,000 ÷ 35 = 57.2 years.

**DEMOLITION COST/ENERGY**
The energy to demolish the building will extend this recovery period even longer.

**MATERIAL FLOWS: G. H. SCHETTLER HOUSE REHABILITATION**

**Before**

**After**

**CASE 1:** Rehabilitate Original House
- New Materials Needed: 24.6 tons
- Construction Waste: 23.2 tons
- Total Material Stream: 47.8 tons
- 85.9% recycled content from original construction.

**CASE 2:** Build New House in the Suburbs
- New Materials Needed: 173.5 tons
- Construction Waste: 9.9 tons
- Total Material Stream: 182.4 tons ~4X Case 1
- 0% recycled content (no original construction to reuse).

**CASE 3:** Demolish House and Rebuild Comparable New House (but not a "Monster House")
- New Materials Needed: 573.5 tons
- Construction Waste: 478.3 tons
- Total Material Stream: 351.8 tons ~7.4X Case 1
- 0% or only nominal recycled content from original construction.
173.5 TONS ≈ 11,283,052 CANS

REGIONAL/CLIMATE-BASED DESIGN
- Design worked with factors commonly understood within the local climate
- Vernacular solutions
- Local materials

LOW TECHNOLOGY COMFORT MECHANISMS
- Thermal mass
- Passive thermal control
- Daylighting
- Convective Cooling

LOW TECHNOLOGY
- Thermal Mass
- Passive Thermal Control

DAYLIGHTING
- Let the light in

CONVECTIVE AIR FLOW
- Warm air rises
- Cross ventilation
Stewardship of the Built Environment

**ORIGINAL WALKABLE COMMUNITIES**
- Source of New Urbanism precedents
- Source of Transit Oriented Development precedents

**LIFE-CYCLE ASSESSMENT (LCA)**
Measures the overall environmental impact:
- Fossil fuel depletion
- Other non-renewable resource use
- Water use
- Global warming potential
- Stratospheric ozone depletion
- Ground-level ozone (smog) creation
- Effects on water bodies
- Acidification
- Toxic releases to air, water, and land

**LIFE-CYCLE ASSESSMENT**
A recent LCA study (2009) of four buildings in Canada revealed that in each case, the retention of the existing building had more favorable impact values than their removal and replacement with new construction.

**SOCIAL AND ECONOMIC CONSIDERATIONS**
- Education and marketing
- LEED
- Building codes
- Secretary of the Interior Standards
- Life cycle cost assessment
- Economic Analysis
- Economic Incentives
- Community Revitalization: “Smart Growth”
- “Green Sprawl”

**EDUCATION AND MARKETING**
- Project an enhanced image for preservation
- Build relationships
- Dispel the “myths”
PROJECTING AN ENHANCED IMAGE FOR PRESERVATION
- Move from iconic museums to vital communities

BUILDING RELATIONSHIPS
- Work proactively with public, oversight agencies and boards, and multiple stakeholders

COLLABORATIVE PARTNERSHIPS
- Landscape Architect
- Architect
- Interior Designer
- Facility Manager
- Contractor
- Mechanical Engineer
- Regulatory & Planning Agencies
- Electrical Engineer
- Structural Engineer
- OWNER
- Architectural Facilitator
- Construction Manager
- Utility Companies
- Civil Engineer
- Regulatory & Planning Agencies

DISPELLING THE MYTHS
- Win-Win solutions
- McDonald’s, Freeport, ME
- Rite Aid, Camden ME

LEED AND OTHER RATING SYSTEMS
- In addition to LEED, other systems are in use.
- Become familiar with proactively engaging the scoring system
- Use as first step not the final solution
- Advise on new metrics development
Stewardship of the Built Environment

September 30, 2010

DISPELLING THE MYTHS
Define feasible solutions that meet multiple criteria

LEED ↔ Preservation

Big-D Construction Headquarters, Salt Lake City, UT
- First LEED Gold project in Utah
- Among the first LEED-Gold/Preservation Tax Credit projects in the country
- RDA Financing

BUILDING CODES
- Enhance awareness of opportunities and constraints for solutions

- Form based codes: historic/vernacular precedents
- High performance building codes and smart codes: accommodate older and historic buildings
- IEBC alternate compliance: make code officials aware
- Reasonable accommodation versus exemptions: find solutions rather than denying the problem

SECRETARY OF THE INTERIOR STANDARDS
The basis for many local design guidelines needs to reconsider:
- Sustainable design issues
- Smart codes
- High performance building standards
- Interface with LEED and other performance metrics

SECRETARY OF THE INTERIOR STANDARDS
Reassessment and evolution

LIFE CYCLE COST ASSESSMENT
The present value of all cash flows over the lifetime of a building:
- First cost
- Operating cost
- Maintenance cost
- Cyclical replacement cost
- Disposition cost
- Includes factors for time value of money
ECONOMIC ANALYSIS

In lieu of the more complex LCCA, simple payback analysis may be more readily understood by the public, practitioners, and public officials.

**Simple payback:** period of time needed to recover additional money spent based on energy savings alone.

Generally accepted simple payback period is 3-5 years.

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ECONOMIC INCENTIVES

Even under current conditions, there are funding incentives:
- Community Development Block Grants (CDBG)
- Energy Efficiency and Conservation Block Grants (EECBG)
- Tax Credits
  - Historic Preservation: 20%/10%
  - Low-Income Housing: 4%/9%
  - New Market: 39%
- Historic Preservation Incentives
- Redevelopment opportunities

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Impact of Various Economic Activities

<table>
<thead>
<tr>
<th>Per $1 Million in Expenditures</th>
<th>Highway Construction</th>
<th>New Construction Buildings</th>
<th>Rehabilitation of Historic Buildings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jobs</td>
<td>33.6</td>
<td>36.1</td>
<td>38.3</td>
</tr>
<tr>
<td>Household Income</td>
<td>$1,197,000</td>
<td>$1,223,000</td>
<td>$1,302,000</td>
</tr>
<tr>
<td>State Taxes</td>
<td>$101,000</td>
<td>$103,000</td>
<td>$110,000</td>
</tr>
<tr>
<td>Local Taxes</td>
<td>$85,000</td>
<td>$86,000</td>
<td>$92,000</td>
</tr>
</tbody>
</table>

---

COMMUNITY REVITALIZATION: “SMART GROWTH”

- Main Street and beyond
- Walkable Communities
- LEED-ND
- Job Creation
- Local impacts

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GREEN SPRAWL

Constructing sustainable buildings in locations that negate their sustainability benefits.

View of Los Angeles from the Getty Museum (a LEED Silver building)
THANK YOU!

Robert A. Young, PE, FAPT, LEED ap

Email: young@arch.utah.edu
URL: http://faculty.arch.utah.edu/young/