8. High-Performance Reconstruction and Historic Preservation: Conflict and Opportunity

By Jean Carroon, FAIA, LEED AP

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There is no denying that conflicts exist when striving for high-performance reconstruction in historic buildings. This is not to say that one precludes the other, but rather that the combination creates new layers of complexity. In the extreme view, each camp perceives the other as single-issue voters unwilling to recognize the actions required for social, economic, and environmental sustainability.

On the one hand, critics of high-performance reconstruction or deep-energy retrofits caution that a hyperfocus on operational consumption misses the forest for the trees. The cumulative environmental damage of new products—raw resource extraction, manufacturing, transportation, construction, and end-of-life disposal—used to achieve high performance may never be offset by lowered operational energy. Alterations may also cause long-term damage to historic buildings, create shorter cycles of material life, and have adverse impacts on occupant health.

On the other hand, critics of historic preservation contend that preservation standards focus too narrowly on visual integrity, freezing buildings into tidy idealized images of the past and undervaluing the urgency of energy- and water-use reduction. Windows are lightning rods for strong opinions about how historic buildings should be treated. Many believe that window replacement in historic buildings is essential to reduce energy consumption and that, by disputing this, historic preservationists undermine high performance and incorrectly place aesthetics above environmental sustainability.

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The Welcome & Admissions Center at Roger H. Perry Hall at Champlain College, Burlington, Vt., was certified LEED Platinum in 2011. The renovation and addition to the 150-year-old building restored the historic windows and added interior storm windows to achieve an overall value of R-20 with an air infiltration 60% better than code.

These simplified viewpoints are muddied by a shared problem—the relative valuations inherent in the current economic system, which are based on an incomplete assessment of costs for materials, water, and energy. The true prices of these and other building-related components generally do not include so-called "externalities," such as environmental damage, toxicity, and health impacts incurred along the life cycle.

Using a market system that relies on an incomplete assessment of costs encourages the replacement of worn-out materials with less expensive but also less durable products. For example, a slate roof might be replaced with artificial slates or asphalt shingles; terrazzo floors might be replaced with sheet goods. An incomplete assessment of costs discourages the use of new, perhaps more expensive technologies to conserve underpriced water and energy because basing critical decisions primarily on first costs makes the payback unacceptably long. Reduction in energy bills does not usually justify installation of photovoltaics because it takes decades to recover the investment. Life cycle costing is meaningless in judging sustainability when environmental and social externalities are excluded from the analysis. Basing critical decisions about historic buildings purely on an incomplete assessment of economic factors undermines both historic preservation and high-performance reconstruction by encouraging short-term solutions.

Because the two camps are both victims of an economic system that is destructive to the environment and to older and historic buildings, there is an opportunity for a new dialogue between them that shatters entrenched attitudes and advocates for carbon-based costing. To explore this, we must first define the inherent conflicts.

ENERGY VERSUS AESTHETICS: OPENING UP THE DIALOGUE

Although high-performance buildings are not just about energy consumption—just as historic preservation is not simply about appearance—energy and aesthetic issues do provide a framework for comparing proponents' philosophies. The resulting dialogue will, I hope, generate even larger questions about how we define and progress toward a sustainable world.

A common misconception is that historic buildings are energy hogs; this is contrary to the facts. A systematic tracking of the energy use intensity (EUI) of all commercial buildings in the U.S. and Canada finds that those constructed before 1920 actually have a lower EUI than those in any other decade until the 21st century.[1] This is further supported by data from the U.S. General Services Administration, the Architect of the Capitol, and the United Kingdom's Ministry of Justice, which all report that the oldest buildings in their portfolios use the least energy per square unit.[2]

Nor is this the whole picture, because EUI ignores the amount of physical space provided for an activity. That same study of 256 court buildings in the United Kingdom found that while the historic and modern courts had identical EUI, the modern facilities used 68% more energy per courtroom to "provide the identical function of justice" because the new courts are so much larger.

Energy use intensity, when used as a solitary value, is a flawed metric, but reducing energy use and shifting to less-polluting energy sources is an essential goal in environmental stewardship. Strategies for doing so in historic buildings are similar to any design effort and use synergies that offer multiple benefits. Sometimes this means reestablishing linkages. For instance, if the original landscape provided important solar shading but the trees died, were pruned, or simply failed to flourish, spiking cooling loads need to be addressed as part of an integrated design and not just as an undersized mechanical system. Sometimes it means creating new linkages. A new green (vegetated) roof can lower the air temperature at intake valves and reduce heat island effect, which combined with efficient lighting and interior and exterior shading will lower cooling loads.

External design strategies which improve building performance are often the most contentious issues in the adaptive reuse of historic buildings. Visible elements such as green roofs, solar collectors, photovoltaic systems, and nontraditional shading devices are generally discouraged. Review relies on the interpretation of the Secretary of the Interior's *Standards for the Treatment of Historic Properties with Guidelines for Preserving, Rehabilitating, Restoring & Reconstructing Historic Buildings*, the first version of which was released by the National Park Service in 1978. The current publication was codified in 1995 and applies to all historic properties.

The *Standards* are neither technical nor prescriptive, but are intended to promote responsible preservation practices that help protect the nation's irreplaceable cultural resources. It is the subjective interpretation of

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Green vegetated roof installation at the John W. McCormack Post Office and Courthouse in Boston is appropriate for a historic building because it is not visible from the street. The LEED Gold renovation uses 20% less energy and houses 10% more federal workers.

the *Standards* that determines when "visual impact" is unacceptable. The published technical briefs issued by the National Park Service illustrate the thesis that modern technology should not be visible on the building's primary façades or roof line. Following the lead of the NPS, the theme is widely promulgated in materials and guidelines at the local and state levels as well.

Is "visual impact" really what we should be squabbling about? The National Historic Preservation Act of 1966 (NHPA) was intended to create leadership in the federal government to act as "an agent of thoughtful change, and a responsible steward for future generations."[3] A central premise of all historic preservation is "reversibility," which favors changes that can easily be undone. The very concept acknowledges that future generations may "reverse" current actions. Safeguarding the physical fabric of historic buildings, while facilitating change that allows historic buildings to be viable and vibrant, is a more responsible approach in the face of urgent environmental issues. Visible green roofs, shading, and solar technology installed carefully to do minimal harm give a positive and practical message about the past, present, and future.

Negotiating the installation of green roofs or the placement of solar panels creates a gentle breeze compared to the tropical storm spawned whenever "energy" and

1 National Round Table on the Environment and the Economy and Sustainable Development Technology Canada 2009, Figure 7, Geared for Change, Energy Efficiency in Canada's Commercial Building Sector, www.nrtee-trnee.ca, www.sdtc.ca; and U.S. Energy Information Agency, "Consumption of Gross Energy Intensity for Sum of Major Fuels for Non-Mall Buildings" (2003).

2 Office of Business Performance, Public Buildings Service (GSA), "Financing Historic Federal Buildings; An Analysis of Current Practice" (May 1999); communication from the Architect of the Capitol to the author, 18 June 2008; "Age Energy Research; A Study of the Energy Usage of Buildings Relative to Their Age," Jon Wallsgrove, HMCS Estates Ministry of Justice (May 2007).

3 Advisory Council of Historic Preservation, http://www.achp.gov/overview.html, accessed 11 February 2012.

“historic windows” are discussed in the same sentence. Advocating for retention of original windows might seem to be only about aesthetics, but it is also about weighing low-tech against high-tech, existing materials against new, and known toxins against suspected ones. Scrape back the myopic obsession on appearance, and historic preservation is one of the few counterweights to our toxic throwaway culture.

RALPH R. THOMPSON

The University of Virginia chose to renovate rather than replace New Cabell Hall in part due to the significant environmental impact of new construction. PVs were ruled out as not being cost-effective.

New Cabell Hall aerial view, n.d., by Ralph R. Thompson, courtesy University of Virginia Visual History Collection (prints07757). Special Collection, University of Virginia Library.

MEASURING THE MAGNITUDE OF TODAY’S THROWAWAY CULTURE

The sheer volume of material use in our economy has caused concern for decades. In 1992, world leaders participating in the Earth Summit declared that “a principal cause of the continued deterioration of the global environment is the steady increase in materials production, consumption, and disposal,” to wit:

- In the last 50 years, humans have consumed more resources than in all previous history.
- In the United States, total material consumption increased 57% from 1975 to 2000, to 6.5 billion metric tons.
- From 1975 to 2000, worldwide consumption of raw materials (not including food and fuel) doubled.
- A smaller and smaller percentage of what is being consumed is renewable (e.g., agricultural, fishery, and forestry products), declining from 41% in the U.S. in 1900 to less than 5% by 2000.

Waste is the physical evidence of the heedless way we utilize natural resources. According to the World Resources Institute, “[O]ne-half to three-quarters of annual resource inputs to industrial economies is returned to the environment as wastes within just one year.” Paraphrasing the “Living Planet Report,” people are turning resources into waste faster than nature can turn waste back into resources. In economic terms, we are no longer living off nature’s interest, but drawing down its capital.[4]

Diverting construction waste is a well-established part of all green building metrics, but this distracts from the problem of resource reduction. The U.S. Environmental Protection Agency suggests that we should be asking not how to recycle or reclaim waste materials, but rather

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CSI and CSC Release MasterFormat 2012 Updates

The Construction Specifications Institute (CSI) and Construction Specifications Canada (CSC) have issued the 2012 updates to *MasterFormat*®, their flagship product used to organize construction documents for commercial, industrial, and institutional building projects in the U.S. and Canada.

CSI and CSC added 76 new numbers/titles, changed 18 of the existing numbers/titles, and deleted three that duplicated other existing numbers/titles.

“After reviewing the latest changes to *MasterFormat* proposed by its users, CSI and CSC experts made a number of updates, making it even easier to organize project manuals, or store and retrieve project information,” said CSI Executive Director/CEO Walter Marlowe, PE, CSI, CAE.

“These changes further refine *MasterFormat*, ensuring that this standard filing system reflects the evolving needs of the industry and facilitates effective communication between project team members,” said CSC President Bruce J. Gillham, CTR, CCCA.

One of the most significant updates to *MasterFormat* involves the addition of numerous titles in Division 33 – Utilities. The additions expand coverage of sanitary sewerage and septic systems work. A number of new titles address septic tanks, filters, and pumps.

CSI and CSC also:

- Added three new titles to Division 09 – Finishes: Concrete Staining, Interior Wall Paneling, and Metal Interior Wall Paneling.
- Amended Theater and Stage Equipment to Broadcast, Theater and Stage Equipment, and added titles to address Lighting Rigging Systems, Scenery Rigging Systems, and Curtain Systems.
- Expanded Operation and Maintenance of Plumbing Piping and Pumps to include Video Piping Instructions, Plumbing Piping Cleaning, Plumbing Piping Repairs, and Plumbing Piping Relining.

The annual revision cycle process is conducted by the *MasterFormat* Maintenance Task Team, a committee of volunteers appointed by CSI, CSC, and *MasterFormat* stakeholders ARCAT, ARCOM, Building Systems Design, Inc., Specification Consultants in Independent Practice, Digicon, and Canadian National Master Specifications.

MasterFormat is a master list of numbers and titles classified by work results or construction practices, used to organize project manuals, detail cost information, and relate drawing notations to specifications.

For more on the 2012 updates, please visit www.masterformat.com.

these questions: “Is there a way to eliminate this waste completely, to provide these same services with fewer resources and no adverse environmental impacts? Can we do this by substituting something else that does not wear out so fast, can be reused, that can be fully or almost fully recovered and repurposed?”[5]

Buildings are our largest objects. Reusing or repurposing billions of square feet of building stock avoids the heavy environmental impact of new materials and new construction. New construction in the U.S. is estimated to be responsible for nearly 50% of all raw resource consumption. In global terms, the U.S., with less than 5% of the world’s population, uses about 15% of all resources consumed on the planet for new construction.[6] The EPA advocates for the 3R’s—Reduce, Reuse, Recycle, in that order. The agency also stresses using low-impact and nontoxic materials. That is easier said than done.

PRODUCT EXTERNALITIES – EXAMINING CARBON EMISSIONS AND TOXICITY

New materials and goods are responsible for 42% of the U.S. Greenhouse Gas (GHG) Inventory, as estimated by the EPA.[7] The impacts on human health are harder to quantify, but as material consumption has climbed, so has environmentally harmful output—notably synthetic and persistent organic chemicals, radioactive compounds, and heavy metals.[8]

There is new attention being placed on individual building products to identify more complete life cycle impacts in terms of greenhouse gas emissions and materials used. These efforts are encouraged by the recent creation of the 2030 Challenge for Products to reduce carbon impacts, the Healthy Building Network, and green building metric systems such as the Living Building Challenge, LEED, and Green Globes. Reporting usually takes the form of an Environmental Product Declaration (EPD), with recent explorations into a Health Product Declaration (HPD). The reporting depends upon life cycle assessments, which track products from cradle to grave, a complex proposition at best.

Using life cycle assessment, the Preservation Green Lab, a part of the National Trust for Historic Preservation, evaluated the climate change reductions that might be offered by reusing and retrofitting existing buildings rather than demolishing and replacing them with new construction. After analyzing eight building types in four U.S. climate zones, the report concluded that building reuse almost always offers environmental savings over demolition and new construction. Cautioning that “it can take between 10 and 80 years for a new, energy-efficient building to overcome … the negative climate change impacts that were created during the construction process,” the report stresses that the type and quantity of materials matter in both renovation and new construction.[9]

Measuring the carbon impacts of products is one thing, but trying to assess the toxicity created from cradle to grave and during service life is even more difficult. A very small percentage of all known chemicals are tested for human health impacts, and any exploration into materials reveals worrisome concerns about toxins. The sobering 2010 report, “LEED Certification: Where Energy Efficiency Collides with Human Health,” warns that even green building systems can do little to ensure hazardous chemicals are kept out of buildings with our current regulatory and review process. “Building materials are

4 World Wildlife Fund, Zoological Society of London, and Global Footprint Network, “Living Planet Report,” 2008, at: http://wwf.panda.org/about_our_earth/all_publications/living_planet_report.

5 “Sustainable Materials Management: The Road Ahead,” EPA530-R-09-009, June 2009, p. 31, at: http://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0CCQQFjAA&url=http%3A%2F%2Fwww.epa.gov%2Fosw%2Finforesources%2Fpubs%2Fvision2.pdf&ei=D3NzT52sOY3mggfa4dBY&usg=AFQjCNGFDxk7UglA2HiA9jC1gnPQ9qEtWQ.

6 USGS Factsheet FS-068-98, “Materials Flow and Sustainability” (June 1998), at: http://greenwood.cr.usgs.gov/pub/fact-sheets/fs-0068-98/fs-0068-98.pdf.

7 “Sustainable Materials Management: The Road Ahead,” EPA530-R-09-009, June 2009, p. 8.

8 “Material Flows in the United States: A Physical Accounting of the U.S. Industrial Economy,” World Resource Institute, 2008, p. 2, at: http://pdf.wri.org/material_flows_in_the_united_states.pdf.

9 “The Greenest Building: Quantifying the Environmental Value of Building Reuse,” Preservation Green Lab, National Trust for Historic Preservation, 2011, p. vi, at: http://www.preservationnation.org/information-center/sustainable-communities/sustainability/green-lab/valuing-building-reuse.html.

PETER VANDERWARKER

Before/after photos of the undercroft space at Trinity Church, Boston, a National Historic Landmark designed by H. H. Richardson. The renovation created program space in the underutilized basement, increasing functionality without having to build a new addition.

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Detail of the intricate restoration work at the John W. McCormack Post Office and Courthouse, in Boston, a 702,000-gsf project completed at a construction cost of $160 million.

known to include many well-recognized toxic substances …. The final building structure comprises thousands of these chemicals."[10]

The historic preservation industry spends a great deal of money and time relocating identified toxic miracle materials from the past—asbestos, lead, PCBs, to name just a few. Many of these can't be eliminated, so they are sent "away" for dilution or, one hopes, true containment. Given that toxic industrial and agricultural chemicals now show up in every body tested anywhere in the world—even in newborn babies[11]—there is no such place as "away." Nor is there much doubt that today's miracle products will once again prove to be tomorrow's prohibited materials. We live in a toxic world in no small part because of building materials, which brings us back to windows.

The environmental and health impacts of new windows are difficult to assess because of the spottiness of life cycle assessment studies, but available reports are consistent in identifying their relatively short life cycle and high embodied energy. Unfortunately, a comprehensive research project at the University of Minnesota Center for Sustainable Building Research reviewing cradle-to-grave life cycle assessment on 150 window variations in North America was halted for lack of funding.[12]

The greenest, healthiest solution might be a less-is-more approach to windows using combinations of refurbishment, new storm windows, film, and shading devices to achieve the greatest energy-use reduction with the least amount of new GHG emissions, environmental degradation, and toxicity. Tools for evaluating existing window performance and their role in the building envelope are becoming more readily available. Infrared thermography, air infiltration testing, and computer modeling all facilitate before-and-after analysis of how building enclosures are functioning.

Existing windows are as diverse as the buildings they reside in. Original construction, physical condition, and the current and potential role of the entire wall system in energy performance vary from project to project. To assume that replacement of windows should be mandatory, or that it is the most environmentally responsible way to achieve high performance, ignores the complexity of life cycle assessment, whole building design, and energy sources. It creates the same kind of line-in-the-sand position that historic preservation establishes with "no visual impact."

WHOLE BUILDING DESIGN – ACHIEVING HIGH PERFORMANCE + HISTORIC PRESERVATION

Can historic buildings meet the criteria of high performance? The answer is yes, of course. The practice of

BEFORE: GOODY CLANCY; AFTER: © ANTON GRASSL / ESTO

A courtroom in the original John W. McCormack building (top) and the reconstruction (above). The 1933 Art Deco federal building, designed by Cram & Ferguson, was the site of many historic judicial decisions on New Deal legislation. In 1972 it was renamed for the former Speaker of the House from Boston. The project won Silver honors In Building Design+Construction's 2011 Reconstruction Awards.

10 "LEED Certification: Where Energy Efficiency Collides with Human Health," Environment and Human Health, Inc., p. 8, at: http://www.ehhi.org/leed/.

11 "Body Burden – The Pollution in Newborns: A benchmark investigation of industrial chemicals, pollutants and pesticides in umbilical cord blood" (executive summary), Environmental Working Group, 2005. At: http://www.ewg.org/reports/bodyburden2/execsumm.php.

12 At: http://www.csbr.umn.edu/research/lca_windows.html.

historic preservation has always been about managing change. It has never denied new requirements for comfort, universal design, life safety, or security, to name but a few. The drive for high-performance buildings is merely one more evolution in balancing multifaceted and complex goals for our built world.

Historic buildings benefit in equal measure to their nonhistoric counterparts from the new technologies that facilitate less resource consumption during operations, including: water-conserving plumbing fixtures; graywater and blackwater reuse systems; mechanical systems that take up less space, use less energy, and improve zone control, such as chilled beams, radiant heating and cooling, variable refrigerant systems, and dedicated demand-controlled outside air and displacement ventilation; alternative sources of energy (or conservation), such as ground-source heat pumps, solar hot water systems, and photovoltaics; control systems, such as Digital Addressable Lighting Interface (DALI), which allow changes through programming rather than relocation; continuous or stepped dimming of lights; LEDs and other lighting improvements; and daylight/occupancy sensors.


PETER VANDERWARKER

Built in 1798, the Massachusetts State House has remained viable and in continuous service through more than two centuries of changing technology and performance criteria. The National Historic Landmark is a testament to the compatability of historic preservation and sustainable design.

Depending on the period, style, and location of construction, historic buildings may have passive design elements that can be enhanced, including building mass and form, daylighting, shading, and ventilation strategies. Integrated design and whole building thinking are essential in achieving the best possible performance in historic buildings, including considering ways to increase occupant density and reduce underutilized space by creating new rooms in attics and basements, limiting storage, and combining service and amenity areas. As more-efficient mechanical, lighting, and control systems are developed, occupant behavior is monitored and modified, and buildings are routinely retro-commissioned, operational energy, one component of high performance, will continue to decline.

STEPPING INTO THE FUTURE: WHAT LEGACY WILL WE LEAVE?

Embracing new performance criteria does not, in and of itself, lessen the heritage value of a site or a building, but it often necessitates changes that over time are taken for granted. Indoor bathrooms have long since replaced the original privies on the historic University of Virginia campus, a UNESCO World Heritage Site. The Massachusetts State House, a National Historic Landmark, remains in active use after more than two centuries despite no longer being heated with wood or lit with candles. Another century from now, what aspect of current historic preservation and high-performance guidelines will be considered quaint or primitive?

Hopefully, our descendents in the 22nd century will be shocked and grieved that we did not automatically design passive strategies in new buildings and celebrate them in the old; that we used materials so wastefully that we routinely "gutted" and demolished functional structures; that we did not address energy- and water-use reduction holistically; that we did not mandate long service life and repairability in our materials and objects; and that our market system did not account for environmental, health, and social degradation.

The great naturalist John Muir once said, "When we try to pick out anything by itself, we find that it is bound fast by a thousand invisible cords that cannot be broken, to everything in the universe."[13] This is exactly the challenge and the opportunity as we reach for "sustainability" in our built world.

Neither "historic preservation" nor "high-performance" advocates have all the answers, but we can learn from each other. Historic preservationists need to seriously rethink what stewardship means. High-performance advocates must look beyond operational consumption issues to more comprehensive solutions and effective metrics. Both camps should unite behind policies that promote long-term sustainability instead of short-term decisions driven by incomplete life cycle costing. Long-term sustainability must never be far from our thoughts, even as we struggle with short-term urgency. We must strive to be worthy ancestors. +

13 Ronald H. Limbaugh and Kirsten E. Lewis, eds., The John Muir Papers, 1858-1957 MICROFORM, (Stockton, Calif.: University of the Pacific , 1980). With accompanying Guide (Alexandria, Va.: Chadwyk Healey, 1986). At: http://www.sierraclub.org/john_muir_exhibit/writings/misquotes.aspx#2.

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