PART I

OVERVIEW
THE NEED FOR IMMEDIATE ACTION to address climate change and the related environmental degradation is increasingly urgent, and the major role that the building industry must take in abating the crisis is unequivocal. Yet, a 2008 survey of design professionals from across the United States found that some still question the actuality of climate change, even though environmental scientists have concluded with unusual unanimity that dramatic change is well under way. Two years before the survey, *Time* magazine trumpeted, “The debate over whether Earth is warming up is over. Now we’re learning that climate disruptions feed off one another in accelerating spirals of destruction. Scientists fear we may be approaching the point of no return.”

"Human activity is putting such a strain on the natural functions of the Earth that the ability of the planet’s ecosystems to sustain future generations can no longer be taken for granted."

—(2000) United Nations Millennium Ecosystem Assessment
The year 2007 was noteworthy because of the new certainty and alarm expressed by international scientific groups about climate change and its rippling effects on ecosystems, biodiversity, geopolitical stability, and economic security. The United Nations Environment Programme Year Book 2008 announced that climate change "is now recognized as a universal public issue that will dominate global attention for at least a generation."
The reasons for climate change are complex, but the fundamental factor contributing to global warming is attributed by the Intergovernmental Panel on Climate Change (IPCC) to a dramatic increase in anthropogenic (i.e., caused by people) greenhouse gas concentrations. Atmospheric concentrations of methane (CH$_4$) and nitrous oxide (N$_2$O) have increased markedly since 1750 and far exceed preindustrial values determined from ice cores spanning many thousands of years, but the greatest concern stems from the dramatic increase in annual carbon dioxide emissions (CO$_2$), which grew by about 70 percent between 1970 and 2004, due primarily to the use of fossil fuels. The single biggest sector responsible for creating carbon dioxide directly and indirectly in the United States is the building industry, followed by transportation, which is closely aligned with how we acquire products and move between buildings.

**Building Impacts**

The impact of buildings on greenhouse gas emissions and the depletion of natural resources is staggering. In terms of land use and material extraction, the building and construction industry has the greatest impact of any sector. Buildings are primary contributors to environmental degradation during all phases of service—construction, operation, and deconstruction or demolition. In the United States, buildings account for the following:

- 37 percent of primary energy use
- 68 percent of all electricity use
- 60 percent of nonfood/fuel raw materials use
- 40 percent of nonindustrial solid waste or 136 million tons of construction and demolition debris per year
- 31 percent of mercury in municipal solid waste
- 12 percent of potable water use
- 36 billion gallons of water use per day
- 20 percent loss of potable water in many urban systems due to leakage

![Figure 1.2](image-url)  
**Figure 1.2** Global greenhouse gas (GHG) emissions due to human activities have grown since preindustrial times, with an increase of 70 percent between 1970 and 2004. Figure 2-3 in Climate Change 2007: Synthesis Report published by the Intergovernmental Panel on Climate Change of the World Meteorological Organization.
38 percent of all carbon dioxide emissions
49 percent of all sulfur dioxide emissions
25 percent of all nitrous oxide emissions
10 percent of particulate matter emissions

Every year, another 1 million acres of farmland in the United States are given over to buildings, and the number of cars per household continues to climb.

Transportation is a constant reminder that buildings are not isolated events that can be individually improved, thereby solving our climate crisis and creating an environmentally sustainable world. Alex Wilson, president and founder of BuildingGreen, Inc., the Brattleboro, Vermont, publisher of Environmental Building News (EBN), has suggested that the energy used by building occupants to travel to the building be incorporated into a holistic analysis of a single building’s environmental impact. Typically, the aggregate energy used to get to and from a building is very high, as much as 2.4 times the building’s energy use, according to Wilson. No similar calculations have been done to estimate the environmental impact of the infrastructure required to transport energy, water, and waste to and from a building, but the concept of transportation energy intensity points out that the continuing effect of a building is not limited to its operation alone. If we are to green our buildings and our world, we must frame both problems and solutions as holistically as possible.

“Green” has become the umbrella word covering the complex issues of reducing or even eliminating adverse environmental impacts. Within the conversation of green as it relates to buildings, an evolving terminology provides a framework for analysis and judgment of issues, some of which are particularly applicable to historic buildings.
1.2 HISTORICALLY GREEN—WHAT MAKES EXISTING BUILDINGS GREEN

“The greenest building is . . . one that is already built.”
—Carl Elefante, FAIA, Quinn Evans|Architects

Embodied Energy

*Embodied energy* is the description of energy used directly and indirectly in raw material acquisition, production of materials, and the assemblage of those materials into a building. Every building starts with an environmental debt that includes resource depletion, energy, and manufacturing from the impact of construction. Embodied energy is an attempt to quantify one significant part of this debt.

According to a formula produced for the Advisory Council on Historic Preservation during the energy crisis of the 1970s, a typical 50,000 ft\(^2\) commercial building embodies about 80 billion Btu’s of energy, the equivalent of about 640,000 gallons of gasoline. Tearing a building down not only wastes this energy but also requires more energy and more raw materials to construct a new building.

The urgent and immediate need to reduce carbon emissions makes the reuse of buildings an imperative because the embodied energy expenditure has already occurred. Even the most energy-efficient new building cannot offset its embodied energy for many years. The United Nations Energy Programme estimates that the embodied energy of a building is 20 percent if a building is operational for 100 years, which is two to four times longer than most buildings in the United States are in service. The shorter the service life, the greater the ratio of embodied energy to operating energy is. As buildings are made more energy-efficient, the ratio of embodied energy to lifetime consumption also increases, placing even greater significance on the energy used in construction, recycling, and final disposal.

Embodied Carbon

Attempts to quantify embodied carbon stem from the acknowledgment of carbon dioxide emissions as a contributor to climate change. The intent in embodied-carbon calculations is to estimate the amount of carbon emitted through building construction, including the entire cycle of material extraction, fabrication,
Using ICE data, *New Tricks with Old Bricks*, a 2008 study from the British Empty Home Agency compares carbon dioxide emissions in new construction with the refurbishment of existing homes. The study concludes that when embodied CO$_2$ is taken into account, new, energy-efficient homes recover the carbon expended in construction only after 35 to 50 years of energy-efficient operations.\(^19\)

“Existing buildings in the United States outnumber new buildings by more than 100 to 1. If the United States is going to reduce its greenhouse gas emissions, the greening of existing buildings must be included, too.”

—Charles Lockwood and Deloitte\(^20\)

**Durability**

Durable, long-lived materials and composite durability of a construction system such as a masonry wall are common in many historic buildings and a logical part of sustainable design. Notes Peter Yost, a building science expert with 3D Building Solutions, LLC, “If you double the life of a building, you halve the environmental impacts [of its construction].”\(^21\) Durable materials, especially those with low maintenance requirements such as exterior masonry, slate roofs, terrazzo floors, wood framing (properly protected from moisture), and even three-coat plaster on wood lath, can last hundreds of years, spreading the original environmental impacts over time. These materials often have a lower recurring embodied energy as well, which is the energy required to maintain, repair, and restore materials. Although less-durable materials may not involve as much energy in their manufacture, the need for frequent replacement, combined with the need to dispose of the product following removal, results in a higher total embodied energy over the life of the material.\(^22\)

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Figure 1.4 Durable and beautiful materials, such as those shown in the lobby of 175 Berkeley Street in Boston, designed by Cram and Ferguson in 1947, have low recurring embodied energy and often reduce the need for toxic and frequent cleaning (Refer to Chapters 6, 7, and 8 for additional information about the impact of material choices, healthy interiors, and maintenance.) *Photo by Nick Wheeler © Frances Loeb Library*
Indigenous Materials

The older a building, the more likely it is to have utilized indigenous materials, whether adobe in arid climates, redwood in the Pacific Northwest, or stone in areas of quarries throughout the country. Indigenous materials offer advantages on a number of levels, frequently including inherent durability for the climate in which they originate (such as earth construction), lower transportation requirements, and support of local economies. The appropriate use of indigenous materials is one of the many lessons that historic buildings can teach the design community.

Repairability

Repairability is at the heart of many existing buildings and building components—from wooden windows to slate roofs. When a portion of a wooden window fails, new wood can be spliced in, broken glass can be replaced, weights and pulleys can be repaired. The same can be said for slate roofs, which can be repaired with incremental replacement and consequently last 50 to 100 years. Repair rather than replacement creates an economy that values and employs local craftspeople, extends the life of products, keeps construction waste (or materials requiring recycling) to a minimum and reduces the need for new products that by definition have a negative environmental impact—regardless of how they were manufactured or the amount of recycled material they contain.

Moving from a culture of replacement to one of repair and renewal is essential for reducing our environmental impact and becoming a regenerative society, rather than one that is merely doing less harm.
Passive Survivability

Passive survivability acknowledges design features in a building that allow it to function even when modern systems and energy sources fail. Vernacular and older historic buildings demonstrate passive survivability by necessity, having been constructed before dependency on off-site energy sources and mechanical systems. Rediscovery and understanding of these design strategies is an important part of building reuse, as well as a lesson for new design.

Daylighting

Many older buildings have large windows, light wells, narrow footprints, and glass transoms and doors to bring light (and air) deep into buildings. Old storefronts often still have prism glass for refracting light into the back spaces, and although it’s less common, it is still possible to find examples of glass-permeated sidewalks designed to allow light into below-grade storage and work areas.

Ventilation

Natural air movement was a requirement prior to mechanical systems. Windows and doors were placed for facilitating cross-ventilation. Planning a chimney draft that brought cooler basement air up to clerestory windows or roof vents operated by wire pulls was common in church design in the nineteenth century, and the same strategy was used to allow heat to updraft through floor vents. Designs in hot climates recognized the cooling sensation of air movement by placing fans powered by people or weighted pulleys in both interior and exterior spaces.

Water

The use of cisterns is as old as recorded history, and water-storage tanks are still visible on the roofs of many nineteenth-century urban buildings. History offers significant examples of societies that understood and managed water as a communitywide resource, including the Nabateans, who created Petra and other desert cities with diverse water runoff and catchment systems.

Energy

Because they incorporate design for passive survivability, many older buildings use less energy than more recent buildings. Data from the Department of Energy indicate that commercial buildings constructed before 1920 use less energy per square foot than buildings from any other decade up until 2000 (see Table 1.1). A 1999 study by the General Services Administration found that utility costs in the GSA’s inventory of historic buildings are about 27 percent less than in non-historic structures.23
Long Life/Loose Fit

Long life/loose fit is a term coined by Stewart Brand in *How Buildings Learn: What Happens After They’re Built* (1994). The concept is that a building can and should last a long time but allow for changing uses over time. Many historic buildings demonstrate long life/loose fit with creative designs that successfully provide for dramatic new uses—a mill building becomes housing, an armory becomes a theater, or a barn become a visitor’s center.

Transit-Oriented Design (TOD) and Walkability

Transit-oriented design recognizes the importance of providing transportation options to allow people to live and work without using personal automobiles. Families living in areas with quality public transportation are found to own approximately 50 percent fewer cars than families without public transportation options. Historic buildings frequently exist close to public transportation because they were built before automo-
biles had become a widespread transportation option. Communities with historic buildings often have characteristics that support walkability—safe sidewalks that provide easy access between buildings, physical separation from cars, generous crosswalks, and traffic-slowng street details.

1.3 TERMINOLOGY OF EVOLVING GREEN DESIGN

“When we try to pick out anything by itself, we find it hitched to everything else in the Universe.”
—John Muir

Life-Cycle Assessment (LCA)

Life-cycle assessment (LCA) attempts to assess and quantify the environmental and cost impacts of materials and assembled systems. LCA is based on the fact that all stages in the life of a product—whether a widget or a building—generate environmental impacts on water, land, and air, that, in turn, have impacts on human health. True greenness of a product must include a holistic evaluation. The stages for a widget include raw material extraction and acquisition, manufacture, transportation, installation, use, and waste management. Economic performance is factored into the evaluation by including the initial investment and the cost of replacement, operation, maintenance and repair, and disposal. A building is more complex because it includes a composite of materials, but the same imperative to consider the holistic impacts applies. In the always-evolving approach to living more lightly on the earth, understanding the LCA of our decisions is essential because of the complexity of the issues. (For a further discussion of LCA refer to Chapter 3 and Chapter 7.)

Carbon Neutrality

Carbon neutrality is the goal of living in a way that does not create carbon dioxide—the primary gas contributing to global warming. Any effort to address this holistically—upstream, midstream, and downstream carbon impacts—considers everything from the mining of materials for fabrication, to material transportation, use, and disposal.

Most frequently, when mentioned in relationship to buildings, carbon neutrality refers only to building operation or to the CO₂ produced by the use of energy in building operations. The 2030 Challenge—issued by Santa Fe, New Mexico-based Architecture 2030 and adopted by the American Institute of Architects—presses for designs and renovations to create buildings that operate without using fossil fuel or any greenhouse-gas-emitting energy and reduce greenhouse gas emissions by 50 percent.

This is clearly important because of our overwhelming dependence on coal to create electricity. Currently, 70 percent of the greenhouse gases created by building operations result from electricity consumption, and 50 percent of the electricity used in the United States is made with coal, which pollutes in multiple ways. The 2030 Challenge claims (www.Architecture2030.org) that extreme but uncoordinated efforts to reduce greenhouse gas are quickly reversed by the construction of new coal-fired power plants. For instance, if every college campus building in the United States reduced CO₂ emissions to zero, the “CO₂ emissions from just four medium-sized coal-fired power plants each year would negate this entire effort.” The proposed far-reaching solution is to make all buildings, including those already built, reduce operational greenhouse gas emissions by 50 percent. Unlike LCA, the 2030 Challenge does not account for greenhouse gas created during construction and renovation.
New and renovated buildings begin operation with a negative balance in greenhouse gas emissions, but the greenhouse gas created by renovation is estimated to be 30 to 50 percent less than new construction for each dollar spent. All buildings also create greenhouse gas at the end of life. Even if all materials are salvaged and reused, that work still requires energy. Attempting to understand and quantify these impacts is part of the evolving focus of metric tools and guidelines used in green design (see Chapter 3) and one part of the evaluation undertaken as part of full life cycle assessment discussed on page X.

**Zero Net Energy (ZNE)**

Zero net energy construction attempts to design and construct buildings that operate with only energy generated on site. This approach addresses only operating energy not embodied energy or the environmental impacts of construction systems. The design requirements for a zero net energy building are very dependent on regional location and site opportunities.

**Recycling and Down-cycling**

Recycling and down-cycling are often confused. Recycling is essentially taking a product and using it to make the same product—such as paper included in the production of new paper or used ceiling tiles contributing to new ceiling tiles. Down-cycling is reusing the waste of one product in the making of another, such as adding crushed window glass to bituminous paving or new countertops. Both recycling and down-cycling postpone the transition of a manufactured material to waste, with the assumption that material recycling will keep a material in the production cycle longer than down-cycling.

**Cradle to Cradle**

The term and subsequent certification program, Cradle to Cradle, or C2C, is a concept presented by William McDonough and Michael Braungart in their book of the same name in 2002, with the subtitle *Remaking the Way We Make Things*. The basic concept of C2C is the elimination of waste and the reduction of raw material use by creating products and, by extension, buildings.  

![Figure 1.8](image-url) Fenway Park in Boston, Massachusetts, uses salvaged materials as part of a holistic strategy for greening the facilities. New bar tops were made from the salvaged materials of a bowling alley removed from one of the buildings in the complex, which is a National Historic Landmark. The Right Field Roof, State Street Pavilion, Left Field Deck all have lane bar tops. Reusing existing materials has the dual benefit of reducing landfill and avoiding the environmental impact of new products. (Refer to Chapter 7 for impacts of new materials.) © Jordan Wirfs-Brock
that at the end of service life can be remade into the same product. Of course, even the remaking of a product requires resources—energy, equipment, and water.

**Rapidly Renewable Resources**

Many products claiming to be green use “rapidly renewable resources” or materials that have a shorter harvest rotation than wood, which usually means less than 10 years. (Refer to Chapter 7 for additional information about green products.)

**Biomimicry Design**

*Biomimicry design* celebrates the extraordinary systems and materials found in the natural world and attempts to apply these lessons and opportunities to human-created products and living. Biomimicry also uses design to recall and reinforce our connection to nature.

**Regenerative Design**

*Regenerative design* is sometimes characterized as being “beyond green” because of the assumption that many of the green guidelines merely create a society that is less harmful to the environment. The goal of regenerative design is to create buildings, places, and systems that actually restore or even establish environments that are truly sustainable.

**Smart Growth**

*Smart Growth* is a movement that encourages compact development that combines multiple land uses in a way that preserves open space and provides communities with options in housing and transportation that make efficient use of shared infrastructure. Regional planning and economic health are guiding principles, as well as restoration of the natural environment.
Land Use Changes, Carbon Impacts, and Neighborhood Reinvestment

By Patrice Frey, deputy director of the Sustainability Program, National Trust for Historic Preservation, with research assistance from Paul Anderson, Monica Andrews, and Carl Wolf

In recent years, land has been developed in the United States at a rate of approximately three times that of population growth [see Figure 1.10]. In fact, the average American uses five times more land than just 40 years ago. For example, while the city of Baltimore, Maryland, lost about 250,000 residents in the last quarter century, its suburbs expanded by 67 percent.¹ In yet another older Northeast city, Philadelphia, metropolitan population growth has grown by 66 percent in the past 50 years, but land development has grown by 401 percent.²

Land use has a tremendous impact on carbon emissions. Research has demonstrated that in the United States, people who live in more sprawling locations drive 20–40 percent more than those who live in more compact urban areas.³ Yet as the authors of the recent Growing Cooler report note, “For 60 years, we have built homes ever farther


from workplaces, created schools that are inaccessible except by motor vehicle, and isolated other destinations—such as shopping—from work and home. The planning and transportation theory of “smart growth” has emerged as an alternative to such sprawling development, and promotes high concentration of growth, transit-oriented development, and walkable, mixed-use communities.

The research surveyed in Growing Cooler shows that much of the [projected] rise in vehicle emissions can be curbed simply by growing in a way that will make it easier of Americans to drive less. Smart growth tactics could “reduce total transportation-related emissions from current trends by 7 to 10 percent as of 2050,” according to some projections. The Brookings Institution notes that carbon savings from smart growth extend well beyond those associated with decreased driving. Compact development often means reduced heating and cooling costs because homes are smaller or are in multifamily buildings. District energy systems can be used for power generation, which also creates substantial carbon savings. Municipal infrastructure requirements for roads, sewers, communication, power, and water are reduced by high-density developments. Brookings points out that the reuse of existing structures provides carbon savings, as well.7

Sprawl is a relatively recent phenomenon, because pre–World War II communities were built more compactly out of necessity. These neighborhoods tend to be dense, walkable, feature mixed uses, and are very often accessible to public transit. It makes sense that a significant component of a smart growth strategy would be to reinvest and redevelop in older urbanized areas to take advantage of their inherently sustainable features. Nevertheless, there are numerous obstacles to reinvestment in these older areas.

DEMOGRAPHIC SHIFTS AND THE ABANDONMENT OF SUSTAINABLE COMMUNITIES

Major demographic shifts in the last half-century have resulted in the movement of millions of Americans from older and historic communities in the Northeast and Midwestern United States to points south and southwest. This southward flight has been fueled by the significant restructuring of the American economy, including the loss of manufacturing jobs that were previously concentrated in the Northeast and Midwest.

While older industrial cities (now known as rust-belt cities) hollow out, tremendous population growth has occurred in areas such as Atlanta, Phoenix, and Las Vegas, where sprawl is the dominant form of development, and where water resources in particular are scarce. The result is the movement of millions of people from more sustainably designed places to far less sustainably developed areas that face uncertain futures given rapidly escalating gas prices and water scarcity.

There is some good news, however. Reinvestment in many traditionally planned communities in some

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4 Ibid., p. 2.
5 Ibid., p.4.
6 Ibid., p. 9.
regions of the U.S.—largely on the coasts—is occurring. With gas prices increasing, Americans now have more incentive than ever to live and work in transit-accessible areas. Recent analysis suggests that while housing prices have dropped between significantly nationwide, homes in center cities or in transit accessible areas have retained, or even increased in value.⁹

Nonetheless, rustbelt cities lie fallow and remain significantly underused and potentially under-valued assets. This poses several important questions: Is it environmentally responsible to encourage growth in areas of the country that are environmentally unfit to handle it—while masses of infrastructure and buildings in sustainable designed cities rot? What are the real environmental consequences of such decisions? Or is disinvestment in the rustbelt just a simple—if troubling—economic and political reality with no solution?

The answers are not so clear. But with millions of square feet of abandoned building stock, the questions seem to warrant at least some consideration. This is an area in which additional research and thought is of enormous importance.


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1.4 RETHINKING ASSUMPTIONS—HOLISTIC DESIGN

“What we need is a new ethic in which every person changes lifestyle, attitude and behavior.”

—Achim Steiner²⁴

Rethinking the Linear Design Process—Integrated Design Process

The process of building design and renovations has been characterized as a linear process in which a lead designer develops concepts, then passes the design sequentially to specialized consultants who address specialty range of issues without regard to the work of others. Recognition of the interconnection and complexity of the natural systems and the need for holistic design has led to formalized presentations about integrated design, a process that gathers the entire project team together to create designs that benefit from the synergies of different areas of expertise.

Rethinking Building Costs—Can We Afford Not to Be Green?

The first costs of green building are often suggested as an impediment to environmentally responsive design. Within the construction industry, there are always comparisons between initial costs and lifetime value, but identifying the differential cost of green design has become increasingly difficult, as requirements for energy efficiency become embedded into building codes and options for green materials and building systems increase. Two reports from Davis Langdon, a consulting firm offering cost-planning and sustainable-design-management services, confirm this trend. Examining the Cost of Green (2004) and Cost of Green Revisited (2007) both concluded that there are so many cost factors in construction today that it is nearly impossible to detect any sta-
tistically significant difference between the cost of conventional and green buildings. Documentation of direct financial benefits because of environmentally sensitive design is also increasing. Benefits include energy and water savings, reduced waste, improved indoor environmental quality, greater employee comfort/productivity, reduced employee health costs, and lower operations and maintenance costs.  

**Rethinking Space Utilization—Less Is More**

Recognizing that physical space is an extremely valuable resource, universities, governments, and businesses are reexamining how they use space and how new technologies and changing social patterns have altered scheduling and shared uses. Better utilization of existing resources frees funding for other needs and significantly reduces carbon emissions by slowing the need for new facilities and making the best use of operating costs (and the resulting emissions).

The University of Michigan began the ambitious Space Utilization Initiative in 2007 to evaluate and improve the use of 29 million gross square feet of space. The initiative was developed as a key tool for reducing the university’s operating costs by developing greater efficiencies and maximizing the use of facilities.

The United States General Services Administration (GSA), one of the largest landlords in the country, began an extensive review in 2002 of how workplaces are used by their tenant organizations, which ultimately led to more efficient use of office areas and a reduction in overall space needs. Here are some of the important findings of the GSA’s Workplace 20-20 program:

- Organizations often underutilize their workspace.
- Organizations often configure the available workspace in ways that do not support the new work styles.
- The work force itself has an inaccurate idea of how it spends its time.
- Self-reporting is a poor source for reliable programming data.

Partners in the Workplace 20-20 study—including HOK, Spaulding & Slye Colliers, DEGW, Gensler, Studios Architecture, Business Place Strategies, Interior Architects, as well as Carnegie Mellon, MIT, University of California Berkeley, Georgia Tech, and the University of Michigan—confirm that underutilization of workstations is typical of both government and private sectors. Hewlett-Packard, for example, has been able to reduce its total portfolio use of space by over 30 percent through the realignment of space to reflect the working habits of a mobile workforce.”

**1.5 THERE IS NO FINISH—CREATING A CULTURE OF REUSE, REPAIR, AND RENEWAL**

“A building is not something you finish. A building is something you start.”
—Stewart Brand

Much has been written about our current culture of consumption. We have created a world where it is usually easier and less expensive to replace something—whether cell phone or building—than to repair it. We are, as Carl Elefante writes in the *Forum Journal*, “drunk on the new,” but new buildings cannot solve the environmental dilemma we have created. We must reshape our culture to become one of reuse, repair, and renewal that is respectful of existing resources, including buildings. It is not the makers of glitzy new green buildings who will significantly reduce carbon emissions from buildings but the facilities managers and owners responsible for the buildings that already exist.
John C. Kluczynski Federal Building

Chicago, Illinois

LESS IS MORE

In June 2006, GSA leveraged WorkPlace 20-20 tools and guidelines to renovate two floors of Chicago’s timeless Mies van der Rohe-designed John C. Kluczynski Federal Building for the Great Lakes Region, Public Buildings Service. Workplace consultants conducted in-depth analyses of the organization and its work patterns through interview, focus groups, surveys, and cultural analysis. As a result, the GSA optimized the interior environment to fit the way the agency works while also maximizing environmental goals.

The analysis identified a widely held desire to increase interpersonal communications while breaking down organizational stovepipes. The resulting design created egalitarian and nimble work settings by combining:

- Stunning corner views, reserved for group spaces
- Low partitions and increased individual work surfaces
- Rapidly reconfigurable standard-sized offices and meeting rooms
- Glazed-walled private offices throughout, located away from windows
- Open, well-appointed reception and break room areas as gathering destinations

Post-occupancy surveys confirm that the new plan “strikes the right balance.” Flexible configurations contributed significantly to the reduction in total space consumed and lowered churn costs to a bare minimum.

GSA also reclaimed over 16,000 square feet of inefficient file-storage space by investing in a managed 1,260-square-foot high-density system that centralized all regional document and supply management services. Not only do the occupants use space more efficiently and better control their files and supplies, but resulting savings (14,000 square feet at $32 per square foot), equate to $450,000 per year, or enough to finance the system support, file management, copy and mail operations, and plotting needs of the growing agency.”


The earth is not given to us by our parents, it is lent to us by our children. —Kenyan proverb

Commissioning—Making Sure Buildings Work as They Should

Existing buildings represent 98 percent of the available square footage in any one year and operational inefficiencies are normal. The sixth white paper produced by Building Design + Construction points out that the majority of buildings, both new and existing, do not function as intended and strongly promotes commissioning and recommissioning buildings. A concept promoted by the green building movement, commissioning originated with the practice of taking newly launched ships on shakedown cruises to make sure everything was working properly.
Commissioning and recommissioning recognizes that buildings and building systems require stewardship in order to function optimally. “Building systems, particularly HVAC systems, are forever falling ‘out of tune.’ . . .” Commissioning as applied to a building is a third-party review and inspection of building systems both before and after installation. It is probably one of the most valuable concepts to emerge from green design.

**Maintenance and Repair—Caring for What We Have**

Caring for what we have is at the heart of what in the United States is called historic preservation, but elsewhere in the world is referred to as heritage conservation. The technical publications and Preservation Briefs of the National Park Service include information on maintenance and repair of dozens of materials, including adobe, slate roofing, masonry, woodwork, cast stone, and terra cotta. Published in 1978, Brief #3, *Conserving Energy in Historic Buildings*, is still germane, as is the more recent Brief #47, published in 2007, *Maintaining the Exterior of Small and Medium Size Historic Buildings*. Maintenance is an inherently sustainable strategy.

**Healthy Skepticism—Protecting What We Have**

“Art must experiment to do its job. Most experiments fail.”

—Stewart Brand

At the 2005 Symposium for Sustainability organized by the Association of Preservation Technology, architect and building forensic expert John Lesak argued for the application of the precautionary principle. Professionals involved in the stewardship of historic and existing buildings, he explained, constantly address the miracle solutions of previous generations, whether lead paint or asbestos or even inadvertently created mold. The business of building forensics, which diagnoses failures of structure, material, and detailing—often focuses on recent buildings, not just historic structures. New materials and systems have not consistently stood the test of time nor have they always proved the miracle solutions advertised. Stewardship of existing buildings, especially those of great historic significance, demands that the first tenant do no harm to the existing cultural resource. Even as we move decisively to address climate change, new systems and new products must be used with caution in buildings that have already survived for decades and even centuries.

**Regional Solutions—Thinking Globally**

Many of the issues raised in this chapter—life-cycle analysis, building and infrastructure reuse, and transportation energy intensity—demonstrate that an individual building’s impact on the environment cannot be assessed independently of the immediate region and the entire planet. The urgency of responding to climate change extends to regional planning and in urban design decisions that evaluate land use, resource depletion, transportation, and energy considerations to create true sustainable development (see Chapter 2).
People’s Food Co-op

Portland, OR

Current Owner: People’s Food Co-op
Building Type: Retail
Original Building Construction: 1918
Historic Designation: None
Restoration/Renovation Completion: 2003
Square Footage: 5,400 ft²
Percentage Renovated: 45% + 55% new construction
Occupancy: 20 people (60 hrs/week) 2–20 visitors (1–2 hrs/day)
Southeast Portland Uplift Community Award, 2003

“People’s Food Cooperative cultivates a thriving local economy by integrating ecological responsibility, local food systems, and cooperative ownership with equitable business practices in a lively community marketplace.”

—Mission Statement

PROJECT DESCRIPTION

The People’s Food Co-op demonstrates the benefits of thinking holistically, not just in an integrated building design but in how a building and organization affects a community and neighborhood. The co-op symbolizes the ongoing process of environmental commitment by accepting the management of systems within the building to ensure human comfort and encouraging social change with inducements that invite walking, biking, and public transit use. The expansion and renovation project employed an integrated design process and biomimicry as a guide in creating a setting for gathering and learning about the environment. The small brick building was constructed in 1918 as a feed store and purchased by the PFC in 1970. The decision to renovate and double the size of the building sought to articulate a symbiotic relationship between the building and nature, with the added aspiration of employing labor-intensive construction that utilized volunteer labor and indigenous and salvaged materials.
Site Utilization and Material Synergies

- The layout of the addition takes advantage of the site to capture daylighting potential and benefit from solar heat gain. A south-facing thermal-storage bottle wall permits sunlight and heat gain in the winter, while the mass of the cob wall (straw, sand, and mud) actively cools the space in summer.

- South-facing community sunspace achieves maximum solar exposure during the winter and during the summer is protected by a roof overhang and deciduous trees.

Community Connectivity

- The L-shape of the building was intentionally chosen to create a courtyard for community gathering.

- The co-op provides incentives for biking, walking, or using public transit by displaying maps and schedules, providing discounts, offering an unusually large volume of bike parking, and providing bicycle delivery of goods.

Water

- Water is considered an asset on the site and is either harvested or infiltrated using two sections of green roof, permeable paving, bioswales, and a 1,500-gallon underground cistern beneath the courtyard.

- All plantings are drought-tolerant and watered with an efficient drip system. Paving systems are porous to promote groundwater recharge.

- The intent was to use the stored water for toilets, but this requires a permitting process that has not yet been completed.

Energy and Integrated Design

- An integrated design approach—daylighting, low-emissivity windows, insulation with an R-22 value in the walls and R-44 in the ceiling, efficient systems and monitoring—reduces energy consumption 16 percent below the Oregon Energy Code and saves roughly $1,700 per year.

- Heating and cooling use a combination of passive ventilation, direct solar gain, night flushing, ground-source heat pumps, and efficient natural gas combustion. Radiant tubing in-slab on the first floor and a conventional duct system on the second provide heat drawn from the ground-source heat pumps. The cooling sequence begins with passive ventilation drawn through a vertical shaft that extends from the first floor through the roof to facilitate night cooling. A fan can add the airflow if needed, and if night cooling proves inadequate during the day, cool water
Figure 1.12 The south-facing courtyard of the People’s Food Co-op hosts community events, with permeable paving materials, rain gardens, and xeriscape planting to reduce stormwater runoff, a major source of pollution (refer to Chapter 4 for more information). Cheyenne Glasgow photo, courtesy People’s Food Co-op

Figure 1.11 The front wall of the People’s Food Co-op in Portland, Oregon, shows the sculptural potential of the cob (a mixture of straw, dirt, and sand) used in the thermal wall. The building demonstrates the mission of promoting ecological, social, and economic sustainability. Cheyenne Glasgow photo, courtesy People’s Food Co-op
AN INTRODUCTION TO SUSTAINABLE SCHOOLS

GREEN DESIGN ELEMENTS
People’s Food Co-op

Sustainable Sites:
- Bicycle accommodation
- Green roof
- Permeable paving materials
- Xeriscaping
- Bioswales

Water Efficiency:
- Graywater system (planned)

Energy and Atmosphere:
- Ground-sourced geothermal heat pumps
- Solar chimney (ventilation)
- Natural ventilation

Building Envelope and Materials
- The design strategy sought the lowest possible environmental impact by first keeping all material use to a minimum, followed consecutively by seeking salvaged materials and post-consumer materials (like unused paint), biodegradable materials, and finally, new materials from local sources and near-by managed forests.
- Cob (a mixture of straw, dirt, and sand) was used as infill material in a portion of the wall. Because it is malleable, it was also used to form benches, and decorative sculpture was included in the wall. Used glass bottles were inset in the cob wall as a design feature.
- Siding on the new construction is made from remilled cedar telephone poles from a local supplier.

Operations and Maintenance
- The designer wrote a custom and detailed operations-and-maintenance manual to promote longevity and to maintain the memory of how the building is designed to operate.

Material and Resources:
- Over 90 percent construction waste recycled
- Recycled content materials
- Colorful recycled-glass-bottle thermal storage (placed in wall)
- Cob infill
- Forest Stewardship Council (FSC)-certified wood

Indoor Environment Quality:
- Operable windows
- Low-VOC materials and finishes

Additional Features:
- Occupant recycling program
- Vermicomposting
- Organic products

can be circulated through the in-slab radiant tubing to assist in heat removal—but this is carefully monitored to avoid condensation on the slab.

■ Smart design and construction included avoiding details that allow thermal bridging from interior to exterior. For instance, the concrete slab at the entry is jointed at the door threshold to create a thermal break.
HARRIS CENTER FOR CONSERVATION EDUCATION

PROJECT TEAM

People’s Food Co-op
Cynthia Bankey, AIA
Dave Wadley
City of Portland Office of Sustainable Development
Hemmingson Construction, Inc.
Portland General Electric
SOLARC Architecture and Engineering, Inc.

Harris Center for Conservation Education
Hancock, NH

Current Owner: The Harris Center for Conservation Education
Building Type: Assembly/Interpretive Center
Original Building Construction: 1913
Historic Designation: None
Restoration/Renovation Completion: 2003
Square Footage: 8,580 ft²
Percentage Renovated: 73% + 27% new construction
Occupancy: 50 people (60 hrs/week)

“Building green is more than just a building process; it is the whole process. Site planning, design, construction and materials must all be considered. Recycling, energy efficiency, indoor air quality and resource conservation were blended into the renewed Harris Center because we care about our heritage, we care about our people and we care about our planet.”

—Dave Birchenough, Trustee and Building Chair
PROJECT DESCRIPTION

The Harris Center for Conservation Education is the result of an integrated design process that began with the goal of utilizing the existing building, constructed in 1913 as a summer residence, to create an environmentally respectful modern facility for a nonprofit educational organization. The final project, by seeking low environmental impacts, is also a good example of passive survivability, or the ability to function without the support of modern mechanical systems dependent on off-site energy sources. The project employed local indigenous materials or durable new materials made from recycled or renewable products. The greatest importance was placed on energy efficiency.

Composting Toilets—In-House Waste Treatment Plant

■ Waterless composting toilets that provide nutrients, instead of waste, to the earth are used throughout. Aerobic bacteria convert human waste into fertilizer and prevent nitrates from reaching the groundwater.

■ The composting toilets reduced impacts on the existing septic system, and the construction cost and site disruption of a new system was avoided.

Super Insulation and Sealing of Building Envelope

■ The owner chose to use the most energy-efficient windows possible, and triple-glazed fiberglass windows were installed throughout, with an estimated eight-year payback on heating costs. Two separate coatings of low-E metallic oxide and pockets of argon gas between the layers of glazing provide a 50 percent reduction in ultraviolet transmission and a 25 percent reduction in solar heat gain, as compared to typical double-glazed windows.

■ Blown cellulose, from recycled newspapers, created an R22 insulation level in existing 2 feet, 4 inch exterior walls, which were strapped to achieve a 2 feet, 6 inch cavity.

■ Expanding foam was used to seal the building into an airtight envelope, nearly eliminating the transfer of energy between inside and out. Blower-door testing, performed after the air barrier was completed, showed an overall leakage area for both new and renovated space of 1.05 square inches per 100 square feet of shell.

Renewable Energy and Energy Conservation

■ The wood-pellet boiler was the first installed in a public building in New Hampshire, and possibly the first in New England. Wood pellets are a biomass fuel made nearby from sawdust, a recycled waste product of New England’s renewable for-
est industry. The estimated annual energy cost is $1,200 to heat almost 10,000 square feet of space.

- The fully automated hydronic heating system uses an external silo and auger system to carry pellets to the boiler.
- Solar panels reduce dependency on commercial electric energy.
- Energy-efficient fluorescent lights and motion sensors are used throughout the building; long-lasting LED’s (light-emitting diodes) are used in exit signs.

**Durable, Recycled, Natural, and Renewable Products**

- The Babbitt Room Addition, a post-and-beam octagon built by a local company, uses posts from Harris Center-managed and -logged stands of Eastern white pine. Reinforcing the connection of posts and rafters, the knee braces use local bent hardwood of oak, maple, and birch. The huge West Coast-grown Douglas fir rafters and compression ring were recycled from a mill building in Massachusetts, built in the early 1900s, and still show the rusting nail holes.
- All four outdoor decks were built using Trex, a manufactured plank made from recycled grocery bags and waste wood. Both second-floor decks were surrounded with railings and balustrades of recycled, century-old cypress resurrected from a river bottom in the South, which were then enhanced with cutouts of animal silhouettes by Harris Center trustees.
- Siding made of cement, sand, and wood fibers replaced less-durable wooden clapboards.
- Resilient floors, such as in the kitchen, are made from recycled SBR (styrene-butadiene rubber) automobile tires and reprocessed EPDM (ethylene-propylene diene monomer), a commercial roofing material.
- Linoleum in the bathrooms is made of all natural materials, including linseed oil, wood flour, rosin binders, and dry pigments, mixed and rolled onto a natural jute backing.
- Original wood flooring was recycled by patching existing rooms with flooring removed from other areas. All new wood flooring is FSC (Forest Stewardship Council) “green certified” yellow birch from a forest managed for sustainability.
- Office carpet tiles are made with 100 percent recycled backing and 34 percent recycled nylon face.
- Bathroom sink counters are soapstone, a natural product acquired from Vermont.
Figure 1.13 The Harris Center for Conservation Education in Hancock, New Hampshire, demonstrates an integrated design strategy to minimize impact on the environment, with a wood pellet boiler, blown cellulose insulation, and solar panels that reduce dependency on the commercial electrical grid. © Coldham and Hartman Architects

Figure 1.14 At the Harris Center for Conservation Education, local materials and timber framing created a new and dramatic daylit space that incorporates the most energy-efficient windows available at the time of construction. Expanding foam was used to seal both the old and new buildings into an airtight envelope, nearly eliminating the transfer of energy between the interior and exterior. © Coldham and Hartman Architects

Figure 1.15 Durability was chosen over both heritage and natural materials at the Harris Center for Conservation Education, with new siding made of cement, sand, and wood fibers replacing wooden clapboards. The same strategy was used in the decks, which are constructed of a material made from recycled grocery bags and waste wood. Decisions about “green” material selections are not always clear-cut and can engender much debate. (Refer to Chapter 7.) © Coldham and Hartman Architects
The building is ventilated using an energy-recovery ventilation system that transfers most of the heat energy in stale exhaust air to incoming, fresh, outdoor air.

To minimize harmful fumes, only water-based paints, stains, and clear finishes were used, as well as formaldehyde-free wheat-board for cabinetry.

Vinyl products were avoided. ABS (acrylonitrile butadiene styrene) pipe was used instead of industry-standard PVC (polyvinyl chloride) pipe for plumbing.

All outdoor, pressure-treated structural lumber was preserved using EPA-approved ACQ, an environmentally advanced formula that is arsenic and chromium free.

Each room is an individual heating zone.

Operable windows connect occupants with the natural world outdoors.

The two main floors are ADA-compliant and readily accessible.

Daylighting is used in the large meeting room in the Babbitt Room Addition.

The Harris Center now meets all life and fire safety codes and includes a three-story emergency exit stairwell.

**Maintenance and Operations**

- Systems commissioning was done at project completion.

**PROJECT TEAM**

The Harris Center for Conservation Education
Coldham & Hartman Architects, LLC
energysmiths
Walter Cudnohufsky Associates
Ryan Hellwig
Kohler and Lewis
Downing Engineering Professional Association
Bruss Construction, Inc
“By combining a painstaking dedication to restoring the original architectural vision of H. H. Richardson with several innovative elements of sustainable technology, you have turned Trinity Church into a symbol of all that historic preservation represents in the 21st century.”

—Richard Moe, President Emeritus of the National Trust for Historic Preservation
PROJECT DESCRIPTION

Because Trinity Church in the City of Boston—designed by H. H. Richardson and richly decorated by John La Farge and others—is considered one of the most important buildings in the United States, all proposed work is reviewed by local and state historic preservation commissions. The project undertaken between 2000 and 2005 was multifaceted but sprang from the intense need for on-site space to support the many hundreds of programs hosted by the vibrant Episcopal parish, the fifth largest in the country.

Sustaining the community, protecting the building, and keeping the church fully operational throughout construction were essential elements of the work. From the first meetings, the process included a fully integrated design and construction team led by a disciplined building committee whose standard of excellence supported collaborative and creative problem solving. The project is an example of the important synergies that spring from integrated teams with overlapping goals achieved by every solution. The final work of the team included establishing an ongoing maintenance program and a long-term master plan for completion of remaining restoration work.

Figure 1.16  Completed in 2005, the partial renovation and expansion of Trinity Church in the City of Boston, a National Historic Landmark, added 15,000 square feet of space below the building and incorporated a ground-source heat pump system. Six wells set around the perimeter of the building extend 1,500 feet below the church. 

Peter Vanderwarker photo, courtesy Goody Clancy
Site Utilization and Rainwater Harvesting

- The building is physically constrained by a very limited site (less than 10 feet on three sides) outside of the building footprint. The only physical expansion possible required capturing space below the building without altering or impacting the wooden-friction piles that support the structure and remain intact because of the high water table. The floor level of the new spaces is approximately 7 feet above the wood pilings. All rainwater falling on the building and site is collected and stored in drywells around the perimeter of the building. When the water table, which is electronically monitored, falls to a level that might expose the wood piles to air and encourage rot, water from the wells is circulated below the building to recharge the water table.

- Strategies for claiming every available square foot of below-grade space included placing the machine room below a small area of on-site parking, locating new bath-
Figure 1.18 In the new below-grade spaces at Trinity Church, minimal use of new materials met multiple goals, which included reduced environmental impacts of manufacturing, aesthetic celebration of the original stone foundations, and creation of flexible open spaces. The church is a vibrant urban institution that on a daily basis hosts a diverse range of events and groups. © Goody Clancy

rooms below the exterior porch (an area that limited ceiling heights), placing drywell water storage beneath the broad masonry steps, and creating new storage spaces below an existing cloister garden.

Energy and Systems

A new geothermal heat pump system reduces the energy the church must purchase by about 40 percent. The system, which utilizes six 1,500-foot vertical wells located within the 10-foot site adjacent to the building, eliminates the need for traditional cooling towers and is ideal for the air conditioning required in the new assembly spaces. No air conditioning was added to the interior of the church sanctuary. An existing connection to purchased steam was maintained for hot water and heating, but the inclusion of a variable frequency drive regulates both the heating and cooling pump systems to provide efficiency.
The design of new spaces takes both structural and aesthetic advantage of the existing walls and foundations. The team sought solutions that left existing materials visually exposed and relied on pilings known to have been set in the 1870s but not used in the final structure. Salvage stone found in the excavation was used wherever possible, and new materials were selected on the basis of their recycled content and local origin.

**PROJECT TEAM**

- Leggat McCall Properties LLC
- Goody Clancy & Associates
- Carol R. Johnson Associates, Inc.
- LeMessurier Consultants
- Walter B. Adams AIA (SBE)
- Lawrence Architectural Planning
- Cosentini Associates, Inc.
- Nitsch Engineering, Inc.
- Shawmut Design & Construction
- John Canning Studio
Historic Academic Group; Mahan, Sampson & Maury Halls, U.S. Naval Academy

Annapolis, Maryland

**Owner:** Department of the Navy

**Building Type:** Institutional

**Original Building Construction:** 1899

**Historic Designation:** Buildings are contributing structures on National Historic Landmark Site.

**Restoration/Renovation Completion:** 2002

**Square Footage:** 200,000 ft²

**Percentage Renovated:** 100%  

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**PROJECT DESCRIPTION**

The project exemplifies 21st-century rediscovery of passive-survivability features incorporated into an older building design. In the 1890s the need for daylight in the classrooms and offices was a critical aspect for the educational mission of the buildings. With the introduction of electrical lighting, skylights were removed and windows became secondary light sources. The energy efficiencies and user delight of reinfusing offices, classrooms, and passageways with natural daylight were a key concepts of the design.
Daylighting
- Reestablished skylights bring natural light to the interior of the building. Transoms and sidelights are used to share light from the perimeter. Increasing ceiling height at the perimeter windows took advantage of the entire window fenestration. The window glass has low emissivity with a shading coefficient no greater than .59. Lighting controls are provided by blinds and stepped switching. Light finish colors were used throughout for optimal surface reflectance.

Building Envelope
- Rigid insulation (2") increased both wall and roof R-values to 8. Thermal insulation blankets and board were added, using recycled material wherever possible. Convection loss through the building envelope was reduced with proper detailing, weather-stripping, and sealants. Windows were replaced with energy-efficient insulating glass units, with aluminum frames for low heat loss. Windows are set deep in the masonry walls for high-angle solar shading during the summer.

HVAC Systems
- The building’s original natural ventilation was reestablished with operable windows.
- The thermal efficiencies of the masonry building envelope were a primary contributor to the HVAC design. Systems were selected for partload operating efficiency. Air-distribution zones separate perimeter from interior air-handling units. Design included properly sized high-efficiency motors, variable frequency drives, variable air handling distribution, and low-temperature (high delta), low-pressure air supply provided to reduce fan requirements.
- A direct digital control system optimizes operating efficiencies.
Figure 1.21 Historic buildings, such as these at the U.S. Naval Academy, often demonstrate strategies for greater penetration of natural light and ventilation through interior spaces. High ceilings, transoms, and transparent partitions facilitated both. General lighting levels were designed for 30 footcandles, which was lower than the established standard. Direct/indirect fixtures were used wherever possible with room occupancy sensors and stepped lighting levels. *Richard Mandlekorn photo, courtesy Goody Clancy*

Figure 1.22 The renovation at the U.S. Naval Academy reestablished skylights, which bring natural light into the interior of the building. To increase daylight penetration, two-story atria were created with glass walls that carry light into adjacent spaces. Because over 50 percent of the electricity in the United States comes from coal, reduction of lighting loads offers an important strategy for reducing greenhouse gas emissions at the same time that indoor environmental quality improves. (Refer to Chapters 5 and 6 for additional information.) © Goody Clancy
GREEN DESIGN ELEMENTS

Historic Academic Group; Mahan, Sampson & Maury Halls U.S. Naval Academy

Sustainable Sites:
- Sediment- and erosion-control plan
- Reduced site disturbance to preserve trees

Water Efficiency:
- Low-flow fixtures
- Self-closing water faucets

Energy and Atmosphere:
- Low-temperature and low-pressure air supply
- Economizer cycle, 100 percent outside air
- Direct digital controls
- High-efficiency motors, fans and variable-speed drives
- Additional insulation and low-E windows installed
- Energy-efficient light fixtures, 30 fc ambient level
- Direct/indirect fluorescent fixtures throughout
- Stepped lighting controls and occupancy sensors

Materials and Resources:
- Recycled content materials
- Construction waste management
- Concrete with fly ash from local source
- Wood veneers and flooring from sustainably managed source

Indoor Environment Quality:
- Lights wells, skylights, and interior windows allow daylight to flow deeper into the building.
- Stepped lighting levels (with sensors)
- 100 percent outside air available
- Low- or no-VOC-emitting products
- High level of occupant lighting and air control

Plumbing Systems
- Toilet rooms were intentionally stacked to minimize distribution runs, and distribution pipe was insulated to reduce system standby losses.
- Localized hot water heaters were used for preheat with a centralized high-temperature hot-water system.

Electrical Systems
- General lighting levels were designed for 30 foot-candles, lower than the established standard of 50 fc.
- Direct/indirect fixtures were used wherever possible with room occupancy sensors and stepped lighting levels.

Indoor Air Quality
- Operable windows throughout.
- Outdoor air economizer system is capable of supplying 100 percent fresh air.
- Individual thermostatic control in each office and classroom.
- The air-filtration system includes prefilter and afterfilter.
- Separate zoning of systems is provided for each floor (use) and location (perimeter versus interior).

PROJECT TEAM

Department of the Navy
Goody Clancy & Associates
SAR Engineering
Heller & Metzger
Morton Thomas
Rolf Jensen Associates
Acentech
Hanscomb Associates
Lawrence Architecture Planning
ATC Associates
Whiting-Turner
Forbes Park

Chelsea, MA

Current Owner: Forbes Park LLC
Building Type: Multiunit Residential/Public Park/Restaurant
Original Building Construction: 1923
Restoration/Renovation Completion: Phase One September 2008
Square Footage: 400,000 ft²
Percentage Renovated: 60% + 40% addition

BUILDING DESCRIPTION

The Forbes Park loft community is a creative example of the renewal of dilapidated structures and regenerative site design. The nineteenth-century waterside industrial complex has been transformed into a mixed-use development that supports environmentally sensitive living and encourages community interaction. A series of lights called "Forbes Orbs" functions as an energy-conservation awareness system, identifying the type (and cost) of energy being supplied to the buildings at any given time. When power is “free” or coming from on-site wind generation, a blue lamp is displayed; off-peak energy is green; peak energy consumption is yellow; and grid-powered energy used during peak hours is red. This innovative lighting system is also linked to an onsite wind turbine that produces the facility’s free “blue-light” energy. It is anticipated that roughly 60 percent of the energy used by the 250 lofts during the day can be supplied by the 165-foot, 600kW wind turbine. At night, the turbine recharges a fleet of hybrid electric cars at plug-in stations; the cars are available for rental use by Forbes Park residences. The same color-coded light system (minus the “free” signal) will illuminate the windmill to allow the community to share in personal energy conservation practices.

Site Regeneration

- Restored over ten acres of indigenous vegetation and natural animal habitats and established a three-quarter-mile River Walk where parking lots once were.
Figure 1.23 Radiant flooring systems were used throughout the new lofts at Forbes Park. The masonry walls act as thermal sinks for heat absorption. The units were designed to allow the large windows to facilitate natural cross-ventilation. © Forbes Park LLC

Figure 1.24 The developer hopes that the 600 kW wind turbine will supply roughly 60 percent of the energy used by the 250 lofts during the day. The project restored over 10 acres of indigenous vegetation and natural animal habitats and developed a ¾-mile River Walk. © Forbes Park LLC
GREEN DESIGN ELEMENTS

Forbes Park

Sustainable Sites:
- Shared fuel efficient cars
- Public transportation proximity
- Underground parking structure
- Water taxis
- Natural habitat restoration
- Xeriscaping
- Waste pipe removal

Water Efficiency:
- Graywater system
- Low-flow plumbing fixtures
- Dual-flush toilets

Energy and Atmosphere:
- Wind turbine
- Radiant floors
- Thermal massing
- Natural ventilation
- Energy Star appliances
- Energy conservation light system

Materials and Resources:
- Sustainable harvested materials
- Existing material reuse (brick and concrete)
- Occupant recycling program

Indoor Environment Quality:
- Atrium
- Large operable windows
- Low-VOC materials and finishes

Additional Features:
- Onsite composting
- Exterior skywalk
- Environmental education center
- Sustainable restaurant and bar onsite

Rainwater Harvesting
- Dual-flush toilets use rainwater that has been filtered through a runoff-collection system for sewage conveyance. Stormwater not used within the building is sent through an onsite canal system that creates brackish water before releasing it into the adjacent river.

Natural Ventilation and Daylight
- Central atrium provides daylight and ventilation.

Integrated Heating and Cooling Design
- Passive heating and cooling strategies are used in conjunction with energy-efficient HVAC. Masonry walls act as thermal sinks for heat absorption. Radiant flooring systems are used throughout.

Efficiency Strategies
- Certified low-energy appliances and low-water-use plumbing fixtures are used.

PROJECT TEAM

Davis Design Development Corp.
Forbes Park LLC
ENDNOTES

7. Ibid.
12. Ibid.
13. This includes leakage from pipes in the ground, approximately one half of which are owned by the building-owner. Congressional Budget Office, *Future Investment in Drinking Water and Wastewater Infrastructure* (November 2002) Available at: www.cbo.gov/doc.cfm?index=3983&type=0.
16. Ibid.
17. Ibid.
27. Ibid., p. 38.