Stewardship of the Built Environment: the Emerging Synergies from Sustainability and Historic Preservation

Abstract

In the United States, the predominant land use goal has been to extract and maximize profit from the land in the near term. Sustainability and its underlying concept of stewardship of the built environment run counter to this extraction-based philosophy. Beyond sustainability, the recognition of the value of existing buildings has resulted in a growing interest in historic preservation. Sustainability, stewardship, and preservation have reached a nexus and are beginning to espouse similar values—economic, ecologic, and social viability. Unfortunately, the entrenched mindset of immediate return imperils the realization of the economic and social sustainability implied by these three approaches of how to reshape the built environment.

This case study explores a rehabilitation project that enabled its owners to meet concurrent historic preservation and environmental conservation goals while reusing an existing historic building. Beyond modeling a paradigm that an individual homeowner can readily undertake, it reduces energy consumption while *increasing* thermal comfort and demonstrates that reusing a building minimizes the total stream of building materials coming through a site. Most importantly, it shows that rehabilitating an older house is financially competitive with constructing new buildings.

With acceptance of the synergies that these concepts interactively generate, a longer term sustainable built environment can be realized. Through the stewardship of the built environment, the relationship between reused buildings and a healthy natural environment will become increasingly evident in the future societal viability of reused buildings that can result in the reduced suburban expansion pressures and renewed use of the urban core.

Keywords

sustainability, preservation, stewardship, conservation, revitalization

Stewardship of the Built Environment: the Emerging Synergies from Sustainability and Historic Preservation

Introduction

Sustainable architecture looks at long-term socioeconomic goals rather than just near term financial ones. In the United States, the predominant long term goal has been to extract maximum profit from the land. In this light, natural (and as of late, the built) environments have always been vulnerable to wasting due to the perception that there was always more land somewhere else and that any land use could change when something more profitable could be built upon or extracted from it. In this fashion, land could also be cast aside when easier development choices existed elsewhere. As a result, current economics-driven practices continually reshape the built and natural environments. This recurring paradigm is clearly evident in how "undeveloped" lands initially prized for their extractable natural resources were subsequently turned into agricultural lands and then finally were smothered by suburban sprawl or previously developed lands are left to deteriorate. These cycles will affect all open and developed land eventually leaving them undifferentiated, lacking vitality, and having little to no regional identity. This can readily be seen by the homogeneity of franchise architecture and seemingly identical suburban housing tracts across the country that have proliferated since the advent of the interstate highway system.

The concept of stewardship of the built environment counters this extraction and consumption-based economic philosophy. Despite the recent emergence of sustainability as viable design medium, the goals of stewardship of the built environment based on long-term environmental sustainability are viewed by many as contrary to the endemic approach of seeking near-term immediate personal economic gain. Long term sustainability, while attractive in principle, pales economically against the near term economic benefits gained from "standard" practices of the past half-century. While defenders of the natural environment have existed as a minority, the current cultural landscape of the United States reflects the premise that the majority has long adopted the depletion-extraction economic perspective as the justifiable paradigm. Today, the fact that vast tracts of the built environment remain underutilized demonstrates how suburban sprawl drains the vitality from central cities. Continuing development of the suburban periphery overwhelms previously individual smaller towns adjoining a central city, consumes open or agricultural lands, and subsequently results in increased traffic congestion, air pollution, and infrastructure costs for highways, utilities, and school systems. The concept of stewardship, rather than extraction, is a critical aspect of sustainable design that evaluates how changes in the built and natural and environments act as a singular system rather than two separate ones. A primary outcome of stewardship is that it can act to engage the practice of redevelopment and in turn reverse the current outward suburban flow back towards the neighborhoods and business districts that already exist within many core cities. Many neighborhoods in older communities already have existing infrastructure, access to public transit, and a far less homogeneous architectural heritage that can act to reduce overall construction expenses, make housing more affordable, and engender a higher and more affordable quality of life than their suburban counterparts.

Concurrent to the emergence of sustainability, the recognition of the economic and social value recaptured in existing buildings has resulted in a steadily growing interest in historic preservation nationwide. While the preservation movement often has been derided as being opposite to the "accepted" concepts of growth and profitability, successful historic preservation projects nationwide have shown that preservation can be a strategy that not only retains a cultural identity of a given community but also can be successful in generating renewed community development and maintaining a long term sustainable aspect of the environment.

Sustainability, Stewardship and Historic Preservation: A Nexus

The renewed interest in preserving and/or rehabilitating buildings at the end of the twentieth century can be directly traced to the American Bicentennial. Tax laws enacted between 1976 and 1986 (Dwight, 1993) made rehabilitating historic buildings attractive and spawned significant growth in the rehabilitation industry. The 1986 tax act, however, has virtually eliminated investment opportunities in historic property rehabilitation. This catalytic decade of rehabilitation activities created an awareness of the amenities that a revitalized central city could provide. Many central city neighborhoods are likely to have the advantages of more non-profit institutions, interesting architecture, walkable neighborhoods, and access to mass transit (Lucy & Phillips, p. 10). Recognition of these amenities has indeed brought about the new urbanist movement of the late twentieth century. While this movement ascribes to providing housing that adopts the amenities common to existing central city neighborhoods, the tyranny of "easy development decisions" still generates a more increased development at the suburban periphery rather than the redevelopment of original built environment that first held (and often still do hold) these features. As described by Lucy & Phillips:

> "In land development, business calculations may lead to options that are relatively easy to accomplish, such as…greenfield residential subdivisions…They receive extra weight with options that are difficult to implement such as mixed-use residential and commercial developments on infill sites even if the more difficult options hold potential for higher profits."

Accordingly, in the past fifteen years, many central city buildings and land have been left fallow as the suburbs push further outward. Since large scale residential projects are more often perceived as more profitable due to the realizable economy in mass production, these projects tend to be large in scope and require large tracts of open (or cleared) land. While new urbanism projects occur in both the suburban and central city contexts, the vast majority still appear to be in suburban locations. As a result, open suburban land is still being developed or central city buildings are being removed to create a "tabula rasa" for new development and existing building stock that can be reused is often removed. Due to the perceived difficulty in navigating regulatory procedures and the expense of assembling tracts within the central city, *particularly in historic districts*, the developers initiate suburban developments more frequently and at a large scale rather than at the individual homeowner scale. Although sustainability, stewardship, and preservation seemingly having reached a nexus in that they all are beginning to reach for the same values—economic, ecologic, and social viability, misperceptions, miscommunications, and outright arrogance and ignorance quite often lead to multiple parties standing in opposition to one another while these common long term goals of economic and social sustainability become imperiled. All parties want certain aspects of the same thing but fail to reach a viable means of doing so, especially as the project scope and scale of larger developments tend to lead to an "all or nothing" attitude from all parties involved. However, a possible alternative having greater implications for sustainability in the long term is the historic preservation/ stewardship approach described in the case study below.

Stewardship of the Built Environment: A Case Study

This study explores the planning and successful navigational process through design reviews of the local Historic Landmarks Commission and the State Historic Preservation Office that enabled it to meet the owners' concurrent historic preservation and environmental conservation goals. G. H. Schettler constructed this home (see Figure 1) in 1904. The house was a single-family home until it was converted into apartments (three one-bedroom and two studio units) in 1936. When purchased for this rehabilitation project in 1994, the house was considered incompatible with twenty-first century housing demands. Heating was provided by several separate motel-styled wall furnaces and fireplace inserts and the cooling was provided by a "swamp cooler" serving just the first floor. Utilities were substandard and much of the infrastructure for the five apartments remained in place. The upstairs had been relatively uninhabitable for over twenty years. Overall the structure system was in good condition and most original woodwork and plaster walls remained although covered by 15-20 layers of lead and latex-based paint or wallpaper. The asphalt roofing and aluminum siding concealed a roof structure and wood siding that were largely intact. The framing and foundations were sound.

Figure 1: G. H. Schettler House before (left) and after (right).

The G. H. Schettler house is typical of the housing in this historic district neighborhood. It is one- half mile from downtown and is served by three local bus lines. The 10 room, 1-1/2 story, Victorian Cottage is approximately 2541 square feet in size. The neighborhood is a mix of 2700 residential and commercial buildings from the nineteenth and early twentieth centuries. The context, location, and amenities of the house exemplify many of the features that new urbanist projects emulate. It does, however, have one particularly notable feature that these others lack. The project *reuses* an existing building rather than constructing a completely new building in the suburbs or replacing an existing building in an existing neighborhood. This project demonstrates what can be done by the individual homeowner in many extant neighborhoods and has won preservations awards from the Utah Heritage Foundation and the Salt Lake City Historic Landmarks Commission.

The successful rehabilitation of the G. H. Schettler House illustrates how the reuse of an existing residential building within an historic district can meet both sustainability and preservation goals that could have a far reaching impact on the stewardship of a sustainable built environment.

From a sustainability viewpoint this project succeeds in many ways. First, it uses a paradigm that an individual homeowner can readily undertake. Second, it achieves reduced energy consumption while *increasing* thermal comfort. Third, it demonstrates how reusing a building reduces pressures on landfills by recycling the existing house and reducing environmental demands created by the production of new building materials by minimizing the total amount of materials coming to and leaving the site. Fourth, it shows how environmental contamination concerns can be addressed. Fifth, it shows that rehabilitating an older house in an existing neighborhood is financially competitive with building a new house. These aspects will be described in further detail below:

<u>A Model Process</u>: Many proponents of new urbanism believe that projects can only be achieved at the large scale. However, it is at the singular scale where a greater opportunity for increasing sustainability and livability remains potentially overlooked—reusing the actual existing built environments that new urbanists model projects after as the means to reinvigorate communities and create more affordable and livable housing. The steps followed are:

- Physical assessment: As part of the purchase agreement, a building inspector investigated the house infrastructure focusing on the roof, structure, and service utilities. Subsequently, an historic preservation consultant identified historic elements to establish a baseline for the historic rehabilitation work.
- Performance programming: The homeowners developed performance requirements to establish the project's *philosophical* objectives. This was done while living in the house for a year to learn the subtleties of the house and to determine the homeowners' needs that the house had to fulfill. The philosophical objective was to rehabilitate the house and retain its historic character while meeting the demands of twenty-first century urban living.
- Schematic design: An architect developed designs based on the programming information. As this was a preservation tax credit project, the homeowners met with the State Historic Preservation Office to ascertain compliance with the Secretary of the Interior Standards. A design review was requested from the city planning department because the building is a contributing building in a historic district and needed a "Certificate of Appropriateness" before work could proceed.
- Design review: Design choices were evaluated and the final design was chosen based on comments from the city and state regulating authorities.

- Construction documents: The construction documents were developed and home refinancing was sought.
- Contractor selection: The contract was awarded after reviewing the price *and* each contractor's proposed approach to completing the work.
- Construction: The rehabilitation took seven months and reversed the 1936 apartment conversion. The roof was completely replaced. The poor conditions of the existing plaster necessitated that the entire second floor be "gutted" to its structural members. New mechanical, plumbing, and electrical systems were installed throughout. The 1970s era aluminum siding and porch features were removed.

Reduce Energy Consumption/Increase Comfort. Since many older houses have inefficient thermal mechanical systems, modern technology can be used to reduce energy costs while increasing the thermal comfort. Conversely, since many historic buildings were built before significant advent of modern mechanical systems, they may retain architectural tectonics that encourage passive thermal control. Before this rehabilitation, there was no centralized HVAC system and thermal comfort was only marginal. Indoor winter temperatures were between 58-72°F on the first floor and between 56-65°F on the second floor. Indoor summer temperatures on the first floor were generally above 85°F and the second floor were 95°F or higher. Only the first floor was actually habitable from a thermal comfort perspective. The average heating bill was $67.00/month, primarily keeping only the *first floor* marginally thermally comfortable. The thermal upgrades included restoring transoms and operable window elements, installing upgraded windows and refitted storm windows, upgrading insulation/infiltration control, and installing a centralized forced air HVAC system that divided the house into two zones controlled by programmable thermostats. With these changes, the average heating bill for using the *entire* house *dropped* to $50.00/month (bearing in mind that this reduction also incorporated the opportunity to nearly double the habitable space while bringing both floors into tolerable thermal conditions for the first time). The temperature for heating is set at 68° with a setback temperature of 60°F. The temperature for cooling is set at 78°F with a setback temperature of 85°F. Since no previous air conditioning system was used, there is no basis for cost comparison. However, for the past three cooling seasons, the air conditioning system has only been needed in July and August (in a climate with an outdoor summer design temperature of 95ºF) and has increased the operating costs an average of $90 for those two months. Calculations show that before rehabilitation the peak heating and cooling loads were 135,075 btuh and 48,077 btuh respectively. After rehabilitation these dropped to 85,564 btuh and 37,275 btuh respectively. These represent 36.7% and 22.5% reductions respectively. The various sustainable design features are listed in Table 1.

Reducing Waste/Increasing Recycled Content. One critical aspect of this design was to evaluate how reusing the building impacts the environment compared to building a new building. This project does this in two ways. First, the strategy of reusing the built environment mitigates the demand for and impacts of building in the suburban periphery

Architectural Tectonics
Brick/adobe construction provides thermal mass
Ceiling height (10’-6”) allows warm summer air to rise above occupied space
Transoms over doors allow warm air relief using nighttime convective cooling
Double-hung windows allow warm air relief using nighttime convective cooling
Large windows provide solar heating in winter
Stairwell/skylight configuration enables stack effect ventilation
Replacement windows on second floor are double-paned wood construction
Light-colored roofing reduces heat gain into attic and urban heat island effect
Tall windows/ceiling height provide daylighting
Lighter wall/floor/ceiling surface treatments provide improved reflective light

Thermal Control/Efficiency
Central forced air furnace provides humidification and air filtration
Split system air conditioner provides cooling inside while rejecting heat outside
Air-conditioning only used in July and August as needed
Furnace combustion air provided directly from outside
Ductwork divides house into two zones—First floor and second floor
Programmable thermostats employ weekday/weekend day/night setbacks
Thermostats control individual zone damper
Gas-fired fireplace inserts (2) uses for first floor local comfort
Paddle-type ceiling fan used in kitchen to enhance comfort cooling/heating
Attic and crawl spaces insulated to meet energy code
Weatherstripping replaced to reduce infiltration
Storm windows removed, regasketed, and reinstalled
Attic vent fan relieves excessive heat
Ridge vent provides supplemental heat relief path

Plumbing
Low flow plumbing fixtures installed
All existing plumbing and waste lines replaced
Frontloading, low-water washing machine installed
DHW tank insulated to reduce heat loss

Electrical/Lighting
Daylighting is used extensively throughout opportunities
Tasklighting is used for visual needs
Programmable timers used for porch lighting
Security lighting is two stage motion sensor activated system
Refrigerator replaced older less efficient one

Table 1: Sustainable Features of the G.H. Schettler House

<u>Socioeconomic</u> Project met historic preservation design guidelines while achieving sustainability goals Retaining building maintained continuity in historic urban fabric Financing capitalized on tax incentives to reduce overall cost Homeowners used innovative home rehabilitation financing program **<u>“Green” Features</u>** Recycled content is approximately 85.9% Reuses existing public utility infrastructure Convective cooling opportunities are used throughout house Natural materials are used in countertops and flooring (no plastic, laminates, or vinyl) First-floor floors are domestic hardwoods (no threatened tree species used) Cabinetry/millwork are domestic softwoods (no threatened species used) Natural-gas used for cooking/DHW (local electricity generation is coal-fired) Whole-house water filtration system removes potential health hazards Water softener reduces minerals in domestic water Electrostatic filter on HVAC reduces dust and allergens Homeowner subscribes to wind-power incentive program from local utility Homeowner uses city provided recycling program House is located approximately 0.5 miles from central business district Access to two transit lines is located ½ block away; a third line is located 4 blocks away

Table 1(continued): Sustainable Features of the G.H. Schettler House

by reducing driving needs and therefore reducing air pollution and by reusing existing infrastructure which strengthens housing affordability. These strengthen the sustainability of the built environment. Second, by its nature, reusing a building significantly lessens the impact of waste materials otherwise created by its complete demolition.

As shown in Table 2 (note: weights are calculated from estimated quantities taken from construction plans and densities found in *ASHRAE 2001 Handbook of Fundamentals*), Case 1 shows that the rehabilitation resulted in an 85.9% recycled content (e.g., the remaining original materials); the demand for new materials was 24.5 tons; and the estimated construction waste, including new construction waste portions, was 22.8 tons. This amounts to a total material stream (i.e., the total approximate weight of materials coming to and leaving the site) of 47.3 tons. A second strategy of simply building a comparable house in the suburbs is modeled in Case 2 where there would be an increased demand for 173.5 tons of new materials and that construction waste would be 8.9 tons. This results in a total material stream of 182.4 tons. Compared to Case 1, this represents a 608% increase in demand for new materials but conversely a 60.9% reduction in waste materials. While this reveals an increased pressure on landfills, more telling is the significant reduction in the extraction of resources needed to produce the new building materials and an overall reduction in the material stream of 74.1%. Case 3 models a growing popular, albeit misguided, approach to “revitalizing” a neighborhood

Case 1: Rehabilitate Original House (2541 sf)

Original House

Materials Demolished :	40,630	(12.0%)
Reused (recycled in place):	298,093	(88.0%)
Total:	338,723 lbs.	
	~169.4 tons	

Rehabilitated House

New Materials Installed:	48,976	(14.1%)
Reused (recycled in place):	298,093	(85.9%)
Total:	347,069 lbs.	
	~173.5 tons	

New Materials Needed:		48,976 lbs. (~24.5 tons)
Construction Waste:	40, 630 + 4,898* =	45,528 lbs. (~22.8 tons)
Total Material Stream:		94,504 lbs. (~47.3 tons)

* 10% of new materials.

Case 2: New House in the Suburbs (2541 sf)

New Materials Needed:	347,069 lbs. (~173.5 tons)
Construction Waste:	17,787 lbs. (~8.9 tons)
Total Material Stream:	364,856 lbs. (~182.4 tons)

Case 3: Demolish House and Rebuild Comparable New House (2541 sf)

New Materials Needed:		347,069 lbs. (~173.5 tons)
Construction Waste:	338,723 + 17,787** =	356,510 lbs. (~178.3 tons)
Total Material Stream:		703,579 lbs. (~351.8 tons)

** 7 lbs./sf. (Source: Center for Environment & Construction, *Implementing Deconstruction in Florida: Materials Reuse Issues, Disassembly Techniques, Economics and Policy*, University of Florida, 2000). *This figure represents the approximate national average.*

Table 2: Comparing Material Streams

which is to demolish existing buildings and build completely new buildings in their place. For direct comparison purposes, Case 3 was formulated on this strategy with the replacement house being considered identical to the original house in size (although a larger house would more likely be built). In this instance no recycled content was anticipated, the demand for new materials was 173.5 tons, and construction waste was

178.3 tons. This results in a total material stream of 351.8 tons. This indicates that Case 1 has an 86.6% reduction the material stream versus the material stream in Case 3.

Reducing Hazardous Contamination. Contamination concerns in older housing relate to lead, asbestos, and indoor allergens. Testing revealed lead in two forms in this house—lead piping and lead-based paint. The house main water line was made of lead and the supply lines used lead-base solder in the joints. All plumbing was replaced with new PEX lines. A high efficiency whole house water filter was installed to remove 99.9% of water-borne lead and other contaminants and the main service was replaced with a new copper line. The lead paint was removed from all interior surfaces and disposed of following health department guidelines. Samples of linoleum, ceiling tile, and insulation tested at a local testing lab verified there was no asbestos content in them. The problem of indoor allergens was addressed by including a high efficiency filtration system in the furnace and selecting finishes that minimize the use of synthetics.

Financially Competitive. The overall cost was $214,500. Of this amount, $209,000 qualified for preservation tax credits. Without tax credits the cost translates to $84.42/sf. and the tax credit reduces it to $67.97/sf. Including the cost of the property and the benefit of tax credits, the overall cost was $119.13/sf. These numbers compete well with remodeling costs and new construction costs and validate that it is possible to reuse the built environment, even one in an historic district, and be financially competitive.

Concluding Comments and Discussion

The concepts of sustainability, stewardship, and preservation have gained increased visibility in the past fifteen years. Surprisingly, all have moved along parallel paths without significant interaction and each in its own way substantiates the goal of long term viability of the built and natural environments. Sustainability recognizes the need to do things in the present that can protect the future. Stewardship recognizes the trade offs that need to be assessed to protect both the natural and built environments. Preservation recognizes the importance of understanding the past while promoting older buildings as part of the future of the built environment. The G.H. Schettler house rehabilitation shows that all three perspectives are compatible with one another. The sustainable aspects demonstrate how existing building stock can fit into promoting redevelopment within the urban core and thereby promote long term revitalization. Extending the idea that this house is typical of a great many in the city and then the nation shows that appropriate stewardship can cultivate a renewed social and economic vitality in the community while reducing the net cycle of extraction and consumption at the national level but on the individual scale. And lastly, the integration of the preservation financial incentives directly helps make the process even more acceptable from an economic perspective while fostering the retention of our cultural roots.

With the further recognition at a broader scale of the synergies that these three concepts interactively generate, a longer term sustainable built environment can be realized. Through the appropriate stewardship of both the natural and built environments, the relationship between reused buildings and the retention of a healthy natural environment will become increasingly evident. Through recognition of the social and economic values offered by historic preservation, the connections of the cultural past to the future societal viability of reused buildings can result in the reduced pressures of expansion at the suburban periphery and renewed use of the urban core. Individually, each is a potentially significant strategy to undertake but collectively they form a synergistically coherent perspective that can hold a tremendous potential for (re)shaping a sustainable cultural landscape and ecosystem.

References

American Society of Heating Refrigerating and Air-Conditioning Engineers. (2001). *AHSRAE Handbook of Fundamentals*. Atlanta: ASHRAE.

Center for Environment & Construction. (2000). *Implementing Deconstruction in Florida: Materials Reuse Issues, Disassembly Techniques, Economics and Policy*. Gainesville: University of Florida.

Dwight, P. (Ed.). (1993). *Landmark yellow pages*. Washington: The Preservation Press.

Lucy, W., & Phillips, D. (2000). *Confronting Suburban Decline*. Washington, DC: Island Press.