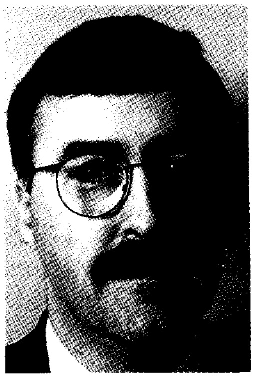
UNDERSTANDING THE VALUE OF REUSING EXISTING BUILDINGS: THE FRONT LINE OF SUSTAINABLE BUILDING PRACTICES



Douglas McRoberts McKean, AIA - B. Env. Design, M.L.A., M. Arch.

Douglas McKean is a Registered Architect with a background in the private practice of architecture, facilities management, and Value Management (VM). He is an Associate with Beyer Blinder Belle Architects and Planners LLP (BBB) in New York, and is the project manager for the restoration of Grand Central Terminal. Before BBB he was the Associate Director for Project Development and Design at Yale University and in 1992 founded Design Constructs, a VM consulting firm, specializing in sustainable design, preservation and adaptive reuse practices and technologies.

ABSTRACT

This paper advocates the need for value specialists to become part of the process of encouraging sustainable design practices. Through an understanding of the "value" of the reuse of existing buildings, the goal is to provide a foundation for the consideration of building reuse, in lieu of new construction, and to disseminate information about VM tools which aid in making informed decisions about sustainable buildings.

INTRODUCTION

Let's see a show of hands, if you were given a choice by a client whether to build a new building or reuse an existing one, which would you recommend? If I guessed right the majority of value specialist and design professionals would answer that they would recommend to the client that a new building would be a better value.

I challenge you all today to open your minds to a broader vision of Value Engineering (VE) - beyond first costs, life-cycle costs, and 'cradle-to-grave' costs are *'cradle-to-cradle'* costs! What I am encouraging is that the meaning of "value" which is in the textbooks needs to be expanded to cover the true cost of construction.

With all of the collective wisdom that goes into the design and engineering of today's buildings, why aren't they any better - better built, better to use and better on the environment. There are a lot of different factors which influence why our buildings are the way they are - one of them may just be a lack of common purpose and sense of responsibility. In the words of the Great Law of the Iroquois Confederacy -

o

'In our every deliberation, we must consider the impact of our decisions on the next seven generations.'

o

Construction for the seventh generation means that environmentally sound, sustainable building practices are employed through the reuse of existing buildings, to be socially and environmentally responsive to those who will come after us, by evaluating the impacts of our material and systems decisions on future generations. All too often existing buildings are torn down for new ones in the first years of their *first* life cycle - one of the 51 Frank Lloyd Wright designed buildings which has been demolished was here in Chicago - Midway Gardens - which was torn down only 15 years after it was constructed and replaced by a gas station and car wash.[1]

Preservation and the reuse of older buildings has long been synonymous in the United States with 'fringe' people marching to save a building to which they have an emotional attachment. It is time that the true *value* of renovation, preservation, restoration and adaptive re-use takes center stage - for they <u>are</u> the front line of sustainable design!. Each building which stand today represents a committment of valuable resources. Can we really afford to take the embodied energy which we have stored in our building stock and throw it into yet another landfill? Approximately 60% of landfills are taken up by construction related debris - far exceeding any other type of waste.

The key to sustainable design is having the proper information to make informed decisions and the key to defining "value" is understanding the broadest ramifications of our decisions - in contrast to standard building practices and expanding on current value engineering methodologies. Building the most economical life cycle cost building is a flawed concept if the analysis does not take into account the validity of the building through 'seven generations.' It is time for more than the real estate market to drive our definition of value and worth - we as design, engineering, and VM professionals must understand and shape the way resources are used.

The valuable resource of embodied energy which is resident in existing buildings should not be wasted! The energy embodied in existing buildings is documentable and should be used in analyzing the true cost and value of buildings. Too often - for many reasons ranging from ego to lack of understanding - buildings are torn down to make way for more "modern" buildings without recognizing and analyzing the worth of the existing construction.

The goal of this paper is to expand the role of VE and design professionals, giving the fields even greater significance by basing decisions on more than just dollars - I suggest that what is needed is a miniature environmental impact statement, taking into account:

- Energy Costs of Manufacturing
- Environmental Costs
- Recycling vs. Landfill Costs
- By-Product Treatment Costs
- Minimization of New Resources

DEVELOPING A CRADLE-TO-CRADLE MENTALITY

It matters not whether the building's systems are approaching the end of their first life cycle or have undergone renovation previously, we have a responsibility to challenge the normal 'build and demolish' cycle. Some of the buildings which are the least sustainable are those which were built within the past 40 years and of those buildings the ones built in the mid-70s are now approaching the end of their first life-cycle! We are on the brink of some great opportunities!

The valuable resource of non-renewable building materials which is resident in existing buildings should not be wasted! Because many of the buildings built within the last 30 years were built with a turnkey mentality, where cheap buildings were constructed for quick sale or lease in a fast-growing business climate - without consideration for long term cost considerations of any kind - energy, operating, or maintenance - who bothered to ask how much this cheap construction was going to cost in the long run? All of us will have the opportunity - and I would state, the responsibility - to correct on the wastefulness of the recent past through the reuse *and refinement* of existing buildings.

○

"To restore a building is not only to preserve it, repair it, or to rebuild it, but to bring it back to a state of completion such as may never have existed at any given moment."

-- E. E. Viollet-le-duc
Dictionaire raisonne, 1854-68

○

In general, preservation, restoration, renovation, and adaptive reuse projects are what I refer to as the front line of sustainable design, because they are our chance to make the "seven generation" philosophy a reality. I offer the following examples of how the reuse of existing buildings demonstrates *real* value:

<u>Preservation / Restoration:</u>

One example of a preservation project's impact on sustainability is the restoration of Grand Central Terminal which has resulted in some planned reconfigurations to the historic landmark to allow it to serve the needs of the building's changed use - to serve as a vital urban center and transportation hub into the next century. Once a combination of three stations - for incoming long distance trains, outbound long distance trains and suburban commutation trains - the station now serves primarily one function, as a commuter train station serving nearly 500,000 passengers each day.

The reconfigurations to Grand Central called for new marble walls to match the historic fabric. At the same time, underutilized areas were planned for selective demolition. The marble from these "dismantled" areas is planned for "quarrying" to be reused within the Terminal - saving energy, environmental degradation and money.

This idea is sustainable, beyond merely reusing the old core and shell and beyond merely restoring the historic finishes. There are aesthetic, energy, environmental, and non-renewable resource reasons why the planned reuse of the "historic" marble - quarried only two generations ago - is a sustainable building practice.

Our specifications for the project define the quarrying of marble from within the building for reuse. The marble which will be quarried is from areas of the building which are being dismantled (there is that word again) because the function which they served originally is no longer required. So rather than have it cut into pieces and sold as paperweights like many historic building's which have been demolished over time, the 80 year old marble panels are being disassembled, measured and tagged for reuse on new wall areas throughout the Terminal and as patches where existing stone has been damaged. It is estimated that the reuse of existing stone will save nearly a million dollars over quarrying and shipping new stone from Italy to match the existing Bottacino Marble. The embodied energy and amount of fossil fuels which were saved by not quarrying and shipping new stone are documentable and substantial.

Even pieces which are broken during dismantling will be reused - to produce patches in areas such as where electrical outlets have been abandoned. So the marble which, in another day and time, might have been cut up and sold as souvenirs (were it not for the preservation efforts Jacqueline Onassis and many others, which saved Grand Central from demolition) will instead serve as a *primary* source of stone for the project.

<u>Adaptive Reuse Projects:</u>

To prove that what Montaigne said many years ago, "We are all of us confined and enclosed within ourselves, and see no farther than the end of our nose"[2] I'll cite a few examples of the lack of sensitivity to building reuse issues from this century. Back in the 1970's, as a military branch of the government was about to transfer a group of historic buildings to the National Park Service for preservation and adaptive reuse, the capital program of the military branch called for the replacing of the historic slate roofs with shingle roofing. The Park Services' attempts to cancel the bids for the roof replacement were denied. Consequently, the historic fabric was lost forever and an improperly detailed asphalt shingle roof was installed - only to have to be replaced in less than its projected useful life.

Unfortunately the lack of vision about existing buildings is not limited to owner type and does not only imperil historic buildings. In the mid 80's, less than five years after construction of the model units, I am reminded of a brand new condominium townhouse development which was torn down for yet another 'spec' office building.

<u>Renovation</u>

A. A Prototype Project

On the bright side, Audubon House, the headquarters building for the Audubon Society in New York City, is a prime example of what this talk is all about - reusing buildings as the front line of sustainable design. It is a model project from which we can all learn. In example after example, from window selection to mechanical systems design, the Audubon House proved that the principal that the reusing buildings is a cost effective, sustainable building practice - and the architects were lucky enough to have a client that wanted documented evidence of same - which is now published in *Audubon House*.[3]

As noted in the book, the project "recycled" in-place "300 tons of steel, 9,000 tons of masonry and 560 tons of concrete. Had the building been demolished, under conventional contract these materials might well have ended up in landfills . . . The preservation of an existing building thus not only represented a conservation of material but also embodied energy . . . Beyond the direct environmental benefits, reuse of an existing structure amounted to a gesture of respect toward the community."

I recommend *Audubon House* as a primer in the field.

B. Research and Analysis -
Asking the Right Questions!

Luckily for skilled VM specialists, where the reuse of existing buildings are concerned, all of the answers are not in the textbooks or engineering manuals - the correct answers are often *only* the result of a questioning mind and thorough analysis. An example of the level of analysis required to make the sound decisions required to fulfill the Iroquois Confederacy's "seven generation" paradigm is evidenced in a project for a laboratory in Galveston, Texas.

When originally asked to participate on this project, I was sent two huge binders of documentation prepared which gave an extremely detailed analysis and answers to each of the 10 building's problems - however they were the answers to the wrong questions. The E/A team documented all of the building deficiencies that needed to be addressed, down to filters that needed to be changed in the existing mechanical systems - so what was wrong with that, you might ask? Think of one of the worst things you could do in a moisture laden environment - expose metal, mechanical systems to the constant corrosive forces of the seaside environment. I asked the facilities director on site some probing questions and, to my great interest, he noted that the outdoor condensing units which most of us have outside our house and which normally last 12 to 15 years - rot out in 2 to 3 years in the Galveston environment - putting an extreme burden on the laboratory's operating budget.

The E/A team produced a Life Cycle Cost (LCC) analysis that didn't take this into account, which resulted in a recommendation that this system was the most economical air conditioning solution. After the input of the short life of the outdoor condensing units was taken into account, the analysis showed that the condensing unit was the *most expensive* life-cycle cost solution by nearly $400,000 or a 30% premium - so much for straight textbook solutions.

So in defining a new direction for the impending renovation, a ground water source heat pump system was recommended - based on the premise that there would be no exterior equipment exposed to the harsh environment and that it would be a more sustainable technology.

D. Reconfiguration

While working for Yale, formulating the capital projects, I noticed an interesting renovation occurring at one of the urban housing projects in town. These half abandoned, dilapidated buildings were being transformed - and not only that someone had come up with a terrific LCC solution to the perennial roofing problems of leaky flat roofs - they put on new pitched roofs - thereby lowering re-roofing costs *forever* (not to mention reducing maintenance costs and nearly eliminating flashing)!

Just down the road, Yale's multi-billion dollar deferred maintenance program from a large number of 30 to 60 year old, under-maintained buildings places a huge burden on the capital program and facilities staff to make wise long term decisions, with limited resources. As a result of the observed success of the housing project's re-roofing, estimates were prepared for a number of dormitory buildings comparing a straight roof replacement of the existing flat roofs against installing a new wood trussed roof system, and then a LCC analysis was performed. Although the new trussed roof was a more expensive, first cost solution, the savings became apparent at the very next roofing cycle - imagine the savings through seven generations!

Recycling

Just reusing buildings is not enough, however, because renovation of say therma-pane windows every 20 years means that the old ones come out and *must be recycled*.

Recycling of demolished materials is an important part of the reuse of existing buildings. As noted in *Audubon House* "recycling for many . . . materials is still in its infancy, and only the metals 'broke even' on a balance sheet; other materials had an associated recycling cost. However, the cost of recycling was *less* than Audubon would have paid for dumping. As markets expand for recyclables, it is likely that in the near future recycling building materials will turn a profit for owners."[4]

The front end of every specification should make it mandatory that all dismantled building material be recycled (except hazardous waste, of course). Notice I again used the term dismantled - not demolished, or even selectively demolished - because most existing specifications don't call for the orderly dismantling of materials so that they can be recycled.

On my train ride to work each day, I pass untold numbers of abandoned buildings. Each month another one or more is bulldozed into a heap - concrete mixed with steel, mixed with brick, mixed with sheet metal, and so on. It is no wonder that all we can do with this material is to fill up another landfill with it - yet until the bulldozer arrived, it was all neatly stacked and piled and separated - right where someone put it not 40 years ago.

CRADLE-TO-CRADLE ANALYSIS

I don't know about you, but I find it hard to fit everything into the neat little boxes that are developed on most forms, whether they are developed for my 401k plan or LCCs. Because I could not find "the box" to input all of the information I believe to be necessary to analyze the true cost of construction, I went looking for a way to accommodate information such as environmental impacts and waste / byproduct analysis into life-cycle analyses.

Numerous modeling tools are available to analyze cradle-to-cradle costs - or at least parts of the story.

A. SETAC Life-Cycle Analysis

The Society of Environmental Toxicology and Chemistry (SETAC) has developed a life-cycle assessment program which goes beyond the normal first cost, maintenance cost, operating cost models to include recycling costs.[5]

Due to the fact that the SETAC life-cycle assessment program is somewhat cumbersome and that some of the information needed to use it is not readily available, many industry, design and engineering professionals have developed more rudimentary sustainability assessment tools and analysis techniques.

B. DOE-2 Energy Use Simulator

The Department of Energy and the Electric Power Research Institute have developed the DOE-2 Energy Simulator which takes into account, and documents with relative ease, energy consumption alternatives - quantifiable characteristics - such as longitude, longitude, building shape and materials, fuel and equipment types.[6]

C. "Evolve" Program

As noted in a recent article in *The Sunday (London) Times,* Doug Cawthorne, a British trained architect who has turned to computer modeling, is developing building modeling software which "mimics the theories of Charles Darwin". A research associate at Cambridge Architectural Research, Cawthorne is refining a computer program which "creates eight 'offspring' buildings which differs slightly from each 'parent'. All are tested against some quantifiable aspect of building performance, such as peak summer-time temperatures, levels of light or construction cost. The offspring that best fits the ideal can be selected as the new parent for another generation of designs. The architect can then carry on breeding generations of buildings and selecting high-performance buildings for as long as he or she likes until the ideal design emerges."[7]

All this using a program which takes only 16 megabytes of memory and produces 8 offspring in less than 30 seconds! Imagine the VE sessions of the future - entering architects CAD (computer-aided design) drawings into the Evolve program and walking away from the VE sessions with that kind of documentation!

D. Environmental Simulation Center

Another computer simulation program which may aid in the reuse of existing buildings was developed by the Environmental Simulation Center of the New School for Social Research in New York City. Their program depicting "the kind of office floors (in Manhattan) that might be candidates for residential conversion"[8] was recently written up in *The New York Times*.

But think of the pro-active, "value engineered" management and marketing tool this software could be for a wide variety of professionals if programmed with the type of construction or the age of the various building systems / components of any given city. Perhaps this software would be titled "Full Employment Software for Design and Engineering Professionals" because using this software architects and engineers would be able to target potential clients based on their specific talents (curtain wall replacement, mechanical systems retrofitting, etc.) and market their services based on the fact that the various elements of the building were at the end of their life cycles, even before the building owners had put out an Request For Proposal for services.

E. Sustainable Design Assessment Profiles

In the development of the Audubon House, "snap shot" impact assessments were produced, such as this one which analyzes the impacts of various chillers.

As noted in *Audubon House*, Table #1[9] compares the environmental impacts of a conventional code-compliant building with an electric chiller (based on New York Power Pool sources of energy) vs. the energy-conscious, Audobon House with a Gas Chiller.

Table #1:	Electric Chiller	Gas Chiller
Nitrogen Oxides	9.3	1
Carbon Dioxide	3	1
Carbon Monoxide	9.1	1
Sulfur Dioxide	13	0.01
Total Suspended Particulates	4.2	0.1

Volatile Organic Compounds	0.7	1
CFCs	2.4	0
Nuclear Waste	2.4	0
Habitat Loss	2.4	Approx. 0

Another form of miniature environmental impact statement is one I developed based on the AIA Environmental Resource Guide's criteria of sustainability, as illustrated in Figure #2 which analyzes the Grand Central marble quarrying scenario discussed previously.

Until base information becomes more readily available as to the exact quantities of each of the categories, noted in the AIA ERG's criteria, we will all have to work with less than perfect information and, therefore, the documentation we can offer our client's will be less than it should be, but until we define the information we need, it will have to suffice.

F. Other Resources

We must share all of the resources we develop, because of the results if we don't. In addition to the computer programs previously discussed, I recommend the following published or computer accessible documents:

- The National Park Service's Sustainable Design and Construction Database
- AIA Environmental Resource Guide
- Audubon House

Additionally, as many of you undoubtedly know, rebates are available to building owners from utility companies which specifically relate to the reuse of existing buildings and can mean real money! For the laboratory in Galveston it will result in $100,000 rebate every year of the multi-year building project.

The Department of Energy also provides grants to demonstration projects to further conservation efforts, I hope you will help me help the DOE spend every dollar which is available in the name of building reuse and sustainability.

CONCLUSION

It is imperative that we make existing buildings work for the future - for without this vision there is no value in what we are building. We must make the conscious transition from a building construction environment where 'making up our minds' is confused with 'making a decision based on what is good for the next seven generations.'

We need to start making buildings which are intended to last 200 years and to think beyond cradle-to-grave life-cycle costs. As I have tried to impress upon you today, reusing buildings where we have already made a hefty commitment of valuable resources should be our first priority. As the Audubon House project showed, and as many other untold reuse project's stories would attest, reusing existing can be cost effective when compared to the normal cradle-to-grave cycle of building and demolition.

In the words of Dr. James Marston Fitch from *American Building: The Environmental Forces That Shape It,* (first written some 50 years ago) "How is it possible that with the world's most advanced technology, our buildings and cities fail to provide the health, comfort and beauty which we have every right to expect from them?"[10]

Hopefully, the attitudes, techniques, and tools I have discussed today will nullify another of Dr. Fitch's statements in that book, where he noted that "few architects today are able to anticipate the full consequences"[11] of the buildings they create and the environmental forces that impact upon it.

VE analyses involving existing buildings have been hampered by a three to five year payback paradigm propagated by a mentality that the only good payback is a short payback - a mind set that we can all no longer afford. Our generation must be *the* generation that makes the Iroquois Confederacy's vision a reality. Hopefully, another show of hands given the 'new construction versus building reuse' question would find some converts in the crowd, or at least some value specialists who will remember that "In our every deliberation, we must consider the impact of our decisions on the next seven generations."

o

"Make no little plans! They have no magic to stir men's blood."

-- Chicago Architect, Daniel Burnham

REFERENCES

1. Lind, Carla, *Frank Lloyd Wright's Lost Buildings,* An Archetype Press Book, Pomegranate Artbooks, San Francisco, 1994.

2. Jackson, John B., *The Necessity for Ruin,* University of Massachusetts Press, Amherst, MA, 1980.

3. National Audubon Society & Croxton Collaborative, Architects, *Audubon House: Building the Environmentally Responsible, Energy-Efficient Office,* John Wiley & Sons, NY, 1994, p.

4. Ibid, p. 136.

5. The American Institute of Architects, *Environmental Resource Guide*, Washington, DC, 1992.

6. Ibid 3, p. 168.

7. Glaskin, Max, "Architects build on Darwinism", *The Sunday Times*, London, England, December 3, 1995.

8. Dunlap, David W., "Bringing Downtown Back Up", *The New York Times*, Real Estate Section 9, Page 1, New York, October 15, 1995.

9. Ibid, p. 108.

10. Fitch, James M., *American Building: The Environmental Forces That Shape It,* Houghton Mifflin Co., 1972, book jacket.

11. Ibid, book jacket.

SUSTAINABLE DESIGN ASSESSMENT PROFILE

Fig. #1

PROJECT: **GRAND CENTRAL TERMINAL**

ISSUE: **WALL MARBLE FOR PANEL REPLACEMENT AND NEW WALL AREAS**

OPTIONS:	PROCURE NEW MATERIAL		REUSE EXISTING MATERIAL	
AESTHETIC ISSUES		*Value*		*Value*
Appearance	Grain and color match issues to match existing adjacent 85 year old stone.	-	Minor grain and color match issues.	+
Durability	Meets Specification	+	Meets Specification	+
Appropriateness	Meets Specification	+	Meets Specification	+
TECHNICAL ISSUES				
Maintainability	Equal to original	+	Original Fabric	+
Availability	Available from Italy through a protracted procurement process	-	On Site	+
Product Quality / Manufacturer's Reputation	Equal to original	+	Original Fabric	+
Recyclability	100% recyclable	+	100% recyclable	+
LIFE CYCLE COST ISSUES				
First Cost	$80 per square foot	-	$40 per square foot	+
Operating / Maintenance Costs	Minimal	+	Minimal	+
Length of Useful Life	More than seven generations	+	More than seven generations	+
Recycling Costs	Moderate	°	Moderate	°