STRATEGIES FOR A SUSTAINABLE RENOVATION: THE LAMAR DODD BUILDING

by

LAUREN DEAN COLUNGA

(Under the Direction of Hank Methvin)

ABSTRACT

This thesis explores the development of a course of action for the sustainable renovation of the Lamar Dodd Building for the College of Environment and Design at the University of Georgia. The term *sustainable design* is defined and the decision making processes, methods of implementation, and technologies used in previous sustainable renovations are examined (Audubon House, Barney-Davis Hall, the Greening of Dana, and Oberlin University). A course of action for the renovation is then developed by looking at opportunities for sustainable decision making during the design process, followed by recommendations about how to use sustainable technologies as educational tools. I conclude by addressing the limitations of my research and suggesting possibilities for future exploration.

INDEX WORDS: Lamar Dodd Building, College of Environment and Design, Sustainability, Sustainable Renovation, Design Process, Audubon House, Barney-Davis Hall, Dana Building, Adam Joseph Lewis Center for Environmental Studies, Oberlin University.

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DEDICATION

I would like to dedicate this thesis to my husband, Nathan. He is the love of my life and was the source of my motivation, even if from afar. This has been a difficult time for both of us, but we made it through. We knew that we could do it and we did it. Thank you for all of your support and patience. I can't wait to spend the rest of my life by your side. I love you.

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Thank you to my mother and father for always believing in me and telling me that I could accomplish anything I put my mind to and thank you the rest of my extended family for their support during the entire graduate school process.

Without my closest friends and the support of my classmates none of this would have been possible. I would especially like to thank Lauren Brandes, Eleonora Machado, and Jennifer Martin Lewis for their support, wit, and trivial pursuit prowess. Thanks for keeping me sane.

Finally, I would like to say thank you to my husband Nathan. He endured a separation from me for two and half years because he knew that this degree is what I really wanted. I am deeply grateful for his support and faith in me. Thank you.

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CHAPTER 1

INTRODUCTION

PURPOSE OF THE STUDY

The goal of this thesis is to develop a course of action for the sustainable renovation of the Lamar Dodd Building. I begin by defining the term *sustainable design* and then examine the decision making processes, methods of implementation, and technologies used in previous sustainable renovations. After this examination I develop a course of action for the renovation by looking at opportunities for sustainable decision making during the design process, followed by recommendations about how to use sustainable technologies as educational tools. I conclude by addressing the limitations of my research and suggesting possibilities for future exploration.

BACKGROUND

The merger of the School of Environmental Design with the Institute of Ecology presents a unique opportunity to form an innovative partnership in education. The new College of Environment and Design (CED) formed by this merger will allow a true interdisciplinary approach between the fields of design and ecology. Goals of the new college include interdisciplinary research, the creation of a mixed use campus, implementing the use of sustainable practices and technologies, and using the entire campus as an interdisciplinary learning laboratory.

To house the new CED, a new campus plan is being designed that takes advantage of existing buildings and site assets while also generating new spaces for learning and social interaction. The final design of the campus will on the learning experiences of all students,

and it is for this reason that the campus design should be a visionary example of what the future holds for this pioneering combination of academic departments.

Ecology and landscape architecture are fields in which sustainable and environmental issues are key points of emphasis in research and design, making this connection between the two disciplines an important consideration in the design of the new campus. The proposed site of the campus affords the CED the opportunity to explore sustainable design in the construction of its new buildings and in the renovation of existing structures. Designing an entire community of interconnected sustainable buildings through a combination of adaptively reusing buildings and new construction is truly a ground breaking step in the field of sustainable design and has very little precedent. The CED has the unique capacity of using this campus design process as a learning opportunity for its students and the surrounding community.

However, the renovation process raises some important questions regarding the installation of new technologies and modifications to existing materials. One of the most important is: what are the conflicts between preservation of a building and the application of sustainable methods and technologies?

One of the goals of this paper is to examine the recent convergence of the fields of historic preservation and sustainable design in the renovation of existing structures. While there are sometimes differences between the two fields, there is an emerging consensus that the disciplines are closer than previously thought in terms of collaboration. Although there are still several possible areas of concern between building preservation and sustainable renovation, the benefits seem to outweigh the negative impacts. For example, the negative impacts from the renovation of a structure might include:

- Loss of layers of building history built up over time,
- Modification of building elements (may replace materials that are significant representations of the time that the building was constructed), and
- Having to work within a pre-designed framework.

While sustainable renovation allows the possibility of:

- Replacement of outdated systems and elements with recent technologies that improve worker health, indoor air quality, the effectiveness of building systems, and connection to the outdoor environment,
- Better ability to achieve the original program of the building,
- Cross disciplinary educational opportunity between design fields,
- The opportunity to educate building users and community,
- Reuse of a historically distinct structure, and
- Savings in money and resources from recycling and reuse of materials.

The actual results of several sustainable renovations will be examined in the following chapters and will help inform the development of a site specific design process for the renovation of the Lamar Dodd Building.

THE LAMAR DODD BUILDING

The Lamar Dodd School of Art on Jackson Street will be one of the first buildings used to house the new College of Environment and Design (CED). This building has one of the most unique architectural designs and layouts on the University of Georgia (UGA) campus, largely due to the vision of Lamar Dodd, the UGA professor responsible for the building's inception and design. Lamar Dodd envisioned the building as an inspirational learning environment "in which to instruct imaginative artists, not today's onrushing army of sure young scientists" ("A Stage"). However, over time the building has been modified to meet the changing needs of its users and to correct problems with the original building plan.

Once again, with the building becoming the new home of the new CED, the building will undergo further modification. This time though, because of a significant shift in the programmatic needs of the new users, the building requires modifications that are far greater than those of the past. Apart from programmatic changes, the building itself could

greatly benefit climatically, financially, and in terms of energy consumption from the installation of new technologies. With the addition of these technologies the building itself can serve as a learning environment that teaches everyday lessons to building users by demonstrating the use of sustainable technologies that are so often espoused inside the classroom, but rarely seen in practice in the everyday university environment.

In order to determine the most appropriate sustainable technologies and the best implementation methods for the Lamar Dodd Building, a definition of what sustainability means to the college must have advance agreement. This definition will determine the direction and the extent of the sustainable development of the new campus and will be a benchmark against which successes and failures can be measured. It is for these reasons that the first item addressed in this thesis is how the concept of sustainability should be defined in the specific context of the Lamar Dodd renovation.

DEFINITIONS OF SUSTAINABILITY

The word *sustainability* and its derivatives have a myriad of definitions:

Sustain:

- "To cause to continue (as in existence or a certain state, or in force of intensity); to keep up, especially without interruption diminution, flagging, etc.; to prolong." Webster's New International Dictionary (Sustainable Measures).

Sustainable Design:

- "The set of perceptual and analytic abilities, ecological wisdom, and practical wherewithal essential to making things that fit in a world of microbes, plants, animals, and entropy. In other words, (sustainable design) is the careful meshing of human purposes with the larger patterns and flows of the natural world, and careful study of those patterns and flows to inform human purposes." David Orr (Dunstan).

Sustainable Development:

- "Development that meets the needs of the present without compromising the ability of future generations to meet their own needs." The Brundtland Commission (Sustainable Development).

• "Sustainable Development is positive change which does not undermine the environmental or social systems on which we depend. It requires a coordinated approach to planning and policy making that involves public participation. Its success depends on widespread understanding of the critical relationship between people and their environment and the will to make necessary changes." Hamilton Wentworth Regional Council (Sustainable Measures).

Sustainable Actions:

• "Actions are sustainable if : 1) There is a balance between resources used and resources regenerated. 2) Resources are as clean or cleaner at end use as at beginning. 3) The viability, integrity, and diversity of natural systems are restored and maintained. 4) They lead to enhance local and regional self-reliance. 5) They help create and maintain community and a culture of place. 6) Each generation preserves the legacies of future generations." David McCloskey, Professor of Sociology, Seattle University (Dunstan).

Other:

"A thing is right when it tends to preserve the integrity, stability, and beauty of the biotic community. It is wrong when it tends otherwise." Aldo Leopold, A land Ethic, from A Sand County Almanac (Dunstan).

As shown by the list of definitions above sustainability is a difficult word, or concept, to define. The lack of a concise definition creates confusion, even among professionals, leaving outsiders to wonder about the validity of a concept which cannot even be succinctly defined by those advocating it. The Brundtland Commission's definition, "Development that meets the needs of the present without compromising the ability of future generations to meet their own needs," is perhaps the most well known of all definitions of sustainability (Sustainable Development). However, this definition fails to provide the guidance and ecological framework that those unfamiliar with the concept of sustainability need when venturing into the world of sustainable design. When it comes time for a business, organization, person, or university to put the concept of sustainability into practice a more concrete distinction is needed between what is considered sustainable and what is not.

Several of the above definitions break down the concept of sustainability into a series of factors including social, economic, and environmental. I agree with these delineations,

but would add technological and humanistic considerations to the list. By humanistic I mean the considerations of design at the scale of an individual person as opposed to looking social considerations. When these aspects are combined, this gives someone contemplating sustainability five facets to look at: social, humanistic, technological, environmental, and economic. Each of these five factors represents an aspect of sustainability that can then be considered individually, be used to define and measure goals, and can allow the definition of sustainability to adapt to the needs of a particular place and time. While these five factors provide a convenient way to analyze different aspects of sustainability, care should be taken to emphasize each consideration in proportion to the others and compromise when necessary. Having a statement of the overall sustainability goals for a project will help guide smaller decisions along the way and provide a central focus.

Having delineated five aspects of sustainable design, it is necessary to provide a framework of sustainable principles to guide the planning and decision making process. William McDonough has generated a list of considerations called *The Hannover Principles* that provide a useful framework for comprehending the relationship between man and the environment and how to make this relationship a healthy and productive one:

1. Insist on rights of humanity and nature to co-exist.
2. Recognize interdependence.
3. Respect relationships between spirit and matter.
4. Accept responsibility for the consequences of design.
5. Create safe objects of long-term value.
6. Eliminate the concept of waste.
7. Rely on natural energy flows.
8. Understand the limitations of design.
9. Seek constant improvement by the sharing of knowledge. (Sustainable Development)

These principles are meant to guide the decision making process, and purposefully do not give specific actions to be taken. Instead McDonough prefers to let companies and organizations "determine how to apply them, how to measure their success or failure, and

how to continually improve with the same set of principles in mind"(Sustainable Development). In this way organizations are free to innovate and not feel limited by a particular set of processes, methods, or technologies.

In conclusion, I have chosen not to add to the plethora of definitions and to limit myself and this project to a one sentence explanation of sustainability. When I address the concept of *sustainable design* in this paper I am referring to the process of solving problems by considering their social, humanistic, technological, environmental, and economic aspects and basing decisions regarding these factors on The Hannover Principles stated above.

DESCRIPTION OF CASE STUDIES

Although sustainable building design so far has mainly focused on the construction of new buildings there are some notable precedents of sustainable renovation. Some of these examples are in academic settings and are excellent sources of information on different design processes, methods of decision making, maintenance policies, and post-construction management. I chose the following case studies based on their relevance, location, and integration of sustainable technologies and processes:

AUDUBON HOUSE

The National Audubon Society selected Audubon House for its new national headquarters in 1990. By being one of the first nationally known corporations to perform a sustainable renovation of an urban building the National Audubon Society set a realistic design example for other organizations to follow. Because they required an economic justification for expenses, used interdisciplinary teamwork from the beginning, and put environmental criteria at the forefront of their decision making process the Audubon society created a realistic design framework for others to analyze and learn from.

BARNEY-DAVIS HALL

The students and faculty of the McPhail Center for Environmental Studies at Denison University took full advantage of the renovation of Barney-Davis Hall as a learning opportunity. Students were actively involved in design process, implementation, and management of the renovation and were entrusted with creating and maintaining a website of the project's progress and performing a post occupancy evaluation of the site. By fully integrating the Barney-Davis renovation into the curriculum, the project became an important real-life exercise in design, sustainability, and experimentation for students and faculty to learn from.

S. T. DANA BUILDING

In deciding to renovate an almost 100 year old building to house its School of Natural Resources and Environment, the University of Michigan made the unique and influential decision to hire a historic preservationist to oversee the building's renovations. By combining the expertise of Quinn Evans Architect (the historic preservationist) with the sustainable vision of the design firm of William McDonough + Partners the school undertook the challenge of maintaining "the century-old building's historic integrity and appearance while creating an environmentally conscious design appropriate for 21st century uses" ("An Architectural").

ADAM JOSEPH LEWIS CENTER FOR ENVIRONMENTAL STUDIES

The Adam Joseph Lewis Center (AJLC) for Environmental Studies at Oberlin University has been called the "most ecologically sound academic structure in America"(Janas). To earn this distinction the students, faculty, and designers of the project had to look beyond the individual sustainable technologies that were available at the time and design the site to work as a system that was greater than the sum of its parts. The most

unique aspect of the AJLC building was the integration of the building with the site. The building was designed to act in concert with its surroundings, and in return the surroundings were designed to enhance the experience inside the building as well as serve as an educational model for learning about sustainable design.

WHAT THESE CASE STUDIES HAVE IN COMMON

All of the case studies presented in this paper have certain elements in common. For example, all of the studies address the problems of improving the building envelope, upgrading their HVAC (Heating, Ventilating, and Air Conditioning) systems, and maximizing the use of natural light. In order to eliminate repetition and excessive length in the coming chapters, I created the chart below to succinctly illustrate how the four case studies each deal with these common aspects of renovation.

Table 1.1 A comparison of the common aspects of renovation from the four examined case studies.

Location/ Information	Audubon House	Barney-Davis	Dana	Oberlin
Building Location	• Built in 1891 • Building Renovation • 1991-1992 • 700 Broadway, New York City, New York.	• Built in 1894 • Building Renovation • 1997-1998 • Denison University, Granville, OH.	• Built in 1903 • Building Renovation. • 1998-present • School of Natural Resources and the Environment, University of Michigan, Ann Arbor, MI.	• January 2000 • New building. • Adam Joseph Lewis Center for Environmental Studies, Oberlin College, Oberlin, OH.
Architects	Croxton Collaborative Architects. Flack and Kurtz Engineers Environmental Science: Dr. Jan Beyea	HJRL Architects. Lincoln Construction.	Quinn Evans Architects (Historic Preservationists) with William McDonough and Partners. Ove Arup and Partners Engineers.	William McDonough and Partners Architects. Rocky Mountain Institute. John Todd (Living Machine). John Lyle with Andropogon Associates (landscape). David Orr.

Location/ Information	Audubon House	Barney-Davis	Dana	Oberlin
Building Size (Sq. Ft.)	98,000 sq. ft.	28,000 sq. ft.	Original Building 39,000 sq. ft.; 11,000 sq. ft useable space and 2,250 sq. ft. mechanical space added during construction.	13,600 sq. ft.
Cost per SF.	Building: $10 million. Renovation: $14 million ($142 per sq. ft. fully loaded(	$4.5 million total. $160 per sq. ft.	$25 million total.	$14 million. $357 per sq. ft.
Construction and Waste Management	• Separation and recycling of building materials: scrap metal, wood, masonry •	• Reuse of original building materials when possible, and recycling of them when not • Contractor materials had to have an MSDS non-toxic rating	• 5,000 brick pavers salvaged and reused in atrium • Recycling center picked up materials • Reused approx 60% pine wood from attic for wood trim and new furniture • 350 original ash wood doors stripped, refinished and reused • Require contractors to pay for their electricity use	• Proper ventilation during construction • Construction sequencing to limit exposure of materials to toxic compounds • Review of product submittals
Recycling	• Chutes installed in building for sorting recyclable to collect in basement • office composting • Recycled plastic countertops • Ceramic floor tiles from recycled light bulbs • Drywall of recycled newsprint and gypsum	• Carpet, ceiling tiles, insulation, see POE section 2 • restored and reused wood floors, doors, cabinets, shelves, floor tiles • Carpet made from recycled plastic bottles	• Fully recyclable ceiling tiles • Compost bins placed throughout building • Three composting toilets added • Recycled PET fabric • 100% HDPE partitions and countertops • Recycled rubber flooring • Bamboo flooring • Natural cork flooring • Natural Linoleum flooring • 100% wool carpet	• Flooring leased from Interface and will be returned when it is worn • Recycled materials: steel framing, aluminum roof windows, ceramic tiles, toilet partitions • Raised floors for easy maintenance access • Waste water recycled through a Living Machine® and reused in the building and landscape

Location/ Information	Audubon House	Barney-Davis	Dana	Oberlin
Daylighting, Windows, and Lighting	• Used Task/Ambient approach to interior lighting • Pendant light fixtures • Reflective interior surfaces • Clerestory windows in perimeter offices allow outside light to reach the interior offices • Dimming sensors • Heat Mirror ® windows • Electronic ballast fluorescent lights • Uses .6-.7 watts per sq. ft.	• Removed dropped ceilings, used transom windows, skylights, and uncovered unused windows • Continuous dimming circuits • Occupancy sensors • Fluorescent lights with electronic ballasts • R-9 windows	• Install skylight over atrium • Fluorescent lights with electronic ballasts • Dimming and occupancy sensors • Task lighting	• Efficient lighting system with .9 watts per sq. ft. of lighting load (3) • Occupancy lighting sensors • Daylighting available for all interior spaces
Solar Energy	• Decided not to install photovoltaics because the payback period for the technology greatly exceed the limit decided on. A decision was made to wait until prices went down.	• Building is wired to house a 5 Kwh photovoltaic system in the future • Building goal is to be eventually be completely self sufficient from solar power.	• PV Panels cover the south side of the atrium providing active and passive solar energy• Provides power for 2-3 percent of the building • Building Integrated PV 8.2 kW, approx 2,300 sq. ft. on south part of new roof	• 3,700 sq. ft. array on south facing roof • Designed for replacement when technology advances • Passive Solar heating and lighting around building
HVAC	• HVAC intake located on the roof away from pollution • High efficiency (85%) air filters • Gas fired absorption heater-chiller • Use of natural gas reduces peak electricity demand • High fresh air ratio for interior spaces • Operable windows	• Two stand alone natural gas boilers (one is a backup) for heating that are easily upgraded • No in-house chiller unit; the building uses surplus from a nearby building • Uses forced air and radiant heating	• Radiant cooling: Chilled pipes on the ceiling cool the warm air and sink it the floor	• Closed loop geothermal wells with heat pumps located throughout the building • Atrium is heated through radiant coils in the concrete • Operable windows
Indoor air quality/Non-Toxic Policy	• Low/No VOC (Volatile Organic Compound) policy • Avoidance of plywood, glues, adhesives and objects that emit formaldehyde • 100% natural wool carpet tacked down (not glued) except for on stairs • Air is exchanged 6.2 times an hour	• Low/No VOC (Volatile Organic Compound) policy • Non-toxic policy • Safe cleaning products.	• Low/No VOC policy • Ensured the duct work to be used in the building was kept sealed during construction to prevent allergens from entering • Water based paint stripper used to remove lead based (50%) paint.	• 100% fresh air ventilation for all occupied spaces • Building orientation takes advantage of prevailing wind patterns for ventilation • Indoor air quality studied with a grant from the National Institute of Science and Technology

Location/ Information	Audubon House	Barney-Davis	Dana	Oberlin
Building insulation (thermal shell)	• Insulation: Air-Krete™ used for walls. Made with magnesium and dolomite compounds extracted from sea water and contains no CFC's (R-12 rating) • Heat Mirror® windows with R-4 rating • Roof has an insulation value of R-33	• R-9 window insulation • FOAMULAR insulation with 4.0-5.0 r-value.	• Built in the brick walls with insulation to improve the building envelope	• Roof R-values of 30 and 40 • R-21 masonry walls • Partial berming on the north side of the building • High performance window glazing
Controllability of systems	• Monitored from a central computer • Manual window operation	• Individual room monitoring and control of temperature • Eventually want to install monitor in the lobby for education on building use	• All systems are monitored by a central computer • Individual rooms are adjusted according to user needs.	• Central building control and monitoring • Website display up-to-the-minute data • Sensors for light intensity, wind speed, solar panel energy production, building energy usage, and living machine status
Certified Sustainable Wood	• Must be approved by Rain Forest Alliance	• From sustainable sources	• Must be approved by Forest Stewardship Council or Good Wood Directory	• Must be approved by Forest Stewardship Council
Water saving	• Water saving plumbing fixtures • Sensor activated water faucets	• Water saving plumbing fixtures • Sensor activated water faucets	• Water saving plumbing fixtures • Sensor activated water faucets	Same as previous • Collection of rainwater for irrigation and reuse
Energy Use	• Building uses 62% less energy than a similar sized building .	• The measures taken have greatly reduced the amount of energy consumed in the building.		• 38% of national average for educational buildings (2001-02) • Goal is to be a net energy producer
Problems	• Presence of moths in the 100% wool carpet • Not currently monitoring the building	• Problems with HVAC noise and operation • Timing of fundraising • some furniture problems.		• Porous paving was not built to construction standards
Other	• Creation of the "Audubon Team" • Use of "off-shelf" products	• Student research and involvement (website development, Post Occupancy Evaluation) and Charettes	• Design charettes with student design groups and the architecture and engineering firms	• Integrated the building and landscape together in the design • 13 public charettes • Living Machine

The above chart illustrates the concept of choosing technologies and designs that are site specific. However, it also illustrates that there are some commonalities among technology choices and ways of solving certain problems. The above chart is not meant to imply that the considerations listed here are all of the issues that must be addressed in design and construction, but is only a brief list and summary of some of those that are the most visible. The following chapters will more fully explore the individual characteristics of each case study and what makes it unique. Finally, having examined the processes and methods of other projects, I will explore how the lessons learned can be applied to the planning and design process of the renovation of the Lamar Dodd building for the College of Environment and Design's new campus.

CHAPTER 2

NATIONAL AUDUBON SOCIETY HEADQUARTERS

The National Audubon Society's decision to house its new headquarters (1987) in downtown Manhattan marked an important turning point in the field of sustainable design. Before the renovation of the Schermerhorn Building, now called Audubon House, the use of sustainable technologies for new construction and renovation was considered out of financial reach for everyday businesses and organizations. However, Audubon House proved that sustainable renovations could be accomplished well within standard market rates, while at the same time creating a pleasant and healthy working environment. By using an integrated design team approach, requiring economic justifications for all purchases, and using environmental criteria to guide their decisions the National Audubon Society crafted an innovative building and design process that would serve as inspiration for countless projects in the future.

TOP: A historic building in Manhattan was recycled into the new headquarters for the Audubon Society. This approach made use of energy embodied in the century-old structure.

Figure 2.1 Drawing of the National Audubon Society's new headquarters (Crosbie 182).

BACKGROUND

Because the costs of renting office space in Manhattan were getting too high, the National Audubon Society began searching for a building to relocate it's national

headquarters to in 1987. After considering several different options for relocating, the National Audubon Society purchased an eight story, 98,000 square foot building at 700 Broadway, New York City, naming it Audubon House. The former Schermerhorn Building was constructed in 1891 and was designed by George W. Post as an example of Romanesque Revival architecture. The historic building was externally in very good condition, but the inside of the building needed extensive renovations. This renovation (1991-1992) provided the National Audubon Society with the perfect opportunity to customize the interior to suit its worker's needs and put into practice the organization's environmental goals:

> Broadly speaking, the team's objectives were to design an office building that would be energy-efficient, environmentally sound, and both comfortable and healthy. The redesign would be accomplished at a competitive market rate, and the finished project would function as a "living model" for future projects. In addition, Audubon House had to take into account factors of safety, building and product performance, and aesthetics. It is in the careful balancing of all these considerations, while keeping the environmental (nontraditional) principles uppermost that the key to the project can be found. (National Audubon Society 45)

WHAT IS UNIQUE ABOUT THIS SITE

The uniqueness of Audubon House permeates through all parts of its inception, design, implementation, and management. From teamwork to specific goals, adaptive reuse to making the project economically justifiable, Audubon House embodies aspects of sustainability that go beyond selecting recycled materials and using solar panels. It is these unique aspects of the renovation that will be explored in this section to give the reader a better understanding of how the entire design process was used to the greatest environmental and economic advantage possible.

BUILDING LOCATION AND REUSE

Perhaps the simplest way in which Audubon House embodies sustainable objectives is by being located in an existing building. By making the conscious decision to remain in an

urban environment, the National Audubon Society not only took advantage of already existing urban infrastructure (i.e. roads, parking, subway systems, and highways), but it eliminated the need for using more resources to construct a new building in a suburban area. This decision saved the National Audubon Society $11 million because it was predicted that a new headquarters would have cost $33 million while the renovation was only $14 million plus the $10 million purchase of the building (Worth).

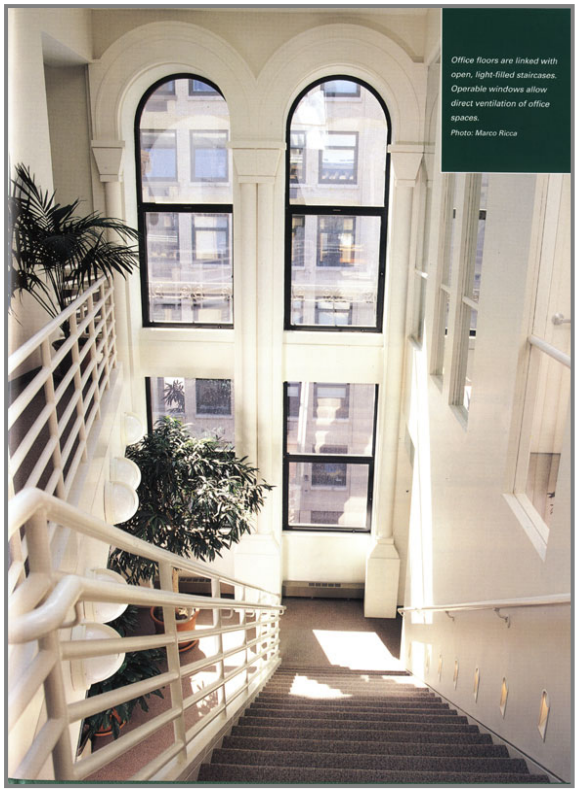

Figure 2.2 Interior View of Audubon House(Crosbie 185).

Another benefit to selecting an existing structure for its new headquarters was that a significant historic piece of architecture was preserved and adapted for a new use. The exterior of Audubon House was fully restored and the turn of the century humanistic design was taken full advantage of when redesigning the interior office spaces. The building's south and west facades receive plenty of sunlight through its massive windows reducing the need for artificial lighting inside the building. The presence of windows that could open to allow fresh air inside was a seeming novelty to most occupants that were used to working in modern glass-curtain buildings. Audubon House was therefore able to capitalize on and preserve the more "human" architecture of another era, while at the same time creating a unique and useable office space for the 21st century.

INTERDISCIPLINARY TEAMWORK

Perhaps the primary reason Audubon House was able to be so comprehensively designed in a sustainable manner was the initial creation of the "Audubon Team." This team consisted of individuals from all facets of design, implementation, and maintenance that worked together on every aspect of Audubon House. This allowed a true cross-disciplinary approach to design resulting in the collaboration of the architects, interior designers, engineers, and scientists at an unprecedented scale. For example, the interior designer worked closely with the chief architects from Croxton Collaborative on the interior layout of office spaces to maximize the use of natural daylight and to organize the lighting fixtures in the most efficient manner (Unger and Grosse 61). The result is a combination of resource efficiency and aesthetic consideration that is seldom seen in building design.

Although teamwork was the driving force behind the innovative renovation of Audubon House, leadership from the highest ranks of the National Audubon Society ensured that the entire project stayed within set bounds and achieved the initial goals set out at the beginning of the project:

> The role of the owner was of paramount importance in the Audubon project. Ultimately, it was up to Audubon's leadership to set the overarching goals of the project, establish the financial terms, hire the building professionals, and resolve disputes. The project benefited immeasurably from greater-than-normal input of the owner as well as from Audubon's environmental expertise. (National Audubon Society 60)

In addition to involving members of the National Audubon Society with the architectural, engineering, and interior design firms, a local community activist group invited the National Audubon Society to attend its meetings. The Concerned Citizens of Broadway were not involved in a public review process, but were pleased by the attendance of

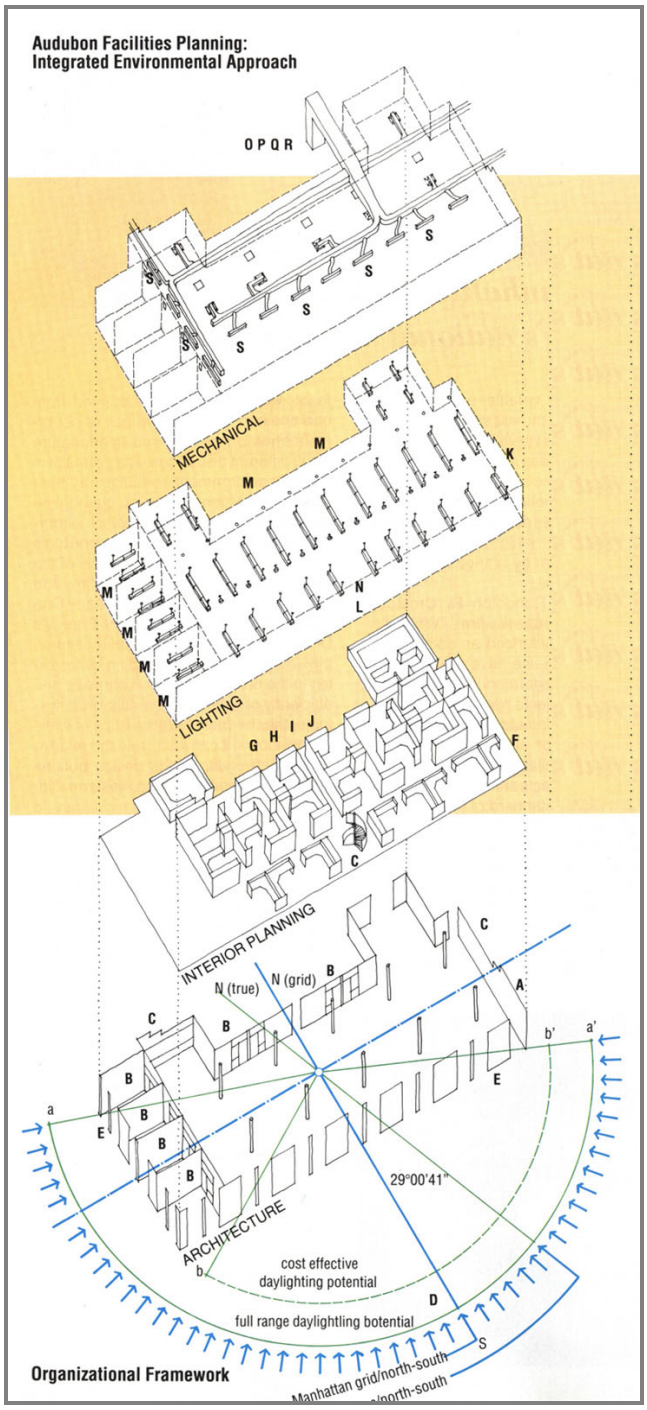

Figure 2.3 The integrated Environmental Approach to Audubon House planning. (Nasatir 96)

representatives of the National Audubon Society at one of their local meetings ("Audubon House"). According to Harriet Fields, the president of Concerned Citizens of Broadway, the National Audubon Society listened to their concerns about crime, graffiti, and neighborhood issues and took appropriate action to address them ("Audubon House"). While the renovation was a private project, the willingness to listen to the constituents of New York illustrates the desires of the National Audubon Society to make Audubon House a welcomed and accepted part of the neighborhood.

ECONOMIC JUSTIFICATION

Looking at Audubon House during its construction Judith Nasatir said, "Potentially the most persuasive element is the clarification of each design decision in terms of its long term cost effectiveness"(95). To achieve the goal of long term cost effectiveness, the Audubon Team set down several financial criteria to be met. First, the cost of the redesign and renovation should fall within acceptable market rates for this type of project. If this goal could be met, then renovating with sustainable technologies could be justified on a short-term economic basis alone. Audubon House realized this cost objective with a final renovation cost of $14 million, equating to $122 per square foot[1] (psf.) for general renovations, with the market standard being from $120-128 psf. (National Audubon Society 48). This proved that sustainable technologies were affordable and accessible to anyone wanting to use them.

The second criterion affecting financial decisions was that,

> systems and products used at Audubon House had to be economically as well as environmentally justified. This entailed looking at initial cost and *premium cost* - the price differential above a product or system with equivalent performance characteristics but lacking the environmental qualities. It also took into account

[1] The fully loaded cost was $142 because they had to replace century old vaults under the sidewalk to comply with a NY law saying that fire trucks must be able to drive up onto the sidewalk. $142 was considered only slightly above a competitive market rate (National Audubon Society 48).

> durability and longevity of a system or product, its maintenance record, rebates (if any), cost of installation, and anticipated payback[2]. (National Audubon Society 50)

This meant that a product whose cost was excessive in relation to its performance or in relation to other comparable products on the market would not be used, even if it might confer greater *environmental* benefits on the project as a whole. This criteria combined with the requirement of a 5-year cumulative payback period for all energy-related systems, ensured that only technologies that were financially *and* ecologically justifiable were chosen for the project. The 5 year standard chosen for the payback period was decided upon by the owners and the chief architects to reflect a realistic time frame that would allow for the use of a wide range of sustainable technologies, while at the same time not excessively exceeding the market standard of a 2-3 year typical payback period (National Audubon Society 50-51).

The length of the payback period is crucial to determining which technologies will or will not be used in a project. The payback period determines how quickly technologies can pay for themselves and make up for financial front-loading that is so typical of sustainable projects. Some of the technologies that confer the most sustainable benefits on a project are very expensive and may not be justifiable in certain cases. Individual projects need to decide early on in the design and planning process what costs it is willing to incur for long-term benefits. Whether or not a product should be rejected just because its financial return is not possible in the short-term (3-5 years) must be made on a case by case basis.

A direct impact of the payback criterion at Audubon House was the decision not to install photovoltaic cells on the roof. Because the payback period of 10 years greatly exceeded the 5 year limit, the team left the decision for photovoltaic panel installation until a later date when costs were more affordable (National Audubon Society 51).

[2] Payback period: the amount of time it takes a system or systems to offset additional cost with accrued savings (National Audubon Society 51).

In addition to trying to offset initial costs by careful choices of products, efforts were made to avoid future costs as well by installing low flush toilets, occupancy sensors, and light intensity monitors. Practicality was also taken into account in product choices, and the Audubon Team decided early on that only products considered "off-shelf" and were readily available to the general public would be used in the renovation. This ensured the practicality of the renovation and the ability of other "real world" businesses and organizations to see the ease of designing sustainably. "We [the Audubon Team] also did not use recycled materials that cost more than 10% in excess of virgin materials" ("Audubon House").

Finally, as much as the Audubon Team would have liked to use the most environmentally friendly products in every scenario, compromises had to be made along the way.

> Such an understanding is critical for any similar project to proceed and can be expressed as a "90 percent solution": It is inherently impossible to achieve total success, but achieving the highest possible success rate is more than sufficient to justify an environmentally driven project. In the final analysis, the environmental and human benefits of striving for an environmentally sound, energy-efficient, design far outweighed any incidental shortcomings. (National Audubon Society 58)

"ENVIRONMENTAL CRITERIA AT THE FOREFRONT OF DECISIONS"

What I would consider to be the most instructive aspect of the National Audubon Society's design philosophy was their ability to put "environmental criteria at the forefront of decisions" (National Audubon Society 45). This is perhaps the most influential of all decision making aspects and shows how local and regional problems can be used to specifically alter and influence design decisions:

> It [our new approach to building and renovation] places environmental criteria, including the sustainable use of resources, energy efficiency, and air quality, on an equal footing with traditional criteria of cost, functionality, and aesthetics. And it makes the case that a building can reconcile all these concerns and still be

> comfortable for its occupants and *cost effective.* More than any other, this last point distinguishes the Audubon Team's approach from most earlier "green" architecture. (National Audubon Society 19)

The National Audubon Society decided early on that they would make decisions that reflected their stance on local, national, and global environmental issues. For example, they wanted to eliminate CFC's because of global warming. Also, because of their stance on the shortage of electricity and their opposition to the James Bay hydroelectric development, they wanted to minimize electricity usage as much as possible. They used these issues "to develop a loose set of environmental priorities for the project" (National Audubon Society 46). These priorities led to the creation of four environmental dimensions that defined major areas of focus for the renovation:

> **1. Energy conservation and efficiency**- one of the simplest areas in which to reduce consumption.
>
> **2. Direct and indirect environmental impacts**- energy use, manufacturing and use of products, materials, and systems (water pollution and waste). Requested vendor information to assess as many upstream and downstream impacts as possible.
>
> **3. High indoor air quality**- consideration of humanistic and environmental aspects to increase worker safety and comfort.
>
> **4. Resource conservation and recycling-** use of recycled materials, and implementation of an advanced building recycling system. (National Audubon Society 47).

These dimensions guided decisions without dictating how to achieve the final outcome, resulting in decisions and processes that could be changed when new data and information became available.

One result of using environmental criteria to shape decisions was the atmosphere of *optimization* instead of compliance. As Randloph Croxton, head of Croxton Collaborative, said, "[Audubon] focused on highest cost justifiable performance. Code minimums were left far behind"(National Audubon Society 28). The focus was shifted instead towards enhancing building safety and comfort. This thought process led to a building that was more insulated, safe, and comfortable for its users, while also greatly exceeding the minimum requirements set out by the government.

Because the different professions of architecture, engineering, and interior design were so integrated on this project, Randolph Croxton found the need to "start looking at the tools available for more precise analysis of the ramifications of the variables over time and their effect on the system as a whole (Nasatir 95)." The Audubon Team turned to the DOE-2 computer modeling system (developed by the U.S. Department of Energy and the Electric Power Research Institute of California) to accomplish this analysis and was able to compare Audubon House's performance to code compliant buildings. By using this technology to evaluate different alternatives, predictions could be made about which combinations would be most efficient and yield the most energy savings in the future. The result of using DOE-2 was the prediction that the "cumulative energy-saving strategies would result in a building 64 percent more efficient than a conventional, code-compliant approach to the building would have produced" (National Audubon Society 65). Clearly, being able to evaluate the benefits and costs of different technologies beforehand leads to a more integrated and cost effective building design.

To summarize, Audubon House is the embodiment of the efforts of a very large and creative team. By choosing an urban building, using an integrated design team from the start, requiring economic justification for purchases, and by putting environmental criteria at

the forefront of decisions the National Audubon Society created a headquarters that truly represents the values of its organization.

WHAT DIDN'T WORK? WHAT WERE THE PROBLEMS?

The only major problem that Audubon House has experienced to date is the presence of moths in its 100% natural un-dyed wool carpeting. Within three years of its opening, the carpets of the building were infested with moth larvae eating the carpet. The wool carpet originally had a topical application of a mothproofing agent called Edolan®ETS, but subsequent changes in recommended cleaning methods may have removed the coating (Audubon House 2). "After recognizing the problem, Audubon officials initially took a wait and see attitude…but when the moths started appearing at the homes of office staff, it was clear that action had to be taken" (Audubon House 2). Several different approaches were considered for removing the moths from Audubon House, including using liquid nitrogen to freeze the larvae in the carpet. Dr. Jan Beyea's idea of introducing lizards into the house to control the population was never actually considered as a viable option and a final decision was made to apply isopropyl alcohol to the carpet over 10 consecutive weekends (Audubon House 2). Several months later the moths began to reappear. Eventually the carpet was replaced with an environmentally friendly carpet manufactured by Interface and (Hamilton).

Most of the other problems that the building has experienced have been minor. Some of the tables were found to scratch easily because they didn't have a typical wood finish (for toxicity reasons) and the occupancy sensors would turn off the lights in a room where people were sitting still for a long time. However, these problems were solved easily. Coasters were used on the sensitive tables and the person sitting next to the occupancy

sensor in meetings would do the "wave" to turn the lights back on (National Audubon Society 158).

I have chosen to list one final topic as a problem, even though it only received a cursory mention in one article that I read: Audubon House is not currently being monitored for environmental benefits (Unger and Grosse 62). Since the National Audubon Society worked so hard to make this renovation an educational process, why has monitoring fallen by the wayside? Collecting data to confirm the long term benefits on worker health, building performance, and energy usage should have been considered just as important an aspect of process as the design and renovation of the building. Hopefully other projects will not copy this aspect of the Audubon Society's design process.

ASPECTS FROM THIS SITE THAT ARE APPLICABLE TO THE LAMAR DODD RENOVATION

All of the items that make Audubon House unique deserve special attention by the new College of Environment and Design (CED). Although these topics and their application will be discussed in greater detail in the chapter devoted the Lamar Dodd renovation, I would like to take a brief look at them now.

Documentation of the process and the recording positive and negative outcomes of decisions were some of the most important contributions of the Audubon House renovation. Also, the overall process is a great example of the benefits of a synergistic design approach combined with unparalleled teamwork. The new CED has a multitude of resources to draw on for its campus design including but not limited to its students and faculty in ecology, historic preservation, and landscape architecture. These resources should be utilized to their full potential and made to be integral parts of the design process.

Another important point raised during the renovation of Audubon House was that of the owner in setting and maintaining goals. From the outset, the CED needs to establish who will be making decisions concerning different aspects of the project and set out clear goals to aim for. This will help maintain a line of authority in the decision making process and will ensure that the overall goals are achieved.

Finally, the use of a value driven design process in combination with a goal of optimization of building performance (instead of compliance to code minimums) is essential to the successful renovation of Lamar Dodd. I hesitate to say that there is no other way that a sustainable renovation can be achieved, but this seems to be the most promising and direct way of attaining that goal. By putting environmental considerations on par with economic realities the design process is transformed into a dynamic course of action instead of a static money-driven practice.

CHAPTER 3

BARNEY-DAVIS HALL, DENISON UNIVERSITY

BACKGROUND

Barney-Davis Hall, constructed in 1894, is currently home to the McPhail Center for Environmental Studies and the English Department of Denison University in Ohio. The 28,000 sq. ft. building was recently renovated (1997-1998) at a cost of $4.5 million ($160 per sq. ft.) and is now "a statement building: a place where environmental principles are upheld and demonstrated to the community"(Barney-Davis). The renovation sought to achieve a balance between historical and environmental goals, and to restore the environmental awareness of the original structure (Barney-Davis). The project's mission statement was

Figure 3.1 Barney Davis Hall (Barney-Davis).

> To provide an elegant, environmentally responsible home for Environmental Studies and English which is a symbol of their aspirations, imparting their message on many levels. (Unger and Grosse 32)

This mission statement for the renovation was supported by a very comprehensive list of goals that was developed prior to initial planning. The list is divided into two sections: historical and environmental goals. This division allowed for very specific goal setting and created a means to cross reference between sometimes conflicting viewpoints. By setting goals early in the process, it was ensured that decisions were based on a consistent standard

and that they worked towards the same end result. The following list is a summary of the goals generated by the Barney-Davis students (see Appendix A for a complete list):

HISTORICAL GOALS:

- Use the building for its historic purpose or take on a new use which requires minimal changes.
- The historic character shall be retained and preserved.
- Changes that create a false sense of historical development will not be undertaken.
- Distinctive features that characterize Barney shall be preserved.
- Deteriorated historic features shall be repaired rather than replaced.
- Treatments that cause damage to historic materials shall not be used.
- Significant archeological resources affected by the project shall be protected and preserved.
- Construction shall not destroy historic materials that characterize the property. The new work shall be differentiated from the old and shall be compatible with the historic integrity of the property and its environment.
- Construction shall be undertaken in such a manner that if removed in the future, the essential form and integrity of the historic property and its environment would be unimpaired.

ENVIRONMENTAL GOALS:

- Barney must be a pleasant and comfortable place to work and be conducive to the academic environment.
- This building must demonstrate that fossil fuel reliance can be dramatically reduced, if not completely eliminated.
- Attention must be paid to user behavior and desires.
- Barney is intended to be a working, living laboratory of sustainable design. It should demonstrate how effective these ideas can be, and how transferable they are to other building situations.
- Local resources and local labor should be used as much as possible in the ecological renovation of Barney Hall.
- Designs and materials must be thought of in the long term and allow for changes to be made as the building continues to age and new technologies are developed.
- Take advantage of the buildings original humanistic design.
- The need for energy consumption in the building envelope should be reduced as much as possible.
- The floor plan designs and landscaping should take aesthetics into consideration.
- This building must consider its direct and indirect environmental impacts. Costs can be reduced by investing in technologies and products which do not require extensive maintenance.
- Use natural materials. (Barney-Davis)

This list has subsequently served as inspiration for other historic/sustainable renovations including the "Greening of Dana" at the University of Michigan, discussed in the following chapter.

WHAT IS UNIQUE ABOUT THIS PROJECT

According to the student run web page "Highlights of the Renovation," several important aspects of the renovation included experimentation, corporate partnerships, education, and student involvement (Barney-Davis). These features provide an excellent framework for understanding the role that the students played in information gathering, project design, and post-construction efforts. I will focus mainly on these aspects, plus the building's post-occupancy evaluation because most of the specific technologies used in the renovation are relatively similar to those of other case studies.

Figure 3.2 Barney-Davis Hall (Barney-Davis).

EXPERIMENTATION

The Barney-Davis Hall renovation was looked at from the beginning as an opportunity to serve as a living laboratory to gather information for other projects in the future. The entire renovation was looked at as an experiment, requiring data gathering, analysis, and documentation of the technologies used. By collecting all of this information and making it available to the public, the "laboratory" of Barney-Davis could serve as an example and tool for other universities to examine and learn from.

CORPORATE PARTNERSHIPS

The students of Barney-Davis seized the opportunity to partner with corporations to decrease costs and provide public education about the renovation. Arrangements were made with manufacturers and suppliers for advertising and dissemination of information to the public and university about the renovation in exchange for the use of their products. It is not clear what sort of financial deals or benefits resulted from this, but the businesses and profession gained invaluable exposure from the permanent displays, web page, and advertising that took place.

EDUCATION AND STUDENT INVOLVEMENT

The renovation of Barney-Davis Hall was used to its fullest advantage by the students and faculty to serve as "a real-life exercise in environmental education"(Barney-Davis). Because the Environmental Studies program at Denison is oriented toward real life problem solving, as opposed to advocacy (Unger and Grosse), the renovation was adopted as part of the curriculum to provide "those students and faculty involved with first-hand experience in applying the goals of environmental studies to the world outside of the classroom"(Barney-Davis). The students, over 150 of them, were involved from the very beginning of the project and made the initial proposal to the Denison Board of Trustees in 1997. Students also actively participated in the planning and design process by researching materials and methods, giving recommendations to the project's designers, and developing a zero-toxics policy.

The all important post-occupancy evaluation (POE) of Barney-Davis Hall was also conducted by students in the Environmental Studies Capstone Seminar in the spring of 1999. This survey provided critical information regarding the performance of the building, user satisfaction, and provided concrete data, upon which recommendations for updates and

changes were based. The impacts of this survey will be discussed in greater detail in the next section. In addition, the students also constructed and ran a website dedicated to the Barney-Davis renovation, which provides a plethora of information regarding the project.

POE OF BARNEY-DAVIS HALL

As described in the POE of Barney-Davis Hall, students in the spring of 1999 performed a post-occupancy evaluation (Appendix B) to measure the overall success of building changes. Success was measured in terms of both user satisfaction and environmental concern, and the renovation was found to be considered successful overall. However, the students recommended improvements and considerations that should be taken into account in the future by the University and other groups wishing to sustainably renovate a historic building. (*All information concerning the POE of Barney Davis hall was collected from the POE of Barney-Davis Hall website <www.denison.edu/enviro/barney/poe/>*).

Survey Methodology:

The class began by gathering data for the renovation and by researching materials and technologies that could be used. After the students became familiar with most aspects of the renovation, they proceeded to conduct a survey of other students , faculty, and staff as well as one-on-one interviews with key university staff and personnel who were directly involved with the renovation.

The survey consisted of questions answered on a scale of 1 to 5 and was given to 28 classes of students, for a total of 302 surveys. Faculty/Staff members were given the survey individually and were also asked three additional questions:

> Based on your interaction with Barney-Davis Hall, what do you like most?
> Based on your interaction with Barney-Davis Hall, what do you like least?
> Are there any impressions that you would like to share? (POE)

Faculty/staff questions and remarks in addition to those of the survey were noted and taken into consideration for the final survey results. Other methods of evaluation that were used included direct measurement of energy usage, direct calculation of payback periods, and life cycle cost analysis.

The Survey

The class divided the survey topics into five categories: site and structure, skin, space, services, and stuff, adapted from Stewart Brand's How Buildings Learn: What happens after they're built. Each group analyzed the results from its survey questions, drew conclusions, and made recommendations concerning those aspects of the renovation. At the end of the survey, general recommendations for the building and university campus were made, as well as recommendations for other groups wishing to undertake a sustainable building renovation in the future.

The *site/structure* group looked at issues like exterior social spaces, outdoor classrooms, bike racks, exterior aesthetics, and landscaping. The group found that overall the users of Barney-Davis were pleased with the building. There were two main improvements that were recommended from the results of the survey. First, was that if an outdoor classroom was built in the future that it be designed as a multi-use social space. Second was that the landscape be more integrated in the design. One faculty/staff member commented,

> I don't like the landscaping – it misses all possibilities for sustainable and regenerative design and it deals with the exterior spaces poorly creating little if any user friendly, thought provoking, or even attractive space. (POE)

Clearly the landscape surrounding Barney-Davis Hall is lacking in connection to the sustainable renovation of the building. None of the technologies used went beyond the building envelope to address the surrounding environment. Why wasn't a connection made

between sustainable design and the outdoor environment during the design process? How could this have been avoided? Was the landscape an afterthought? Because this survey was conducted the faculty, staff, and Board of Trustees are now aware of the design's shortcomings and have the opportunity to address them. In the site/structure conclusion the surveyors realized the shortcomings of this design aspect and stated that "the exterior of the building should be a showcase of the environmental ideas implemented inside the building as well"(POE).

The second category of the survey was *skin* and included "all the material covering the interior and exterior of Barney-Davis Hall" (POE). The students looked at air quality, carpeting, ceiling tiles, flooring, gray water, insulation, light shelves, paint, sky lights, and windows. The main findings from this part of the survey dealt with several issues. First, according to the director of the physical plant of Denison University, because of the limited amount of gray water from facilities in the building, there is no payback from making the system operational, and it may therefore never be used (POE). If a gray water system was used campus wide though, it would provide a much greater payback for the technology.

The next issue was light shelves. Light shelves are shelves with a highly reflective upper surface that disseminate natural light that are placed across windows in rooms. Students (190 out of 292) agreed/strongly agreed that the lighting shelves made a difference. The natural lighting of the building was also one of the most enjoyed aspects of the design according to interviews with faculty and staff. This was made possible by the use of glazed window technology that insulated the windows as effectively as an opaque wall. In addition to the lighting shelves, six skylights were also installed on the fourth floor.

Recommendations included using the high r-value[1] windows in other buildings and increasing the r-value of windows in skylights installed in the future.

Finally, it was recommended that every opportunity to use low VOC products be taken advantage of; the increases in air quality and positive perceptions of the internal environment more than justify the change.

Space was the third group of the survey and looked at classrooms, study space, the environmental studies library, social areas, and offices. The group looked mainly at spatial relations like room size and shape, as well as at the acoustic quality of the spaces. The results led the team to recommend that acoustic quality of ceilings and mechanical systems be taken into account during the design process.

Category four was *services*. They looked at lighting, dimming circuits, elevators, communications wiring, waste disposal, plumbing, and HVAC. The team found that dimming circuits and occupancy sensors made a significant difference in energy use. The main recommendation was to further insulate the HVAC system to decrease noise levels in the classrooms. In addition, the team suggested paying close attention to user satisfaction regarding the systems in the building that were relatively new. By ensuring user satisfaction, these systems will more likely be recommended for use and installed in other projects throughout the university.

Lastly, *stuff* was the fifth category and included furniture, cleaning supplies, plaques, wall decorations, and the kitchen. Perhaps one of the most important recommendations from this group was that the informative plaques describing technologies and products used in the building be more dispersed and obvious. Currently, the plaques are only located on

[1] R-value- A measure of the thermal resistance of a material. Thermal resistance is the opposition of material and air spaces to the flow of heat by conduction, convection, and radiation (National Audubon Society 202).

the first floor of the building where the environmental studies classes are held. By placing them on the second and third floors, in addition to the exterior of the building, the educators could reach a much wider audience.

In the final section of the analysis of the POE, recommendations were made for future renovations on Denison's campus and other universities. Recommendations for Denison University included using the principles and products of the Barney-Davis renovation in other projects and the use of low VOC cleaning supplies and products throughout the campus.

For future green renovations beyond Denison, the surveyors of Barney-Davis hall recommended that a file be kept of all environmentally-friendly products that were used, as well as the implementation of photovoltaics, a campus wide gray-water system, and the use of fiber optic wiring inside of buildings. Most insightful though, was the recommendation to conduct a pre-occupancy survey to determine what changes are most important to the users of the building. This step, combined with the post-occupancy survey would provide an invaluable tool for informing management and design decisions in the future. By conducting post-occupancy surveys every couple of years, the building managers will be able to continually improve the comfort and satisfaction of the building occupants. This is a very important step towards integrating the concept of life-cycle management into the upkeep of a building.

WHAT DIDN'T WORK? WHAT WERE THE PROBLEMS?

In addition to some of the problems listed above, there were several more problems with the Barney-Davis renovation. First, the temperature controls in each of the rooms were not understood, and therefore not correctly operable by most faculty members. Second, the HVAC system, in addition to being noisy, has since been found to be wired incorrectly and

as of 1999 was in the process of being systematically rewired. Finally, the fundraising campaign was ill-timed; it came after a major capital contribution drive had just occurred (Unger and Grosse 37). The mangers of Barney-Davis Hall must be given credit though; they are putting in the time and the effort to respond to the needs and suggestions of the building users.

What can be learned from this project is very important in an age of ever increasing technological reliance. Users of complex technological systems must be taught to understand how these systems work and how to use them properly. If there is a failure of communication between the engineers and the end users, the efficiency and effectiveness of the products will be lost. This defeats the whole purpose of sustainable design.

ASPECTS FROM THIS SITE THAT ARE APPLICABLE TO THE LAMAR DODD RENOVATION

What I respect the most about the Barney-Davis Hall renovation is that its designers knew the building would never achieve perfection. From the very beginning realistic goals were set and it was realized that the building would always be a work in progress. I believe that this is an important outlook to have for a sustainable renovation, especially one in an academic environment. Learning is not about achieving perfection, but is about gaining knowledge from your past experiences and using it to inform future decisions. Imparting this knowledge to the students of Barney-Davis hall is the most valuable lesson that can be learned from this renovation.

The project's major oversight, failing to address the landscape in its design, provides a valuable lesson for the Lamar Dodd Building. One faculty member at Denison did comment unfavorably about the lack of landscape consideration in the final design. However, the fact that no other students or faculty specifically addressed this shortcoming

reveals a limited understanding of the potentials for sustainable design, especially in an academic environment.

The CED has resources available that should ensure that the design of the CED campus is looked at in its entirety, not just as individual buildings and their interiors. The most important step in ensuring that the design of the landscape does not fall by the wayside is the development of a master plan for the entire CED campus before designing each of the individual buildings. The master plan should look at all aspects of the campus design and set out goals for each of the buildings could be integrated with the landscape to expose the more complex interactions that occur between buildings and their surrounding environment. Doing this will demonstrate an understanding that buildings *and* landscapes can be designed as educational resources and would reveal *process* in sustainable design; a dynamic and crucial element that should be emphasized whenever possible. Doing this will not be easy though. It requires a thorough understanding of system dynamics and the interconnectedness of all aspects of design. Basically, we must learn to think holistically and *outside of the building* if we are to move closer to integrating ourselves with our environment. This is the challenge put forth to the CED and its new campus.

CHAPTER 4

S.T. DANA BUILDING, UNIVERSITY OF MICHIGAN

BACKGROUND

The S. T. Dana building, built in 1903, houses the School of Natural Resources & Environment (SNRE) at the University of Michigan in Ann Arbor. Due to a need for more classrooms, offices, and communal space, plans for renovating the building began in early 1997. Scheduled for completion in early 2003, the "Greening of Dana" is projected to cost $25 million dollars and will complete several tasks at once. First, the renovation will serve as a one hundred year maintenance check-up for the building, with upgrades and modifications for outdated systems. Second, the renovation will change the layout of the building to suit the modern programmatic needs of the users. Planned in two phases, the first phase (completed in 1999) enclosed a courtyard with an overhead skylight, adding 11,000 sq. ft. of usable building space. Phase II (to be completed in 2003) involves adding more mechanical space in the attic and the renovation of the 39,000 sq. ft interior of the building for new uses ("University").

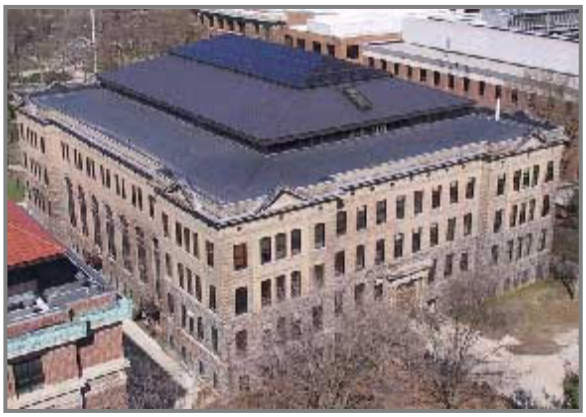

Figure 4.1 The S.T. Dana Building under construction (The Greening of Dana).

Learning from past projects, the Greening of Dana adapted the extensive list of historic and environmental goals from the Barney-Davis Hall renovation and made them specific to their site:

• To not only teach environmental environmentally responsible principles, but to uphold and demonstrate them to the community.
• Promote sustainability, reduce negative health impacts, and serve as a laboratory and educational center for ecological themes.
• To create a comfortable place to learn and work, while simultaneously demonstrating the state-of-the-art in environmentally conscious design.
• Teach environmental sensitivity, respect and consciousness through building design and resource management. Demonstrate how effective these ideas can be, and how transferable they are to other building situations.
• Use local resources and local labor as much as possible in the renovation and construction. (Unger and Grosse 42)

The means by which to achieve these goals were also listed, and served as a guide for the decision making and design process:

• Energy conservation and efficiency
• Use renewable energy (photovoltaics, solar hot water)
• Increase daylight use
• Improve indoor air quality
• Conserve water
• Include operation costs in selecting mechanical equipment
• Material efficiency, increased recycled content/recycleability of building materials
• Life-cycle-based evaluation of environmental impacts
• Maximum reuse and recycling of components and materials from demolition
• Everyday waste reduction programs
• Recycling as many inorganic and organic waste materials as possible
• Maximize educational impact through a multifaceted program.
(Unger and Grosse 42-43)

However, one disappointing fact about the Dana renovation is that the green design goals were not stated from the very beginning of the planning process. According to Unger and Grosse, the SNRE dean didn't approach the project coordinator about developing a list of sustainable goals until after a year-and-a-half of planning had already taken place (44). This greatly limited the extent to which sustainable technologies could be incorporated into the design. However, the architects and designers were very cooperative and integrated as many sustainable measures as possible into the renovation.

WHAT IS UNIQUE ABOUT THIS PROJECT

Although the research methods and technologies used in most renovations may be grouped into similar categories, the processes and methods by which these projects are implemented differ greatly. The following paragraphs illustrate how the Greening of Dana used historic preservation, experimental technologies, and a national rating system to guide the renovation of a significant historic structure.

A HISTORIC PRESERVATIONIST AND A GREEN ARCHITECT

Figure 4.2 Computer rendering of the S.T. Dana building ("The Greening of Dana").

To make the Greening of Dana possible, the University of Michigan teamed historic preservationists Quinn Evans Architects with William McDonough + Partners to oversee the building's design and construction. Quinn Evans Architects is a nationally recognized preservation planning group that has worked on several prominent historic preservation projects including the Library of Congress and the Washington Monument ("An Architectural"). William McDonough + Partners is an internationally renowned architecture and planning firm with a focus on "green" design and the effective use of resources.

The challenge put forth to these designers was "to maintain the century-old building's historic integrity and appearance while creating an environmentally conscious design appropriate for 21st century uses" ("An Architectural"). To meet this challenge, the design team conducted three two-day charettes that included both architectural firms, the engineers, and school-wide design work groups established for the project (Unger and Grosse 44). The combination of different design philosophies resulted in a building

renovation that joined historic preservation goals with sustainable design methods and technologies. As a representative of Quinn Evans Architects said:

> Our goal has been to build a tradition of sustainable architecture that can be adapted to changing times and situations…Historic sites are being defined differently. No longer is historic preservation focusing [only] on 18th and 19th-century sites. ("An Architectural")

The building is being restored to take advantage of the original lighting and ventilation plans and the interior space is being redesigned to meet the new space and program requirements of the users. Original building materials were salvaged whenever possible and then reused within the building. For example, 11,000 board feet of pine wood was salvaged from the attic and was reused as furniture, paneling, and trim (Kosseff). Also, over 5,000 brick pavers were found under the old courtyard concrete floor. The bricks were salvaged by faculty and students and were used to pave the new courtyard area ("University of Michigan").

Uniting historic preservationists with "green" architects proved to be a valuable and sensible combination. Both parties were interested in salvaging and reusing as many materials as possible while also maintaining the historic aspects of the building design (which seemed to support many of the green design goals). This design collaboration reinforced the notion that sustainable design requires a holistic team apporoach and not the expertise of just one field. Projects like the Greening of Dana reveal that the perceived divide between the fields of historic preservation and sustainable design is much smaller than most people think.

This convergence of fields was demonstrated at an American Institute of Architects (AIA) symposium in 2001 that was trying to answer the question "Can historic preservation

be squared with environmentally friendly buildings"(Hawes)? Carl Elefante, an architect with Quinn Evans Architects that attended the conference, said:

> Preservationists saw examples of green adaptations that worked well within their historic fabric and context…Environmentalists saw that historic buildings were able to accommodate state-of-the-art green materials and technologies, just like the modern buildings, while preserving our beloved cities and towns. (Hawes)

Clearly the fields of historic preservation and sustainable design are beginning to realize the benefits of working together.

TECHNOLOGIES

As I have mentioned earlier, most sustainable building renovations address very similar systems and design principles for upgrades. The Greening of Dana however, has taken a more experimental approach with some of its technological choices. By installing composting toilets and implementing a radiant cooling system, the Greening of Dana took the lead in sustainable technology experimentation.

Composting Toilets

Three composting toilets (waterless toilets with an end product that can be used as a plant fertilizer or a soil amendment) were installed during the renovation. One toilet was placed on each of the three floors between the existing restrooms of the Dana building to allow students and faculty a choice on which restroom to use ("The Greening"). By not forcing the technology on potential users, the public is educated at their own pace about how composting toilets work.

Installing the composting toilets in the S.T. Dana building proved to be one of the more challenging aspects of the design to get approved. Financially, the decision was not in favor of their inclusion in the project because the "three compost toilets will cost about twice as much as installing three conventional toilets" (Kosseff). But in the end, the toilets were installed and became a symbol of progress: "There were a lot of things we had

accomplished that were less visible or less innovative, so that was seen as kind of, 'if we can do this, we're making progress' " ("Greener").

Radiant Cooling

Another innovative way that the Dana Building was made more energy efficient was the installation of a radiant cooling system. According to William McDonough + Partners website, Dana's radiant cooling system, also known as a "chilled ceiling" system

> offers effective space conditioning by combining knowledge of convective airflows and a pre-existing system of chilled water lines. Using the knowledge that hot air rises, this radiant mechanical system cools air where it is the warmest through a ceiling mounted radiator enclosing a very thin film of cold water. When warm air comes into contact with this broad, cooled surface, it cools and descends to the floor in a constantly renewing cycle. ("The Greening of Dana")

It is estimated that the use of this technology will result in an energy savings of at least 10% over a traditional forced air cooling system (The Greening).

By experimenting with such innovative technologies as composting toilets and radiant cooling, the Greening of Dana goes beyond using only proven and accepted sustainable products. Testing these technologies pushes the envelope of sustainable design and encourages other universities and organizations to go beyond the status quo.

LEED RATING

The LEED (Leadership in Energy and Environmental Design) program was created by the U.S. Green Building Council to provide a measurement of how sustainable a building is. The Greening of Dana project tried for a gold rating, but in the end received a silver. According to Marie Logan, assistant to the SNRE's dean, "Platinum is the highest rating, but we're not a new building so it's hard to reach that level" ("Greener").

It should be recognized that the LEED rating system is only one of several rating systems used to measure the sustainability of structures and landscapes. It analyzes certain aspects of design and gives points when those aspects meet certain criteria. In this way the

rating system is a good guide to make sure that you address the basic aspects of sustainability. However, projects run the risk of thinking that the rating system addresses all aspects of sustainability and may cause other areas of sustainable design to be overlooked. Designers must learn to be innovative and emphasize those aspects of design that are most applicable to their site, and decide which ones are not. I urge future renovations to go beyond the requirements of a particular rating system and strive for the most sustainable design possible for their site.

ASPECTS FROM THIS SITE THAT ARE APPLICABLE TO THE LAMAR DODD RENOVATION

The Lamar Dodd renovation has many characteristics in common with the Greening of Dana. Both buildings are home to environmental academic programs and provide a real world opportunity to see sustainable design at work. However, the Lamar Dodd renovation has the opportunity to learn from the Greening of Dana project.

The combination of the fields of historic preservation and environmental design proved to be a unique and successful choice for the Greening of Dana. The Lamar Dodd renovation has the opportunity to take this collaboration one step further by utilizing its in-house historic preservation, landscape architecture, and ecology expertise. Having such an informed student and faculty body will allow the CED to have a great impact on how the future campus is developed from the start. I am sure that the CED and university will take full advantage of these resources to create the most sustainable CED campus possible.

Finally, the Greening of Dana chose to measure its success, at least in part, by using the LEED rating system. The new CED campus has the opportunity to go beyond existing rating systems and to set its own standards for what is the most sustainable design for this project. By using a creative design process in combination with in-house resources and

outside expertise, the CED can create a whole new standard against which to measure sustainability.

CHAPTER 5

THE ADAM JOSEPH LEWIS CENTER FOR ENVIRONMENTAL STUDIES, OBERLIN UNIVERSITY

Figure 5.1 The Adam Joseph Lewis Center for Environmental Studies at Oberlin University, Ohio (Adam Joseph Lewis Center).

Among the case studies that I have presented, this is the only one that is not a renovated building. However, the project's integration of the building with the landscape and ongoing monitoring and evaluation make it one of the most valuable case studies for application to Lamar Dodd.

BACKGROUND

The Adam Joseph Lewis Center for Environmental Studies (AJLC), completed in January of 2000, has earned the reputation of being the "most ecologically sound academic structure in America" (Janas). Originally the brainchild of Professor David Orr, the building construction brought together an exemplary group of design and construction professionals from the very beginning of project planning. The entire design process was used as an educational forum for students, faculty, and the community to learn about sustainable design

and to generate ideas. Input for the design was gathered by hosting thirteen public charettes, involving over 250 participants, to develop and refine the project's criteria and goals:

- Discharge no wastewater
- Generate more electricity than used
- Use no materials known to be carcinogenic, mutagenic, or endocrine disrupters
- Use energy and materials with great efficiency
- Promote competence with environmental technologies
- Use products and materials grown and manufactured responsibly
- Landscape to promote biological diversity
- Meet rigorous requirements of full-cost accounting, and promote analytical skills in assessing full costs over the building's lifetime
- Promote ecological competencies and mindfulness of place
- Be pedagogical in design and operation. (Unger and Grosse 57)

These goals helped ensure that the AJLC would achieve its ultimate goal of becoming a "pedagogical tool...[that] instructs as fully and as powerfully as any course taught in it"

Figure 5.2 Model looking at the main entrance (67. Adam Joseph Lewis Center).

Figure 5.3 Model looking at the social plaza (67. Adam Joseph Lewis Center).

(Bonda), and was a place that could teach not only inside the classroom, but through everyday experiences as well.

In addition to setting goals for the Center to achieve, research questions and criteria were developed to evaluate the Center's success. According to the AJLC website, http://www.oberlin.edu/envs/ajlc, the criteria for measuring the center's success were broken down into six categories: feedback, energy, ecological diversity, materials, education and research, and community. These categories provided a means of quantifying and analyzing the achievements of the Center, and a way to inform the public about the building's performance and proposed changes for the future. This process of feedback, analysis, and response has allowed the AJLC to become an effective and efficient tool for environmental education.

WHAT IS UNIQUE ABOUT THIS SITE

There are two distinct ways that the AJLC sets itself apart from the previously described case studies. First, the Center is undergoing extensive system monitoring and analysis. Second, the surrounding landscape was integrated with the building design from the very beginning of the project. By harnessing the interconnected cycles that occur between the built world and the surrounding environment, the AJLC project demonstrates that the field of sustainable design is finally coming full circle in its design considerations of building and landscape. Where as the three previous case studies focused only on the building envelope for improvements and modifications, the AJLC integrates the interior *and* exterior possibilities of sustainable design.

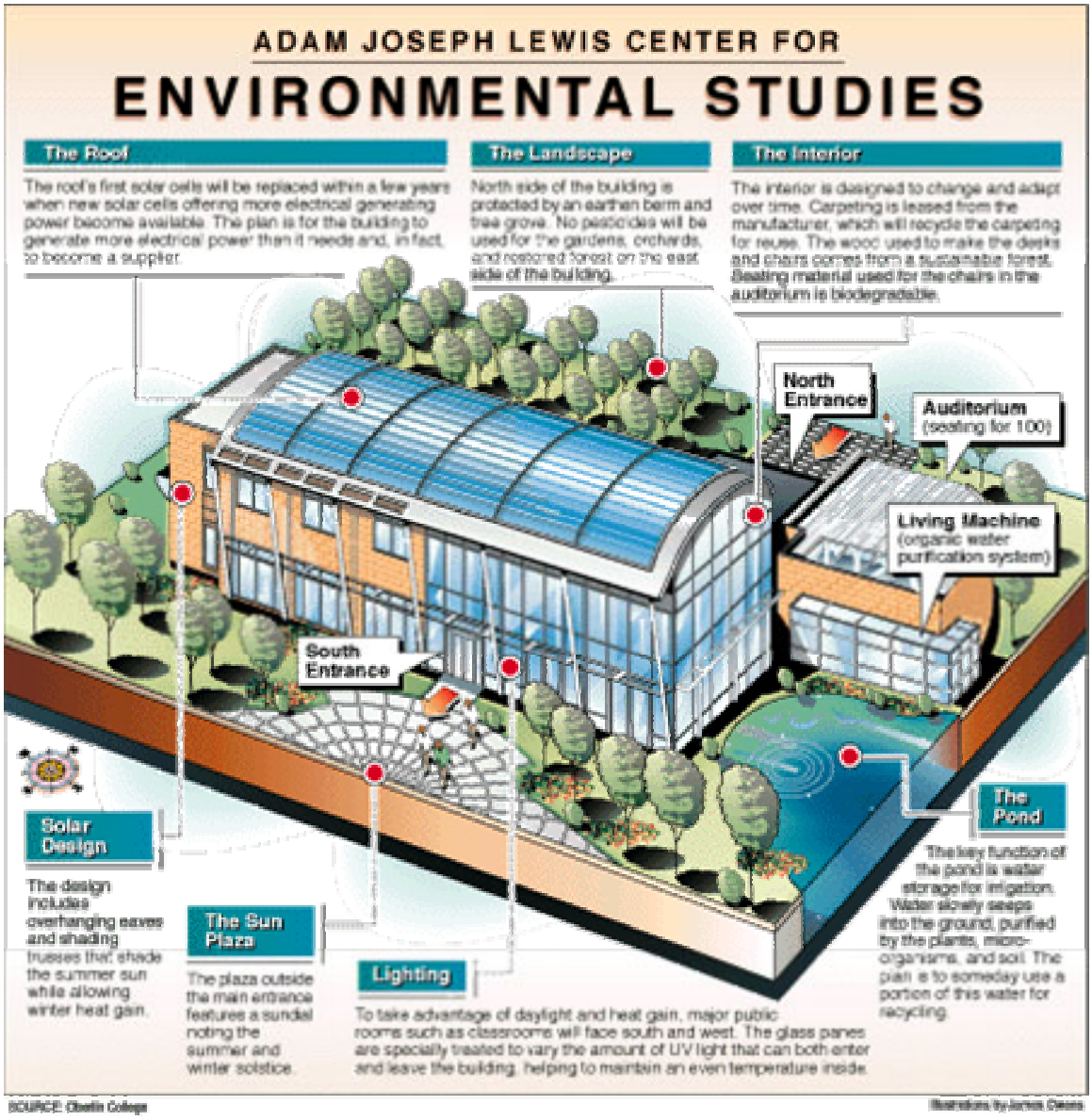

Figure 5.4 How Can a Building Be Like a Tree? (67. Adam Joseph Lewis Center).

SYSTEM MONITORING

According to the AJLC website, their monitoring capabilities are perhaps the most extensive of any academic structure and landscape to date. The main purpose of the installation of this data monitoring system is to see how the AJLC site and its systems evolve over time and to determine how monitoring can lead to improvements in system efficiency and effectiveness.

There are four main areas of data monitoring at the Center: energy use, landscape environmental conditions, indoor environmental conditions, and the Living Machine. Although the system is still being modified and added to, as of 7 October 2002 the variables measured by the system include:

Energy Use:
• Photovoltaic (PV) electricity production
• Energy consumption by the PV system, the heating and cooling system, the lighting system, the Living Machine, and other equipment

Landscape Environmental Conditions:
• Soil temperature and moisture
• Cistern water levels
• Wetland pond water levels and temperature
• Weather conditions (wind speed and direction, air temperature, humidity, barometric pressure, intensity of solar radiation, intensity of photosynthetically active radiation, and rainfall)

Indoor Environmental Conditions:
• Atrium temperature and relative humidity
• Hot water flow and total building water use
• Fresh air supply and return air temperature, heat pump air temperature, and geothermal loop groundwater temperature
• Carbon dioxide levels in individual spaces

The Living Machine®:
• Temperature and relative humidity in the Living Machine®
• Water flow, including water recycling
• Water temperature in each tank
• Dissolved oxygen in 5 tanks and total system metabolism rates
• Effluent conductivity. (Adam Joseph Lewis Center for Environmental Studies)

In keeping with the main goal of using the building and landscape as a "pedagogical tool," all of this data is available to the public on the AJLC website. The data is prominent, easy to understand, and is updated every sixty seconds. At any given time anyone can log on to the website and see a myriad of information regarding building performance and the current weather conditions as shown in the figure below.

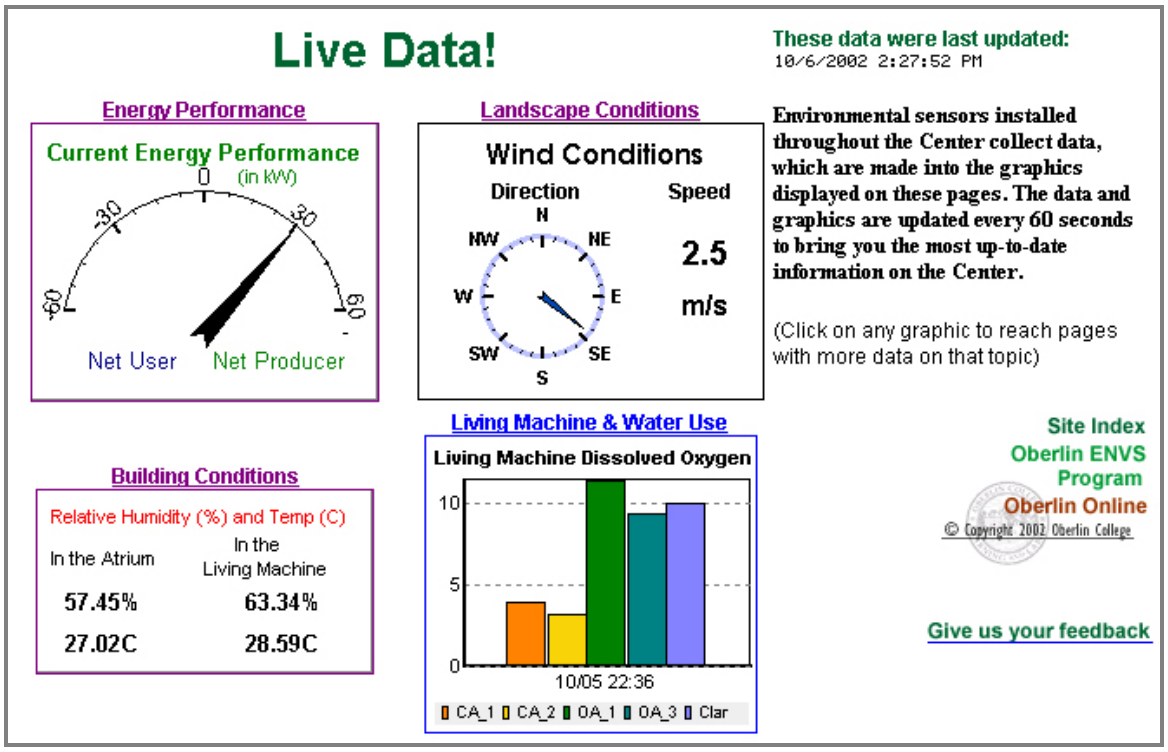

Figure 5.5 Website data display (Adam Joseph Lewis Center).

Providing access to this data is a key element in educating the public and other universities about the successes and obstacles that the center is encountering day to day and over the long term. Storing and organizing the data allows analysis of long-term trends, reveals patterns in energy use, and indicates potential problem areas. Being able to measure and quantify successes and setbacks has proven vital to the continuing evolution and improvement of the Adam Joseph Lewis Center for Environmental Studies.

LANDSCAPE

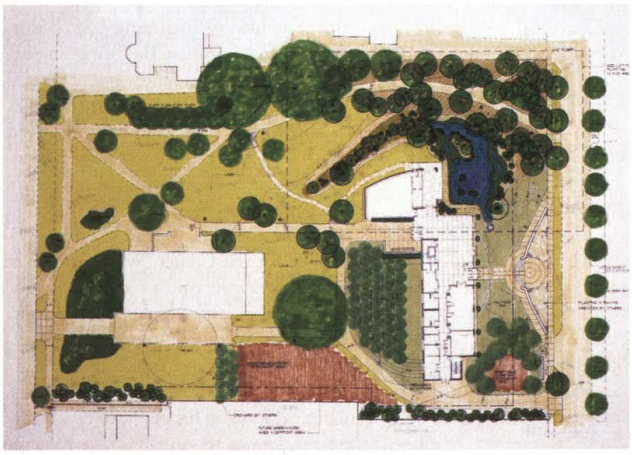

Figure 5.6 Plan view of the AJLC (Bennett 70)

What none of the other case studies has considered up to this point is the explicit connection between their building and the surrounding landscape. Oberlin however, addresses this topic admirably and recognizes the importance of integrating buildings with their surroundings. This is an important and logical next step in the evolution of the case studies that I have analyzed. The case studies have moved from the first efforts to demonstrate the practicalities of sustainable technologies, to universities sustainably renovating individual buildings, to the integration of landscapes with sustainable building designs. Hopefully the trend will continue and lead to renovations of groups of buildings, their landscapes, and entire campuses in other universities and cities around the world.

The AJLC is a beautiful example of how aesthetics, history, and functionality can be combined to produce a productive, educational, and ecologically sound landscape. The new Center landscape is composed of several different ecological communities: native deciduous trees, a wetland, a permaculture (food growing) garden, a lawn, an orchard, and a social landscape (Adam Joseph Lewis Center for Environmental Studies). These different landscapes were designed to work in cooperation with each other to evolve over time and produce a rich and vibrant educational and recreational environment for the community to enjoy.

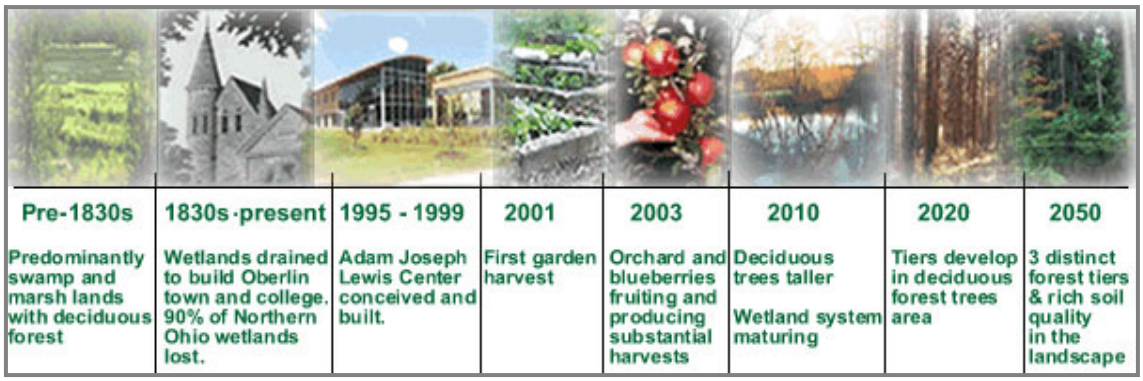

Figure 5.7 Landscape Timeline from Adam Joseph Lewis Center.

Landscape management also plays a crucial role in ensuring the success of the AJLC landscape and provides another way for the Center to show sustainable methods at work in the landscape. Some of the management lessons illustrated by the AJLC landscape are:

- The value of disturbance in ecosystems
- The use of native plant species and the reduced need for pesticides
- The benefits of integrated pest management
- Organic farming methods
- How a landscape can compliment the operations of a building
- How native plants can foster a sense of place and educate about landscape history.

(Adam Joseph Lewis Center for Environmental Studies)

Students, faculty, and volunteers all participate in implementing these management strategies. By creating a population that has a vested interest in the continued well-being of the landscape, the Center is ensuring that the community will stay involved with the maintenance of the garden.

The landscape is not just a separate entity from the building though. The AJLC has harnessed the power of plants, photosynthesis, and rainwater to fully integrate ecological processes with the new building. As trees mature they will provide shade for the building and reduce the heating costs in the summer. When rainwater falls it is collected and used for irrigation during dry seasons. And when a sink or toilet is used in the building, the

gray/black water is processed and cleaned by the Living Machine® housed in the atrium. All of these processes reveal how building and landscape can work together to create a healthy, responsible learning environment that gives back more to the environment than it takes from it. By combining responsible material selection and use, a systems design approach, and a sustainable vision for the future the Adam Joseph Lewis Center for Environmental Studies is leading the way for sustainable design.

Figure 5.8 Wetlands surrounding the building (Adam Joseph Lewis Center).

To conclude I would like to relay a story about an Oberlin student that illustrates how some of the benefits of sustainable building design can not be quantified by measurements or numbers:

> James McConaghie ('03) has been involved in research and operations on the Living Machine since his freshman year. James suffers from "multiple chemical sensitivity" disorder - he gets sick when he is exposed to volatile synthetic organic compounds that are typically associated with new carpets, paints and adhesives. For health reasons, James' classes in the new Science Center and several other buildings on campus must be videotaped so that he can watch them in a location that does not cause him to break out in hives. As a result of the decision to select low VOC paints and adhesives, James could walk into the Center and feel healthy on the first day that the doors were open. That is a measure of success that is difficult to quantify numerically. (Adam Joseph Lewis Center for Environmental Studies)

ASPECTS FROM THIS SITE THAT ARE APPLICABLE TO THE LAMAR DODD RENOVATION

The AJL Center for Environmental Studies has many aspects of planning and design that are applicable to the Lamar Dodd Building and the CED campus. First, the Center's inclusion of the landscape provides an excellent example of how to move sustainable design

beyond the interior of a building. By including the landscape, the Center reaches beyond the bounds of its own building and connects to its surroundings. Although the CED will not have as much open "green" landscape around its buildings, it will have to deal with connections to surrounding buildings and the rest of the university in a more urban environment. This difference in location presents an opportunity to see how similar design principles can be applied in different environments.

The AJLC also serves as an example of how to incorporate the surrounding community into the design process. The CED campus has not only an active student body to draw upon for design advice, but also an active surrounding community that should be involved in the design process. The entire planning process should be open to the public. Everything from the master plan to the renovation of the Lamar Dodd Building could benefit greatly from the involvement of different user groups from the beginning. Holding charrettes for different design aspects will allow user groups to be involved in the design process at crucial points in the design process. Above all, the CED must avoid falling into the trap of assuming that because we are a professional field that we can design the CED master plan in isolation. The CED needs to reach out to community members who will be influenced by the new campus and include their opinions in the design process.

Finally, the CED campus presents an opportunity to monitor a community's energy performance as opposed to looking at only a single building. Imagine the energy savings if the entire CED campus were designed to maximize effectiveness of its systems and reduce inefficiency. The only way to know if this is happening though is to monitor the results of the technologies installed. Audubon House has failed to carry on its monitoring efforts and is therefore no longer a model to learn from. The AJLC however has embraced monitoring efforts and the concept of building evolution. As long as the AJLC monitors and learns

from its building performance data, it will serve as an educational tool for Oberlin University and the public.

In conclusion, it has been proven that sustainable technologies are affordable and can work successfully at the single building scale. That scale now needs to be enlarged. Instead of looking at only one building, the next step is to develop entire communities of sustainable buildings and landscapes. This is where the CED can offer the most to the field of sustainable design and renovation. Individual buildings, including Lamar Dodd, have the opportunity to be designed from the start as a part of a larger whole. Sustainable technologies and landscapes can be experimented with on a campus wide scale, instead of in isolation. It is time to take the systems approach of design and apply it to the community scale. Only then will we be able to see the true potential of sustainable design.

CHAPTER 6

THE LAMAR DODD BUILDING RENOVATION

The goal of this chapter is to develop a course of action for the Lamar Dodd Building renovation based in part upon lessons learned from the previous case studies. The chapter begins with a brief history of the Lamar Dodd Building, followed by a tour of the existing building conditions. Next, a course of action is developed by looking at opportunities for sustainable decision making during the design process, followed by recommendations about how sustainable technologies can be used as educational tools. The overall goal is to explore how sustainable design can be used to transform the Lamar Dodd Building and landscape into a site that can educate and inspire its users on a daily basis.

HISTORY

The Lamar Dodd Building was constructed in 1961 and was dedicated on January 21, 1963. Formerly known the Department of Art Building, it is one of the most unique and controversial buildings on the University of Georgia campus. As Alfred H. Holbrook, former director of the Georgia Museum, said just after the building's opening, "There isn't another structure like it in heaven, earth, or hell" (Sparks 15). Lamar Dodd, a prominent artist and then head of the art school, was the man responsible for the building's design concept. He went against all previous trends in construction and policy at the University of Georgia by designing a building that challenged the status quo of campus architecture. To quote Holbrook again, "It took some nerve to get a building like that in an old stodgy institution like this" (Sparks 15). While most of the other buildings on campus are

dominated by red brick and tall columns, the Lamar Dodd building is a concrete and stucco building that uses large amounts of daylight, access to the outdoors, and ample studio space to create an inspirational learning environment.

Although the 47,000 sq. ft. building goes against the traditional architectural grain of the university, its design concept is well suited for encouraging "thinking outside of the box" and innovative design. The message and intent of the Lamar Dodd Building design was best captured in John Gardner's dedication speech about self-renewal on January 21, 1963:

> I like to think that the students who gain some of their education in your beautiful new building will never again have to travel to cure their blindness […] All too often we are giving our young people cut flowers when we should be teaching them to grow their own plants. We are stuffing their heads with the products of earlier innovation rather than teaching them to innovate […] The development of abilities is at least in part a dialogue between the individual and his environment. If he has to give and the environment demands it, the ability will develop […] But learning is a risky business[…]It is wisdom to cut through such abstractions and artificialities in a periodic return to the solid earth of direct experience - direct contact with nature, face-to-face relations with one's fellow man, fashioning something with ones own hands.

Gardner's speech challenges us to embrace originality and use the innovative design of the Lamar Dodd Building as inspiration for our work and our lives.

The interesting part about any building though is that its original message and intent can get lost over time in the layers of additions and modifications made in the name of progress. Such is the case with the Lamar Dodd Building. The addition of acoustic tiles, the closing of the gallery as a general exit and entrance, air conditioning modifications, and general use have all led to the loss of the building's ability to effectively communicate its original message. The original design has also posed problems in terms of climate control and user comfort. The large amount of windows on the east and west sides of the building

cause noticeable temperature fluctuations that were never completely corrected by HVAC systems.

The new CED has the opportunity to change all of this. New technologies are now available that can strip away systems clutter and ameliorate climatic problems. The building can be used to reveal the processes of its interaction with its surrounding environment as well as educate and inspire its users about design innovation. However, before exploring how all of this can be accomplished, I would like to give you a tour of the existing conditions of the Lamar Dodd Building.

LOCATION AND BASE MAP

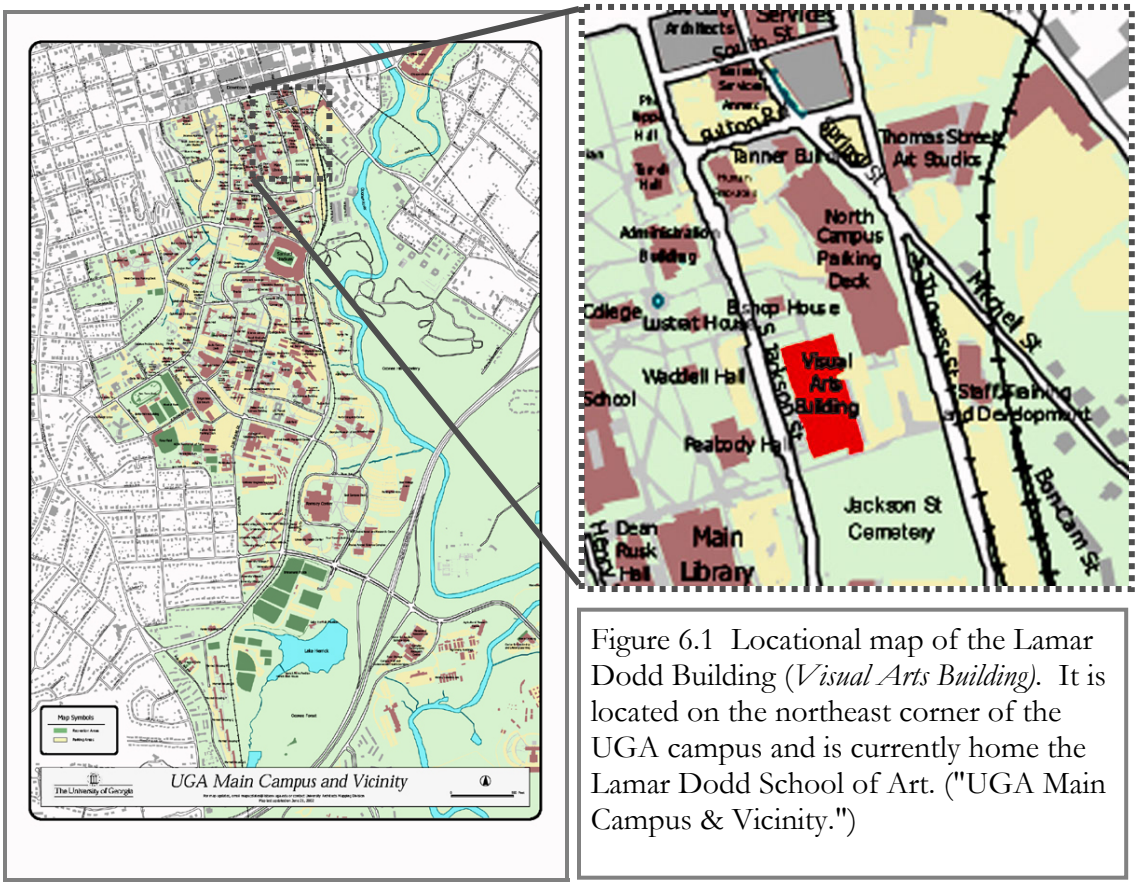

Figure 6.1 Locational map of the Lamar Dodd Building (*Visual Arts Building*). It is located on the northeast corner of the UGA campus and is currently home the Lamar Dodd School of Art. ("UGA Main Campus & Vicinity.")

TOUR OF THE LAMAR DODD BUILDING

The tour of the site begins with a look at the exterior of the building and its surrounding landscape. Next is a walk through of the interior of the spaces beginning with the main lobby and ending with the auditoriums. The lower level of the building is not shown because its areas are very similar in layout and design to the upper levels. Recommendations for specific changes to the site and building are made later in the chapter.

The West Side

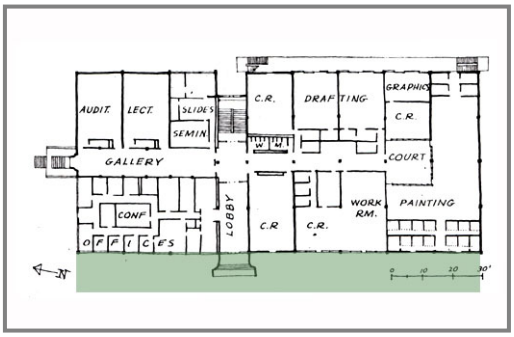

Figure6.2 Map highlighting the west façade of the Lamar Dodd Building. (Original "non-highlighted" map from "A Stage is Set for Art" 60)

The west façade serves as the building's main entrance and faces Jackson Street on the UGA campus. The large amount of windows on the façade present an excellent opportunity to use passive cooling techniques to control temperature fluctuations and increase user comfort.

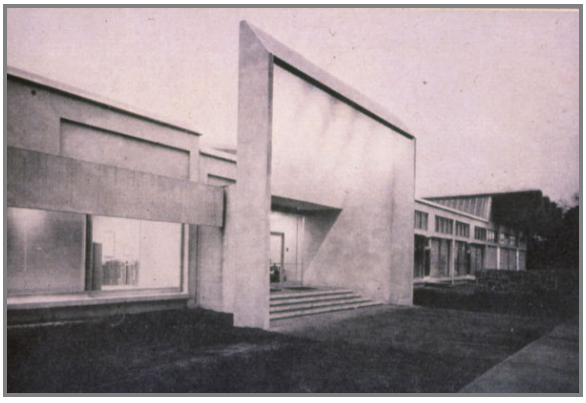

Figure 6.3 West façade of the Lamar Dodd Building in 1963. (*Courtesy of Lamar Dodd School of Art*)

Figure 6.4 Looking south along the west façade. 2002.

The North Side

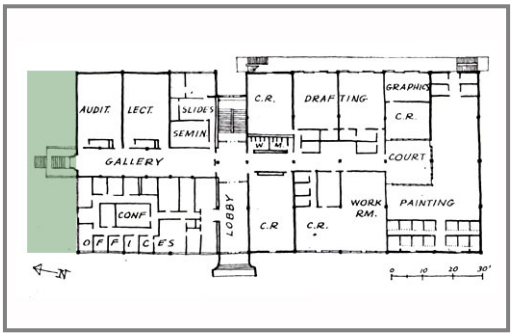

Figure 6.5 Map highlighting the north façade of the Lamar Dodd Building.

The north façade connects the Lamar Dodd Building to the North Campus Parking Deck and the historic Bishop House. Currently both the gallery and the faculty offices open onto this side of the building. There is a large amount of landscape that could be used for educational purposes and as social outdoor areas.

Figure 6.6 Looking at the barrel-vaulted gallery (left-side) and the main outdoor social area on the north

The East Side

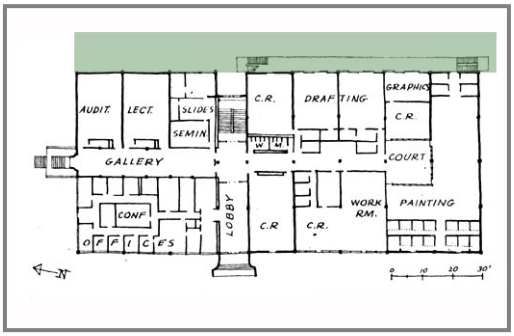

Figure 6.7 Map highlighting the east façade of the Lamar Dodd Building.

The east façade has the greatest number of windows and provides a view over East Athens. Currently there is parking and a drive to the parking deck located on this side of the site. There are possible future plans to infill this site for the CED campus.

Figure 6.8 The eastern façade in 2002.

Figure 6.9 The eastern façade in 1963. (*Courtesy of the Lamar Dodd School of Art*)

The South Side

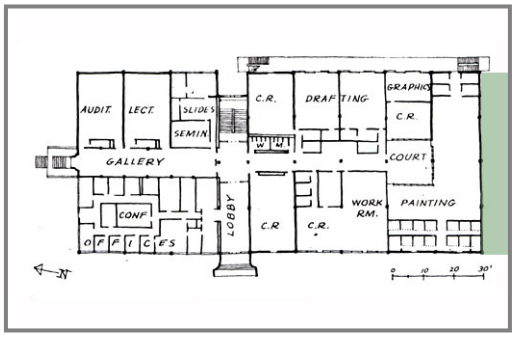

Figure 6.10 Map highlighting the south façade of Lamar Dodd.

The south side of Lamar Dodd is a narrow corridor that leads from the Main Library to parking on east campus. The Oconee Cemetery is located on the south side of the building. The path along this side is a thoroughfare and does not provide major access to the building.

Figure 6.11 Looking west along the south side of the building. 2002.

Figure 6.12 Oconee Cemetery to the south of Lamar Dodd. 2002.

The Main Entrance and Lobby

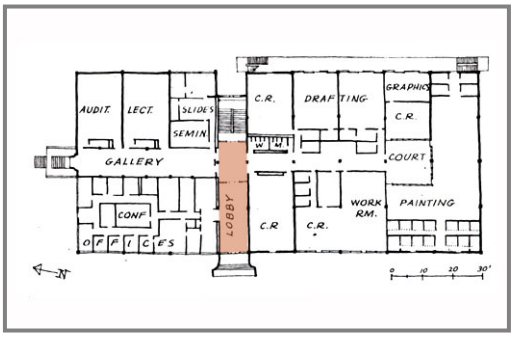

Figure 6.13 Map highlighting the Lobby of the Lamar Dodd Building.

The main entrance to the Lamar Dodd Building is used as a display area for student and faculty art work. From the lobby you can access any other part of the building and can see through the windows on the east façade. The gallery is located at the far left end and the lobby serves as a gathering area before openings. The lobby is where most people enter the building and could be used for future demonstrations concerning the renovation of the building.

Figure 6.14 Lobby in 2002 used as a student art work display area.

The Offices

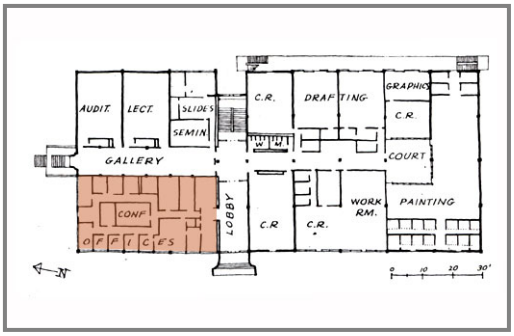

Figure 6.15 Map highlighting the offices of the Lamar Dodd Building.

The offices on the west side of the building have windows that let in a large amount of daylight. However, offices on the interior of the building receive little or no natural light. Clerestory windows could be installed in the interior side of perimeter offices to daylight the interior of the building for all users.

Figure 6.16 View down the main corridor of the offices. Notice the lack of daylight.

Figure 6.17 Interior view of office. 2002.

Figure 6.18 Faculty Lounge at the northwest corner of the building. Perimeter spaces like this have access to a lot of daylight. 2002.

The Gallery

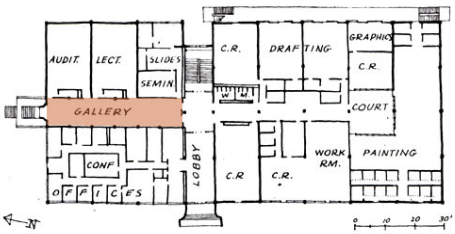

Figure 6.19 Map highlighting the gallery of the Lamar Dodd Building.

The gallery is the formal display area for art exhibitions in the Lamar Dodd Building. The gallery is barrel-vaulted and provides a unique setting for art installations. Possibilities for renovation include installing glass on the north or east part of the ceiling to let in natural light and opening up the north entrance for general access.

Figures 6.20 and 6.21 Inside the barrel-vaulted gallery.

The Courtyard

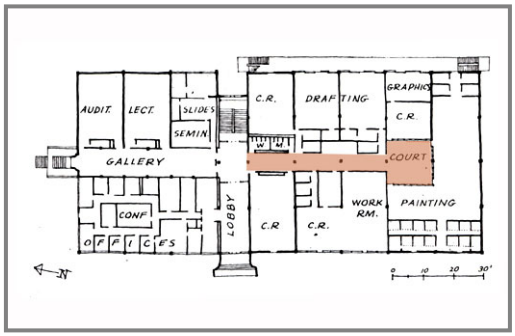

Figure 6.22 Map highlighting the hall and courtyard of the Lamar Dodd Building.

The courtyard was originally intended to be an indoor social area with views into all of the surrounding studios. Over time though, the building has changed into more of a display area and has been closed off with temporary walls, preventing views into the surrounding studios.

Figure 6.23 The courtyard in 1963. (*Courtesy of the Lamar Dodd School of Art)*

Figure 6.24 The courtyard now. (*Courtesy of the Lamar Dodd School of Art)*

The Painting and Studio Areas

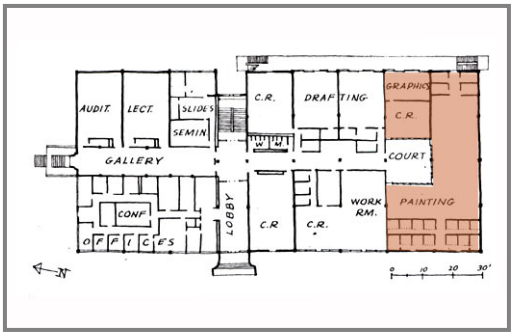

Figure 6.25 Map highlighting the studio and painting areas of the Lamar Dodd Building.

The painting and studio areas of the Lamar Dodd Building are some of the most unique spaces on campus. The batwing extensions on the roof have north facing skylights that allow in a comfortable amount of daylight, reducing the need for indoor artificial lighting.

Figure 6.26 The north facing skylights (1963). (*Courtesy of the Lamar Dodd School of Art).*

Figure 6.27 The interior of the painting studio in 2002.

The Classroom and Drafting Areas

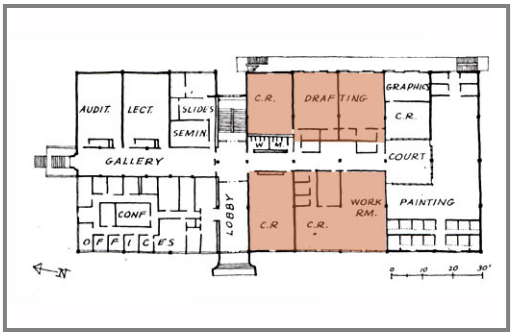

Figure 6.28 Map highlighting the classrooms and drafting areas of the Lamar Dodd Building.

The classrooms inside the Lamar Dodd Building are spacious and open. The drafting rooms have raised loft-like areas that house computer labs and equipment. These rooms are perfect for future CED studios and labs.

Figure 6.29 Inside A classroom on the west side of the building. 2002.

Figure 6.30 A drafting area on the east side of the building. 2002.

The Auditoriums

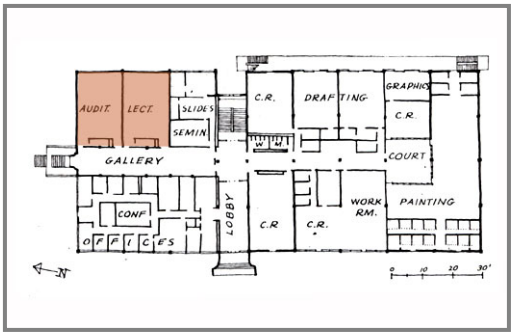

Figure 6.31 Map highlighting the auditoriums of the Lamar Dodd Building.

Figure 6.32 The northern auditorium in 2002.

Finally, the auditoriums are located at the northeast corner of the building off of the gallery. They will provide ample space for large classes and CED sponsored lectures.

As shown above, the Lamar Dodd building has several unique spaces that can be easily adapted to the needs of the new CED by the incorporation of sustainable design. The following section discusses the process of the building renovation, followed by a brief look at possible educational applications of particular sustainable technologies.

THE DECISION MAKING AND DESIGN PROCESS

This section explores the opportunities for sustainable decision making in the development and planning processes of the Lamar Dodd Building renovation. As mentioned in Chapter 1, the definition of sustainable design that I am using for this study is "the process of solving problems by considering their social, humanistic, technological, environmental, and economic aspects and basing decisions regarding these factors on The Hannover Principles." Some of the following opportunities for sustainable decision making come from the earlier case studies and help create an instructive list of considerations including goal setting, consensus building, community involvement, economic cost justification, and project monitoring and maintenance. When these issues are combined with specific technologies and informed design decisions, the entire renovation process will become a learning tool for the CED and the surrounding community.

COMPONENTS OF THE SUSTAINABLE DESIGN PROCESS

Up to this point, several case studies have been examined to study the renovation and design processes of past projects. What this examination has revealed is that each locality has different environmental concerns that can be used to inform design decisions and that local and regional problems can influence planning choices. What local and regional issues can influence the renovation of the Lamar Dodd Building? The new CED campus? These are questions that will have to be answered during the design process.

Described below are opportunities to break out of the normal planning process and explore new ways of making decisions followed by the summary chart that serves as a checklist for the general design process. Although these opportunities are loosely organized according to their chronological order of consideration, the framework is not a timeline to

be followed rigidly. Every planning process is different and issues are often brought up in a different order than listed below. This "organic" nature of the design process should be embraced and used to its full advantage, but a well understood set of goals needs to be made at the beginning to ensure that the planning process is kept on track.

Also, although I have tried to make this list as complete as possible, there are bound to be issues that were not covered. There may also be issues listed that are found to be nonessential to the planning process. Whatever form the final planning process for the Lamar Dodd Building takes, the renovation should always strive to achieve its original aim of creating a building and landscape that teaches and inspires its users on a daily basis.

Planning the Process

There are several steps that are the responsibility of the client that must be looked at before the design and construction can begin. One of the most important steps is the creation of a mission statement that will guide the overall development of the project. Another is building an in-house team that will make decisions throughout the process. Before getting into specifics it is also useful to generate a master plan and go over the entire design process from beginning to end. In general, planning the process will help visualize what lies ahead in terms of decision making and will allow you to map out a general plan of action.

Documentation

As soon as the process of planning for the renovation begins so should the documentation process. Records should be kept from the very beginning concerning meeting topics, community involvement, product selection, costs, and timetables. Documentation can include written, photographic, and drawn media. Anything that be used

to record the process of the renovation should be saved and archived. All of this data will come in handy as references for future projects and for post-construction analysis of the project.

Design Team Formation

The selection of the design team and contractors will be an important first step in determining the outcome of the Lamar Dodd renovation. The design team needs to be involved in the planning process from the very beginning so that they have the opportunity to participate in every aspect of the design process. The design team will be a valuable resource for information and advice and will help set other aspects of the design process in motion. By researching and choosing firms that have a proven record of innovative problem-solving, working with the community, and working with integrated design teams, the CED can take a large step toward achieving its goal of sustainably renovating the Lamar Dodd Building.

Goal Setting

Goal setting should be a participatory process. There are many different stakeholders in the development of the CED campus and the Lamar Dodd Building. By involving as many of these interest groups as possible from the very beginning, the CED will gain input from possible users of the building and will have a large amount of feedback to draw from when making decisions. All of the previously mentioned case studies have held charrettes or met with members of the community to gather input and ideas for design solutions. These stakeholders have helped answer crucial questions such as: What do we want to see accomplished overall? What is the best way to get there? What are the most important areas of concern? The least? Answering these questions begins to develop short

and long-term goals for the project and creates ways of measuring successes and failures. Other schools and organizations have proven that community involvement in these major decisions generates an impetus for change and infuses realistic design needs into the planning process. The CED has a large student, faculty, university and community body to draw from for their goal setting and planning process.

Creating an entire list of goals for the Lamar Dodd renovation is beyond the scope of this study. Only by brainstorming with the design team and stakeholders will the actual list of goals be generated. However, there are several goals that I believe are critical to the successful completion of the Lamar Dodd renovation:

1. Sustainably adapt the Lamar Dodd Building to a new use while simultaneously respecting the history of the structure and embodying the goals of the CED.
2. Create an opportunity for interdisciplinary study, research, and cooperation between the Landscape Architecture, Historic Preservation, and Ecology programs by integrating the renovation into the curriculum and course requirements.
3. Use local and regional issues to inform and influence design decisions. (Ex. Athens-Atlanta commuter rail, student housing needs, Oconee river health, watershed issues, etc.).
4. Optimize building performance instead of complying with building codes or accepted standards. Implement practical yet innovative solutions whenever possible instead of relying on standard methods or technologies.
5. Be a net energy producer instead of a net energy consumer.
6. Keep all rainwater on site.

7. Serve as an example for other universities and organizations to learn from. Learn from other renovation and sustainable design efforts and make all data from this renovation available to the public for future projects.

These goals are purposefully broad. The actual goals will have to be much more specific when the project is underway to address all of the aspects of the design. Although the goals may change over time once the project gets started, the original goals will always serve as a reminder of the initial aim of the project. In this way, the goals set for the renovation are a guiding vision for the entire project.

Decision Making Criteria

One of the difficulties of making decisions for a large project is that decisions are no longer made by an individual, but by several different people. By determining criteria for decision making at the beginning of the project, decisions can be made by different groups of people in a manner consistent with the original intentions of the project. For example, the Audubon House case study was an excellent example of this using life-cycle cost analysis and payback periods to set standards regarding product choices. This process illustrates how decision making criteria can lead to group decisions that fit the constraints of the budget while at the same time putting environmental criteria at the forefront of decisions. By adhering to their original standard of a 5 year payback period, consistent decisions were made that kept the project on track and on budget without sacrificing the original goal of environmental responsibility.

Education, Communication, and Community Involvement

One of the most important aspects of sustainable design and planning is the education and involvement of the surrounding community. The AJLC at Oberlin was an

excellent example of the success of community involvement and input. The AJLC design team held 13 charrettes and involved as many people as possible in the design and construction of their building. By getting people involved in the planning process, AJLC was able to develop a stakeholder base with a vested interest in the outcome of the project. These stakeholders had input into the design of the project and now help with maintenance and management of the site. The CED has a very large base of interdisciplinary students and faculty to draw from, as well as local schools, other universities, conferences, listserves, different academic departments, volunteer organizations, student groups, and neighborhood coalitions. All of these resources should be utilized to ensure a holistic design that takes into consideration as many viewpoints as possible.

Fundraising, Publicity, and Corporate Partnering

Several other sustainable design and construction projects have taken advantage of the benefits of corporate, governmental, and non-profit partnerships. The Barney-Davis renovation took full advantage of corporate partnerships by trading free advertising for use of materials. The AJLC at Oberlin partnered with the National Renewable Energy Laboratory (NREL) and received a grant to help develop a state-of-the-art building monitoring system ("Oberlin College"). These endeavors were successful because the the sponsoring organizations shared the same overall values as the project teams. The CED would gain valuable support, money, and access to resources by seeking out grants, partnerships, and sponsorships for the Lamar Dodd Building.

Inventory and Pre-Occupancy Evaluation

Before making any decisions about what changes should be made to the site an inventory and pre-occupancy evaluation should be undertaken. The inventory will

document the existing and historic conditions of the site and its surroundings, and could include a site analysis, transportation analysis (campus, city, and regional), a watershed analysis, inventory of local resources (volunteer labor, stakeholders), water resources, existing building systems, and others. The pre-occupancy evaluation would document the opinions of the current users regarding the existing conditions within the building and would help the design team identify possible areas of concern. The survey could be based upon the Barney-Davis student survey (Appendix B) and would yield valuable "before and after" information when combined with the post-occupancy evaluation.

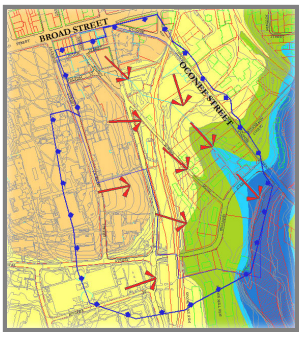

Figure 6.33 Watershed analysis from the 2001 Summer Studio.

Feedback Analysis and Design

The sustainable design process is not linear; making decisions, evaluating the outcome, and then going back and making modifications that lead to new decisions is part of the sustainable design process. Input should be sought whenever possible to inform decisions and above all, once decisions are made the results should be monitored for indications of necessary changes or modifications. The design process therefore becomes cyclical and allows for constant improvements to the system.

Construction and Waste Management

The construction process is one of the most critical opportunities for reducing negative environmental impacts of the renovation. The contractor should be held responsible for all energy used as well as any unacceptable damage done to the site. Student and volunteer labor could sort through debris either for reuse on site or for donation to a

local non-profit organization. For example, if more efficient windows are installed the old windows could be donated to Hands on Athens or Habitat for Humanity. Other measures such as erosion and sedimentation control, recycling non usable items, and tree protection measures would also help ensure an environmentally friendly construction process.

Product Selection

Product Selection is perhaps the most visible and well studied area of sustainable design. There are several lists of companies that sell certified sustainable products and that encourage sustainable product life cycles (see The Greening of Dana and Barney-Davis Green Renovation). These companies' products should be selected and used whenever possible, assuming they are economically justifiable. When there are several products that are new to the market, or offer very different benefits from typical products, those products could also be used as experiments. The Dana Building's installation of composting toilets is one example of experimenting with non-traditional products. Detailed research should be done into which products are the most cost effective, aesthetically pleasing, and environmentally responsible for use in the Lamar Dodd Building.

Data Monitoring and Analysis

Data monitoring and analysis is crucial to attaining the expected performance of the building systems installed during the renovation. Because the building will be designed as a system, there are very complex interactions that will require monitoring and analysis to ensure that all of the different parts are functioning properly. Also, data monitoring provides a way of quantifying energy gains and losses, temperature fluctuations, and other valuable information. The AJLC is the best example of the success of data monitoring and analysis. Sensors throughout their building report information on a myriad of variables that

indicate the operating status of their systems. By being able to quantify the effects of changes to the system over time, the AJLC can document how specific technologies or modifications have impacted building operations.

Not only should this data be monitored, but it should also be conveyed to the public in a meaningful and informative way. The AJLC has a station at the entrance to their building that lets visitors see exactly how the building is performing at that moment and also maintains a website that gives up to the minute information regarding all aspects of building performance and climatic conditions. These displays educate the public about the building's performance and provide and interactive way of informing users about how a building and its landscape can change in response to different conditions.

Post-Occupancy Evaluation

The post-occupancy evaluation is one of the most valuable, and subjective, means for measuring success of a building renovation. The Barney-Davis renovation used the post-occupancy evaluation as an integral tool in the management of the building after the main construction was completed. By listening to building user's comments, the surveyors were able to make recommendations that might otherwise have been missed. The evaluations also provide a way of quantifying user satisfaction as well as documenting changes in occupant's perceptions of the building after the renovation.

Maintenance and Management

Ongoing maintenance and management of the Lamar Dodd Building and its landscape is crucial to its success as an example of sustainable design. Sustainable design can not be limited to the actual construction process, but should integrate the everyday management and maintenance of the building into the planning life cycle. By promoting

environmentally responsible cleaning supplies, practices, and landscape management on a daily basis, the Lamar Dodd building will continue to be a valuable educational resource for the students of the CED, the University of Georgia, and the world.

Checklist for Sustainable Design

The chart shown below is meant to be a general guide for those beginning the sustainable design process. The chart is divided into three main sections shown in **blue.** These main sections are then broken into subsections shown in yellow. Within each of these sections are questions and raise issues that are crucial to the design process. Not all of the issues that should be addressed during the design process are mentioned in the chart. This chart is meant only as a starting point to help start a design process that will holistically address the design of the site. After the chart I discuss how technologies can be used as educational tools in the Lamar Dodd Building.

Chart 6.1 Components of Sustainable Design checklist

Checklist	Component of Sustainable Design
	Pre-Construction Phase
	Pre-Planning Process
☐	Go over the entire design process and evaluate areas in need of more research.
☐	Discuss and write down the overall mission of the project.
☐	Decide which type of design process is most suitable to your specific site and circumstances.
☐	Research and locate local resources that you can draw on.
☐	Build an "in-house" design team to oversee the entire design process.
☐	State who your clients and end users are and what are their general needs.
☐	Begin generating ideas for the master plan of the site and how to involve the community.

	Pre-Construction Phase (Cont'd)
	Documentation
☐	Decide what means of documentation will be used for the entire process: • Record meeting minutes? • Videotape meetings? • Digitizing images for electronic storage? • Archiving letters, internal documents, correspondence, and conversations?
☐	Decide who will be responsible for the documentation process. Who will fulfill this role in the future?
	Goal Setting
☐	Set goals for the overall design process that will help achieve the mission statement made at the beginning.
☐	Answer questions that will guide the entire design process: • What do you want to see accomplished overall? • What do you want accomplished for each piece of the site? • What is the best way to get there? • What are the most important areas of concern? • What are the least important areas of concern? • What local and regional issues can be used to inform goals set for the project?
☐	Develop a list of long and short term goals.
	External Design Team Formation
☐	Build a team that supports the overall goals of your project and involve them from the beginning.
☐	Make sure the design philosophies of the chosen firms match that of your own project.
☐	Decide upon which disciplines you need expertise from for your project.
☐	Make sure that firms considered have proven records of innovative problem solving, working well with the community/client, and working well in teams. • What past projects have they been involved in? • Do previous clients recommend them highly?
	Goal and Objective Setting
☐	Have all parties meet and set specific goals for the project that involve expertise from the design team, the in-house experts, and other interested stakeholders.
☐	Set specific goals and objectives for different aspects of the design process.

	Pre-Construction Phase (Cont'd)
	Goal and Objective Setting (Cont'd)
☐	Document the existing conditions of the site and its surroundings. • Site analysis (campus, city, and regional) • Watershed analysis • Inventory of local resources (volunteer labor, stakeholders) • Water resources • Existing buildings and their components • Site history • Current plans for the site
☐	Perform a pre-occupancy evaluation to document the existing conditions of the site. Identify possible areas of concern from current users. Combine this data with the post-occupancy evaluation to see if the concerns have been properly addressed.
	Education, Communication, and Community Involvement
☐	Decide who you want to involve in the design process. Who are the stakeholders? Who do you want to participate in this process? Figure out ways to get them directly involved with the ongoing maintenance and management of the site.
☐	Determine what sort of forum should be held to encourage input and educate the community. Charrettes? Small meetings? A website to solicit feedback?
☐	Make an effort to educate the general public about what you are doing and why. Try to get their support from the beginning of the design process.
	Charrettes
☐	Determine who to invite to each charrette. • Should all of the stakeholders be present at once? Or one at a time? • Should all participants be local or should they come from all over?
☐	Decide upon appropriate themes for the charrettes: goal setting, design options, connections, dealing with water resources, landscape design solutions, etc.
☐	Determine appropriate timing for the charrettes and how they will be scheduled in accordance with the rest of the design process.
	Feedback Analysis and Design
☐	Analyze the ideas and suggestions from the charrettes. • What can you learn from them? • What topics did they bring up that have not already been addressed? • How can they be integrated into the design? • Does the feedback point to areas of design that need to be modified?
☐	Go back and analyze your previous decisions and design solutions in light of the information gathered during the charrette.

	Pre-Construction Phase (Cont'd)
	Fundraising, Publicity, and Corporate Partnering
☐	Locate corporations, individuals, groups, and organizations that share the same goals as you and that may be willing to donate money or time.
☐	Research and locate organizations that can provide grants or are willing to partner with you to conduct research.
☐	Explore possibilities for exchanging free advertisement of technologies for the use of products.
	Product Selection and Corporate Partnering
☐	Decide what stance you want to take on using experimental technologies: • Do you want to go with what is proven? • Or do you want to experiment?
☐	Research and locate companies whose products show that they share the same mission and goals as you. For example, only purchase wood products from certified sustainable foresters.
☐	Set guidelines for product selection such as price restrictions, life-cycle cost analyses, and pay-back periods, and maximum levels of toxicity. Adhere to these guidelines for all product selections.
	Construction Phase
	Construction and Waste Management
☐	Meet with contractors prior to beginning work and educate them about the requirements for the construction process. Make sure that they understand the standards that they will be required to meet.
☐	Make the contractors responsible for all electricity charges and for any damage to landscape outside of preset limits. For example, FEDEX put large price tags on all of the trees surrounding the site of its new headquarters; clearly indicating how much the contractors would have to pay for damaging any single tree.
☐	Determine how construction debris can be either reused or recycled. Donate any unused materials to local recycling centers or non-profit organizations like Habitat for Humanity.
☐	Have someone onsite making sure that the contractors complete the work according to your specifications.

	Post-Construction
	Data Monitoring and Analysis
☐	Collect data that documents changes in the quantities of electricity, water, and resources that are being used or generated. Collect data on as many variables as possible over time and compare it to data from before construction.
☐	Quantify the changes over time to document how specific technologies or combinations of them have impacted system operation.
☐	Make this data available to the general public so that other projects can learn from your experiences.
	Post-Construction Education
☐	Determine ways that the users can be educated on a daily basis about the design of your site: • Plaques? • Informational signage? • Interactive data display consoles? • Active participation in the management of the site?
	Post-Occupancy Evaluation
☐	Conduct a post-occupancy evaluation and compare the results to a pre-occupancy evaluation, if present.
☐	Analyze the responses. What recommendations can be made for future changes?
	Ongoing Maintenance and Management
☐	Use daily cleaning chemicals that are safe for the environment and promote healthy indoor air quality.
☐	Encourage environmentally responsible landscape management practices including integrated pest management, water conservation, and the use of native plants. Educate users about why these decisions were made.
☐	Educate the site caretakers about the importance of adhering to specified cleaning methods.
☐	Educate the site caretakers about the maintenance and use of all of the sites systems. Make sure that they are well versed in how these systems operate individually and as a whole. The caretakers may be there longer than anyone else involved in the design process.

EDUCATIONAL APPLICATION

Although the installation of energy efficient and environmentally responsible technologies is part of sustainable design, it is also necessary to expose how these technologies work together to form a system. Exposing the technologies and systems used on a site educates users on a daily basis about the interconnection of different processes. Without this exposure people lose sight of the impact that they have on their surroundings and they begin to take the environment for granted. The renovated Lamar Dodd Building has the opportunity to open the eyes of its users to sustainable design by being a building that educates. By revealing different aspects of design as part of as system and making them visible and interactive with the public, the Lamar Dodd Building will be a pedagogical tool instructing everyone that visits it.

The following topics focus on exposing the connections between building, landscape, and environment. They illustrate how different aspects of the Lamar Dodd renovation can be used to educate building users on a daily basis, how the mission of the CED can be embedded in the building itself, and how the lessons taught inside can be applied in the real world.

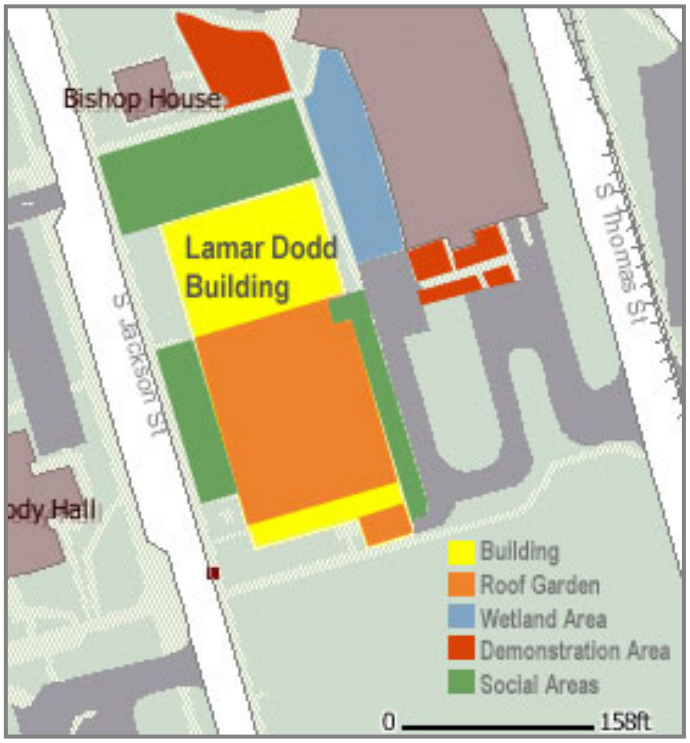

Figure 6.34 Overall concept map for the Lamar Dodd Building and its site.

Daylighting, Windows, and Lighting

Because of the large amount of windows on the west and east facades, the installation of windows with high r-values (i.e. Heat Mirror® windows) would dramatically decrease temperature fluctuations inside the building. These windows would reflect heat and UV radiation from the outside while keeping the inside air a more consistent temperature. Installation of clerestory windows in perimeter offices would also allow more daylight to reach the interior of the building. Occupancy sensors, pendant lights, and dimming circuits could also be installed in every room to increase the overall efficiency of energy use within the building. Venetian blinds and other adjustable shading mechanisms also provide valuable shade and can reduce the intensity of the sunlight entering into a room. Operable windows provide cross ventilation within a building and allow more control over a persons immediate surroundings.

Figure 6.35 Current offices.

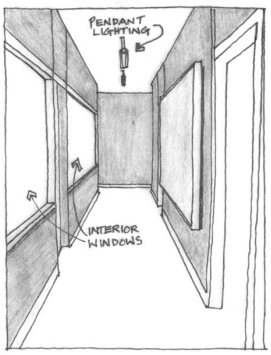

Figure 6.36 Offices with clerestory windows and pendant lighting.

Figure 6.37 Inside Audubon House (Crosbie 184).

Passive Cooling

The use of passive cooling techniques would also be a cost effective way of decreasing temperature fluctuations and increasing user comfort within the building. For example, the offices on the west side of the building could have an enclosed awning and trees that provide shade from the hot afternoon sun. These measures would decrease the need for excessive heating and air conditioning in the winter and summer months and would reduce the amount of bright light entering the offices.

Figure 6.38 Passive cooling techniques for the exterior of the building.

Solar Energy

Because of the Lamar Dodd Building's southern orientation, the batwing extensions on the southern end of the building provide the perfect location to install photovoltaic cells. The technology now exists to install a film to collect solar energy (Building integrated photovoltaics, BIPV) instead of the bulky panels that most people envision. The installation of photovoltaics on such a prominent roofline on campus will be a visible reminder of the energy efficiency of the building and alternative ways of producing energy. The energy produced by the PV panels could be monitored by data sensors that display the

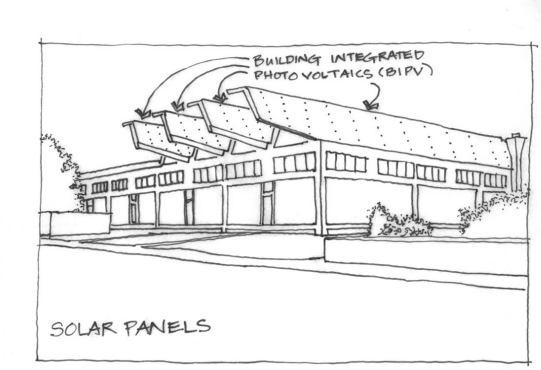

Figure 6.39 Building integrated photovoltaics (BIPV) on the batwing extensions of the Lamar Dodd Building.

current levels of energy production on a display screen in the lobby entrance and on the CED website. Other indicators of solar energy production could also be installed to visibly display energy production. For example, a fountain whose water pumping levels are controlled by the solar panels would be an interactive way showing when more or less energy is being produced.

Building Insulation and HVAC

The building insulation and HVAC system are probably the most traditionally hidden and the most expensive systems within a building. To increase building occupant's awareness of their presence a part of the building could be left "exposed" to reveal a cross-section of the insulation and the pipes of the HVAC system. For example pipes could be revealed in an overhead area or the cooling system could be left exposed all over the building. If there is a roof garden, a section of the interior roof could be replaced with plexiglass to show the gravel and soil substrates above.

The HVAC system also presents an opportunity to move away from fossil fuel reliance and towards alternative energy sources for heating and cooling. Appropriate alternative solutions could include switching to natural gas as a fuel source, tapping geothermal wells, nighttime cooling, and raised floors for access to these systems. Choosing and efficient and effective system that works in concert with the rest of the building will help create a comfortable and energy efficient indoor environment.

System Controllability

When occupants are able to control their own working environment they are able to create a more comfortable working space and thereby increase productivity. Also, operable windows and individual room climate control allow different areas of the building to be

heated and cooled according to their specific situation. This control increases the efficiency and effectiveness of the building's heating and cooling system and reduces the total energy used overall within the building. However, all of the building's users must fully understand how to operate the controls in each of the rooms. If there is a misunderstanding about how the system works, the overall efficiency and effectiveness may be compromised.

Water Collection, Conservation, and Reuse

There are many ways to conserve, reuse, and collect water on site. Bio retention areas (wetlands) collect runoff and allow it to infiltrate slowly over time. Cisterns collect and store runoff for future uses such as irrigation or flushing toilets. All of these water recycling methods provide opportunities for educating the public about water conservation and reuse. Living Machines® purify grey and black water from toilets and water fixtures so that it can be reused later. Wetland areas can be designed and constructed by landscape architecture students, while the aquatic and ecological communities associated with this system could be studied by ecology students. By serving as a prototype for these water recycling methods in Athens, Georgia, and the southeast the CED can educate the public at large about viable alternatives to everyday water use and management.

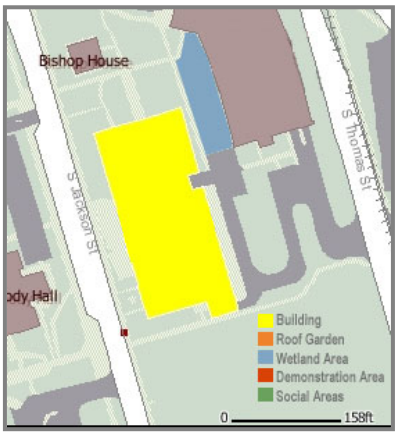

Figure 6.40 Map highlighting the proposed wetland.

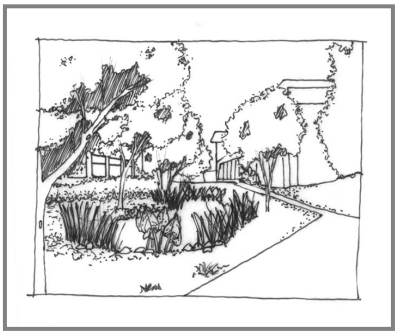

Figure 6.41 Proposed wetland near the Lamar Dodd Building.

Landscape

The landscape surrounding the Lamar Dodd Building presents an excellent opportunity to move the curriculum of the CED from the classroom to the outdoors. Both the ecology and landscape architecture curriculums draw their inspiration from the outdoor environment and should therefore receive as much of their education as possible outside. Demonstration gardens would be an educational way to demonstrate native Georgia flora communities to students of the university and local schools. The gardens could be designed to appeal to a wide range of visitors (i.e. edible gardens, sensory gardens, butterfly gardens, etc.) and could serve as design templates for landscape architecture design studios. The students would have first hand interaction with the gardens by planting and maintaining them year round. These gardens would also be a forum for teaching and demonstrating integrated pest management and innovative construction methods.

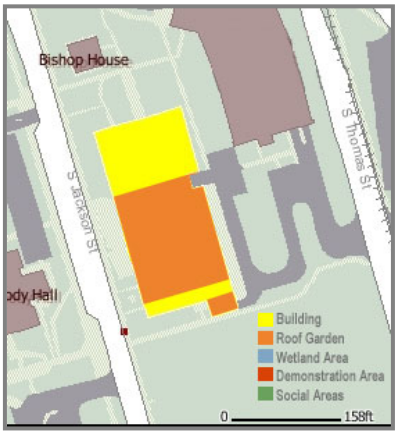

Figure 6.43 Map highlighting the proposed roof garden.

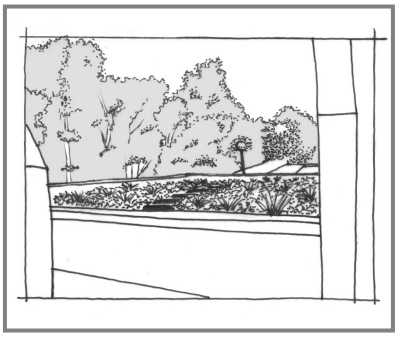

Figure 6.44 View into proposed roof garden.

The installation of an extensive roof garden would also provide an opportunity for students to learn about rare plant communities of the southeast. Extensive roof gardens require minimal management and thrive on harsh conditions. They are not only beautiful, but also provide building insulation. A roof garden is perfect habitat for granite outcrop

plants that are rare and endangered. The gardens could serve as experimental spaces to monitor how different changes affect the flora over time. The rooftop garden would also provide a way of exposing people to Georgia ecology without them having to travel to distant locations.

The master plan for the CED campus should address how the Lamar Dodd Building will connect to the rest of the surrounding buildings and how Jackson Street as a whole can be used as an interface. The landscape surrounding the Lamar Dodd Building can be designed to maximize social interaction among members of the CED, the university, and the public and all sides of the building can serve as vital connections to different parts of the university. For example, because the west façade faces Jackson Street and the main university it should be utilized to publicize the mission and goings on of the CED. The north façade will connect to the new CED campus and could focus more on promoting interdisciplinary interactions between different departments within the CED. Above all, the landscape needs to be used to its fullest potential to educate the students of the University of Georgia about how the everyday environment is connected to their lives. By doing this the CED can begin to interact with the rest of the university and can make everyday student life an exercise in sustainable living.

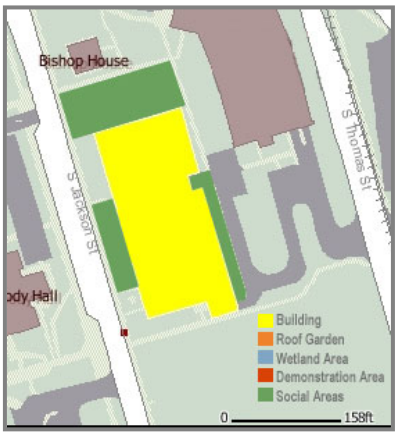

Figure 6.45 Map showing the main social areas surrounding the Lamar Dodd Building

CHAPTER 7

CONCLUSION

The Lamar Dodd Building provides an excellent opportunity for the CED to put its sustainable values into practice. Through building renovation, the CED has the opportunity to adapt an already existing building to fit the needs of its incoming students and faculty. This presents a different challenge than the design and construction of a new building because an existing building has already acquired its own layers of meaning and systems of operation. The challenges of renovation will also have some benefits for the CED including fewer design decisions concerning the overall layout of the building. The renovation can therefore serve as the CED's and the university's first foray into the actual sustainable planning and design process. By involving members of the CED, the University of Georgia, and Athens in the renovation of the Lamar Dodd Building the CED will set the stage for designing an entire campus that is an educational tool and a physical manifestation of the new college's values.

Although this study is as comprehensive as possible, it leads to more questions and reveals limitations. This thesis and the projects it explores are just starting points for a much larger agenda. In order for that agenda to move forward, and hopefully gain some insight from this exploration the limitations inherent in this study must first be addressed.

The first and most important limitation of this study is the scope of my examination: one building. However, for the purposes of this study looking at only one building provides a useful scale for examining the design process and sustainability issues. For example, in addition to sustainable design, the renovation of the Lamar Dodd Building addresses historic preservation

issues, educational application of technology, and interactions between building and landscape. I am not implying that these issues are only relevant at the single building scale, and would like to emphasize that these ideas can be applied at other scales as well. All of the opportunities for sustainable design that were explored for this specific building should be examined for application to other sites within the new CED campus, UGA, and Athens.

The Lamar Dodd Building has the opportunity to be the first structure on the UGA campus to not only question the standard planning and design process, but also to set the tone for future renovations within the CED and the surrounding community. By involving university personnel, contractors, and Athens stakeholders the CED can share its learning process about sustainable planning with the local community and university stakeholders. This process can inspire the university and local businesses to use this project as a minimum standard for future renovation and construction projects. In this way the Lamar Dodd renovation can create an external momentum for sustainable design and can serve as an educational example for the entire community.

Another issue concerning this study is the limited number of case studies of renovated historic buildings, especially in academic environments. While this could be seen as a liability because of a lack of precedent, it could also be regarded as an asset. Because of the lack of precedent, there is no preconceived notion of what a sustainable renovation must or must not be. There is no status quo to fall back on or to limit idea formation. Instead the field is left wide open for interpretation and creative problem solving. Full advantage should be taken of this design freedom. This type of design process is especially valuable in an academic setting such as the CED because it provides a creative outlet for the demonstration of the ideas most important to our disciplines in a real world situation. It takes the field of design beyond theory and creates an environment of application, evaluation, and revision. Having hands on experience in these areas

ensures that students will achieve a full understanding of the implications of specific design choices and how they impact the world around them.

I would like to conclude by reiterating that this paper is not meant to serve as a specific timetable, chronological order, or instruction manual for the renovation of the Lamar Dodd Building. It was not my goal to generate a final plan for the process of the sustainable renovation, or to imply that everything that should be considered during that process is covered within this paper. I have done my best to inform the reader of the most up to date case studies and information concerning this field of design and its application to this site. There is still a lot of work that needs to be done and many questions that need to be answered. For example, what are the specific long term and short term goals for the entire CED campus? For each of its individual buildings? How can the students and faculty be more involved in the design process? What economic and environmental criteria will be used to inform the final design choices? Creating a sustainable CED village requires answering these questions and harnessing the university's commitment to environmental education. I hope that the faculty, students, and staff of the CED and UGA will take the time to fully explore the possibilities of the sustainable design process.

APPENDIX A

COMPLETE LIST OF BARNEY-DAVIS HALL RENOVATION GOALS

HISTORICAL GOALS:

- The renovated building will be used for its historic purpose or take on a new use which requires minimal change to the defining characteristics of the building, its site, and environment.
- The historic character of Barney Hall shall be retained and preserved. The removal of historic materials or alteration of features and spaces that characterize the property shall be avoided.
- The property shall be recognized as a physical record of its time, place, and use. Changes that create a false sense of historical development will not be undertaken.
- Changes that have occurred over time that have acquired historic significance in their own right shall be retained and preserved.
- Distinctive features, finishes, and construction techniques or examples of craftsmanship that characterize Barney shall be preserved.
- Deteriorated historic features shall be repaired rather than replaced. Where the severity of deterioration requires replacement of a distinctive feature, the new feature shall match the old in design, color, texture, and other visual qualities and, when possible, materials.
- Chemical or physical treatments, such as sandblasting, that cause damage to historic materials shall not be used. The surface cleaning of structures, if appropriate, shall be undertaken using the gentlest means possible.
- Significant archeological resources affected by the project shall be protected and preserved.
- New additions, exterior alterations, or related new construction shall not destroy historic materials that characterize the property. The new work shall be differentiated from the old and shall be compatible with the size, scale, and architectural features to protect the historic integrity of the property and its environment.
- New additions and adjacent or related new construction shall be undertaken in such a manner that if removed in the future, the essential form and integrity of the historic property and its environment would be unimpaired.

ENVIRONMENTAL GOALS:

- Barney must be a pleasant and comfortable place to work. Air currents, noise, humidity and lighting levels, and floor and wall coverings should all be conducive to the academic environment.
- This building must demonstrate that fossil fuel reliance can be dramatically reduced, if not completely eliminated. This can be done by selecting materials that use less energy or save energy over their life span, including consideration of energy used during their harvesting,

extraction, manufacturing, processing, transportation, distribution, installation, use, maintenance, recycling and disposal.

- Attention must be paid to user behavior and desires. Users should be able to control their building environment through light switches, operable windows, blinds to control natural light levels, and local thermostats.
- Barney is intended to be a working, living laboratory of sustainable design. This building should teach environmental sensitivity, respect and consciousness through its design and resource management. It should demonstrate how effective these ideas can be, and how transferable they are to other building situations.
- Local resources and local labor should be used as much as possible in the ecological renovation of Barney Hall. An important part of sustainable design is that the local economies and communities benefit (Rocky Mountain Institute, 1995, p.5).
- The renovation must involve technologies and other innovations that promote environmental longevity. Designs and materials must be thought of in the long term and allow for changes to be made as the building continues to age and new technologies are developed.
- The emphasis on sustainability and using renewable resources takes the building back to its original plans. The initial design took advantage of natural light sources through its large windows, transoms, skylights, and even a glass floor that allowed sunlight to filter from the attic to the rest of the building. A sunken light well provided necessary ventilation to flow through the basement level. The renovation must return to these plans and should used passive and active solar energy as much as possible. The need for energy consumption in the building envelope should be reduced as much as possible.
- Barney should welcome people and look appealing, both inside and out. The floor plan designs and landscaping should take aesthetics into consideration.
- This building must consider its direct and indirect environmental impacts, both in construction and everyday use. It should be possible to engage in an exercise of the ecological accounting (life-cycle cost analysis) to demonstrate the overall value and cost-benefit of our design decisions. Part of the statement that should emerge from this building project is that "green" buildings are economical to build and operate (RMI, 1995, p.5). We seek high- value design decisions: technologies and innovations that pay for themselves either through direct reduction in resource use or through life-cycle improvements to the environment. Costs can also be reduced by investing in technologies and products which do not require extensive maintenance, and these should be emphasized wherever possible.
- The principal of using natural materials includes a number of important facets: human health enhancement through the use of natural materials, restoration of original features of the building, rejuvenation of building features (e.g., natural wood trim and floors), and care in the selection of new materials, with preference for non-toxic, recycled, sustainably harvested, and local sources. (Green Renovation)

APPENDIX B

BARNEY-DAVIS HALL POST OCCUPANCY EVALUATION

www.denison.edu/enviro/surveydesign1.htm

Denison Building Issues Survey, Fall 2000 **Please return to**:
_____

You have been selected to participate in this survey about building and renovation issues on campus. The information will be used in an Environmental Studies course this term. *Your contribution to this study is very important, and we appreciate your input:* it should take about 10 minutes. Some questions are fairly personal, and we regret the infringement, but hope you understand: we aren't prying! Please answer all questions as honestly as you can. Your responses will be kept strictly confidential; nothing connects you with this piece of paper. Please return promptly. **Thanks very much for your help!**

1. How *aware* would you say you are about... Not very . . . . . Very

a. ...the Barney-Davis green building renovation? 1 2 3 4 5

b. ...the general idea of what a green building is? 1 2 3 4 5

c. ...the material available on the Barney-Davis website? 1 2 3 4 5

d. ...any specific design aspects of Barney-Davis? 1 2 3 4 5

2. How much do you agree or disagree with these statements? Strongly disagree . . . . . Strongly agree

a. The green renovation of Barney-Davis was a good idea 1 2 3 4 5

b. Barney-Davis has increased environmental awareness on campus 1 2 3 4 5

c. Other campus buildings incorporate "green" design features 1 2 3 4 5

d. There should be more "green" buildings on campus 1 2 3 4 5

e. Barney should be an example of green building design 1 2 3 4 5

3. Barney has increased general campus awareness of: Strongly disagree . . . . . Strongly agree

a. Energy issues 1 2 3 4 5

b. Grey-water systems 1 2 3 4 5

c. Water conservation 1 2 3 4 5

d. Recycling 1 2 3 4 5

e. Green building design 1 2 3 4 5

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4. How often do you *do* the following: Never . . . . . Always

a. leave the radio, lights, etc. on when you leave a room? 1 2 3 4 5

b. recycle, using the DURP bins? 1 2 3 4 5

c. use disposable plates/cups in the dining hall? 1 2 3 4 5

d. bring a reusable mug to the dining hall? 1 2 3 4 5

e. keep your windows open in your room in winter? 1 2 3 4 5

5. Please indicate your *willingness* to... Not willing . . . . . Very willing

a. Use efficient showerheads? 1 2 3 4 5

b. Control the temperature of your room? 1 2 3 4 5

c. Purchase environmentally-friendly school supplies? 1 2 3 4 5

d. Take an ENVS class to fulfill a GE? 1 2 3 4 5

e. Have an electricity meter in your dorm room? 1 2 3 4 5

6. Compared to other people, how much energy do you think you use (1=much less; 5=much more)? _____

7. Which do you think wastes more energy? a. 10 hrs TV *or* 10 hrs radio

(circle one choice for each) b. 10 hrs light bulb *or* 10 hrs TV

8. Please indicate your *willingness* to do the following: Unwilling . . . . . Very Willing

a. use less water on a day to day basis? 1 2 3 4 5

b. be involved in the green design of buildings on campus? 1 2 3 4 5

c. participate in campus recycling efforts? 1 2 3 4 5

d. pay for your own energy bills while at school? 1 2 3 4 5

e. boycott products that harm the environment? 1 2 3 4 5

Please answer questions on the other side too...

9. How big a problem do you think these are on campus? Not a Problem . . . . . Huge Problem

a. Overuse of water and electricity 1 2 3 4 5

b. Lack of recycling 1 2 3 4 5

c. Overuse of water 1 2 3 4 5

d. Inefficient building design 1 2 3 4 5

10. How likely would you be in *supporting* green building design if it: Not supportive . . . . . Supportive

a. Reduced housing costs? 1 2 3 4 5

b. Applied to academic buildings only? 1 2 3 4 5

c. Applied to dorms only? 1 2 3 4 5

d. Applied to both academic buildings and dorms? 1 2 3 4 5

e. Required you to sacrifice some conveniences? 1 2 3 4 5

f. Functioned like a regular building? 1 2 3 4 5

11. Please indicate your level of *concern* about these issues: Little concern . . . . . Great concern

a. Clean air 1 2 3 4 5

b. Loss of endangered species 1 2 3 4 5

c. Fossil energy resources rapidly running out 1 2 3 4 5

d. Your personal water use 1 2 3 4 5

e. Your personal electricity use 1 2 3 4 5

12. Please indicate your level of *awareness* about these issues: Little awareness . . . . . Lots of awareness

a. Clean air 1 2 3 4 5

b. Loss of endangered species 1 2 3 4 5

c. Fossil energy resources rapidly running out 1 2 3 4 5

13. Do you smoke cigarettes? **Yes No** --> If yes, about how many packs per week? _____

14. Gender (please circle one): **Male Female** 15. Class (please circle one): **FR SO JR SR**

16. Are you an athlete? **Yes No** --> If yes, what sport(s)?_____

17. Do you have a job at school? **Yes No** --> If yes, what job(s)?_____

18. Circle the word that best describes your home town: **Rural Urban Other_____**

19. What dorm do you live in? _____ 20. How many roommates do you have? _____

21. What is your major?_____ 22. Estimate your cumulative GPA so far: _____

23. How many times **per year** do you visit the Bioreserve in your free time? _____ visits per year

24. Please indicate your general *satisfaction* with these issues: Not satisfied . . . . . Very satisfied

a. Academic rigor at Denison 1 2 3 4 5

b. Social life at Denison 1 2 3 4 5

c. Your overall happiness at Denison 1 2 3 4 5

25. Please add any comments:

_____
_
_____
_____
_____

Thank you very much for your time!

BIBLIOGRAPHY

67. Adam Joseph Lewis Center for Environmental Studies. 7 Nov 2002. <http://www.oberlin.edu/campusmap/html/envicenter.html >.

"A Stage is Set For Art." Architectural Forum. February 1962: 58-61.

"Adam Joseph Lewis Center for Environmental Studies." Green Buildings BC. 6 October 2002. <http://www.greenbuildingsbc.com/new_buildings/case_studies/Adam_Joseph.pdf>.

"Adam Joseph Lewis Center for Environmental Studies—Oberlin College." U.S. Department of Energy: Office of Renewable Energy and Energy Efficiency. 6 October 2002. <http://www.eren.doe.gov/buildings/highperformance/case_studies/overview.cfm?ProjectID=18>.

Adam Joseph Lewis Center for Environmental Studies. Oberlin University <http://www.oberlin.edu/envs/ajlc>.

"Arts Building Dedicated Here." Athens Banner Herald. 22 Jan. 1963. Georgia Room Collection Vertical Files, University of Georgia.

"Audubon House." Rudy Bruner Award for Urban Excellence. University of Buffalo Libraries. 15 Aug 2000. 7 Nov 2002. <http://ublib.buffalo.edu/libraries/projects/bruner/1995a/audubon_house/maindex.html>.

"Audubon House Provides Good Moth Habitat." Environmental Building News. Volume 5, No. 6. November/December 1996. 3 pages. 15 April 2002. <www.buildinggreen.com/news/audubonmoth.html>.

Audubon House…Building for an environmental future… National Audubon Society. 15 April 2002 . <http://www.audubon.org/nas/ah/>.

Barista, Dave. "Living Machine." Building Design and Construction. April 1, 2001. got from website (need mag info) linked from McDonough.

Barney-Davis Green Renovation. Lindsay Mason. 12 June 2000, Denison University. 23 July 2002 <http://www.denison.edu/enviro/barney>.

Bennett, Paul. "Regeneration: John Tillman Lyle, FASLA (1934-1998)." Landscape Architecture Magazine. 1999 Jan., v.89, n.1, p.64-71,88-91.

Bonda, Penny. "A Building that Teaches." IS DesigNET. October 2000. 28 January 2001. <http://www.isdesignet.com/Magazine/Oct'00/eco.html>.

Brown, David E., et al. Sustainable Architecture White Papers. Quebec: Quebecor Printing, Inc., 2000.

Crosbie, Michael J. Green architecture : a guide to sustainable design. Rockport Publishers ; Washington, D.C., 1994.

"Definitions of Sustainability." Alliance fro Global Sustainability. 29 August 2002. <http://globalsustainability.org/Education/Definitions>.

Dunham-Jones, Ellen. "Comment: Questioning the Stand Alone Building." Dimensions of Sustainability. New York: E & FN SPON, 1998.

Dunstan, Joe. Email to listserve sustainw_l@listproc.wsu.edu. 25 January 1996.

Ehrenberg, Rachel. "Green Dana is Environmentally Friendly." The University Record. 19 Nov. 2001. 26 July 2002. <http://www.umich.edu/~urecord/0102/ Nov19_01/10.htm>.

"Environmental Studies Center, Oberlin College." Steven Winter Associates. 18 April 2002. <http://www.swinter.com/projects/commercial/oberlin.html>.

Filho, Walter Leal. Sustainability and University Life. Frankfurt am Main: Peter Lang, 2000. 2 ed.

Fitch, James Marston. Historic Preservation: curatorial management of the built world. New York: McGraw-Hill, Inc. 1982.

Furlong-Reynolds, Cindy. "An Architectural Firm Builds On The Future While Preserving the Past." Insider Business Journal. University of Michigan School of Natural Resources & Environment. 23 July 2002. <http://www.snre.umich.edu/ greendana/news/insider.html>.

Gardner, John W. Dedication of the Visual Arts Building. University of Georgia, Athens, GA. 21 Jan. 1963.

"Greener, Larger, Renovated Dana Goes for the Gold." Fall/Winter 2001 Newsletter. The University of Michigan School of Natural Resources & Environment. Fall/winter 2001. 26 July 2002. <http://www.snre.umich.edu/newsletter/dana-renovations.html>.

Hamilton, Kenneth. "RE: Moth Problem." E-mail to the author. 16 Sept 2002.

Hawes, Alex. "Going Green." Online Preservation. 27 Nov. 2001. 26 July 2002. <http://www.nationaltrust.org/magazine/archives/arch_story/112801.htm>.

"How Can a Building be Like a Tree?" Green Mac. 18 April 2002. <http://www.greenmac.com/bioneers/McDonough/livingmachine>.

Janas, Marci. "Groundbreaking for Environmental Studies Center Is Tomorrow." Oberlin Online. 24 September 1998. 30 March 2002. <http://www.oberlin.edu /news-info/98sep/groundbreaking.html>.

Jones, David Lloyd. Architecture and the Environment: Bioclimatic Design. New York: The Overlook Press, 1998.

Kibert, Charles J. Reshaping the Built Environment: Ecology, Ethics, and Economics. Island Press, Washington, D.C. 1999.

Kosseff, Jeffrey. "Skylights, compost toilets part of restoration at UM." Crain's Detroit Business." 10 April 2002. 23 July 2002. <http://www.craini2i.com/cdb/archive.mv?count=2&story=cdb276884404541284237>.

Lyle, John T. Design for Human Ecosystems. Van Nostrand Reinhold, New York. 1985.

Lyle, John T. Regenerative Design for Sustainable Development. John Wiley & sons, New York. 1994.

Marien, Michael. Environmental Issues and Sustainable Futures: a critical guide to recent reports, books, and periodicals. 1996. World Future Society.

McDonough, William. "A Centennial Sermon: Design, Ecology, Ethics and the Making of Things." Speech; The Cathedral of St. John the Divine, New York, New York. February 7, 1993.

McDonough, William. "Declaration of Interdependence." Dimensions of Sustainability. New York: E & FN SPON, 1998. pp. 45-53.

Nasatir, Judith. "National Audubon Society." Interior Design. August 1991. pp. 93-99.

National Audubon Society, Croxton Collaborative, Architects. Audubon House: Building the Environmentally Responsible, Energy-Efficient Office. New York: John Wiley & Sons, Inc., 1994.

"Oberlin College partners with National Renewable Energy Laboratory." Adam Joseph Lewis Center for Energy Usage. J. Scofield. 03 July 2002. 06 October 2002. <http://energy.physics.oberlin.edu/articles/OC%20press%20release%202000-04-12.pdf>.

Orr, David W. "The Problem of Education." The Campus and Environmental Responsibility. Eds. David J. Eagan and David W. Orr. New Directions for Higher Education, no. 77, Volume XX, number 1. 1992. Jossey-Bass, Inc. Martin Kramer Editor in chief. Pp. 3-8.

POE of Barney-Davis Hall. Lindsay Mason. 9 March 2000, Denison University. 23 July 2002. <http://www.denison.edu/enviro/barney/poe>.

Reis, Michael. "University Buildings That Educate: The Ecology of Design." Environmental Design+Construction. 22 February 2001. 30 March 2002. <http://www.edcmag.com>.

Snoonian, Deborah. "Historic U. Michigan Building Undergoes Renovation." Architectural Record. 26 July 2002. <http://arhcrecord.construction.com /WEEKLY/GREEN/GR_ARTIC/GW_12_13.ASP>.

Sohnen, Nora. "The Lewis Center Measures Itself". Oberlin Online. 25 April 2001. 30 March 2002. <http://www.oberlin.edu/news-info/01apr/alex_maly.html>.

Sparks, Andrew. "New Home for Art Shocks Old Athens." Atlanta Journal Constitution Magazine. 28 Jan. 1962: 14+.

Sustainable Development International Corp. 29 August 2002. <http://www.smartoffice.com/principles.htm>.

Sustainable Measures. Maureen Hart. 29 August 2002. <http://www.sustainablemeasures .com/Sustainability/DefinitionsDevelopment.html>.

"The Adam Joseph Lewis Center for Environmental Studies, Oberlin College." William McDonough + Partners. 6 October 2002. <http://www.mcdonoughpartners.com/ projects/p_oberlin.html>.

The Greening of Dana. University of Michigan School of Natural Resources and Environment. 23 July 2002 <http://www.snre.umich.edu/greendana/>.

"The Greening of Dana." William McDonough + Partners: Architecture and Community Design. 7 Nov 2002. <http://www.mcdonoughpartners.com/projects/p_snre.html>.

Thompson, J. William and Sorvig, K. Sustainable Landscape Construction: A guide to green building outdoors. Island Press, Washington, D.C. 2000.

"UGA Main Campus & Vicinity." Map. University Architects Mapping Division. UGA. 21 June 2002. <http://owl.camplan.uga.edu/pdf/11x17.pdf>.

Unger, Geri E. and Grosse, Daniel J. A Green Building Compendium. 1999. Earth Day Coalition. Pp. 32-38, 41-45, 56-63. 7 July 2002. <http://www.earthdaycoalition. org/>.

"University of Michigan Walks the Talk." Oikos: Green Building Source. 28 April 1999. 26 July 2002. <http://oikos.com/library/showcase/dana>.

"University to Dedicate Arts Building Monday." Atlanta Journal Constitution. 17 Jan. 1963. Georgia Room Collection Vertical Files, University of Georgia.

Van der Ryn, Sim, and Cowan, Stuart. Ecological Design. Island Press, Washington, D.C. 1996.

Walker Jr., Lester C. "New Art Building for Georgia." College Art Journal 21.2 (Winter 1961-1962) : 129-130.

Worth, Mark. "Audubon's Living Building." In Context. #35. Spring 1993. Page 14. 7 July 2002. <http://www.context.org/ICLIB/IC35/Worth.htm>.

USEFUL WEBSITES

Alternative Building Methods
http://www.uark.edu/depts/dbertonc/Hesc4803/hbam/hbam1.htm

Building Design and Construction Magazine
http://www.bdcmag.com

Center of Excellence for Sustainable Development, U.S. Department of Energy
http://www.sustainable.doe.gov/

Environmental Building Design and Green Building Construction
http://www.yourhomeplanet.com/

Environmental Design and Construction Magazine
http://www.edcmag.com

Greenroofs.com
http://www.greenroofs.com

Second Nature
http://www.secondnature.com

Society for College and University Planning
http://www.scup.org/

Sustainable Architecture, Building & Culture
http://www.SustainableABC.Com/

Sustainable Building Sourcebook
http://www.greenbuilder.com/sourcebook/

Sustainable Construction in the U.S., Report for GeorgiaTech.
http://www.arch.gatech.edu/crc/CIBW82Survey.htm

The Campus Ecologist
http://isu.indstate.edu/wbarratt/dragon/ce/

U.S. Green Building Council
http://www.usgbc.org/

University Leaders for a Sustainable Future
http://www.ulsf.org