ISSUES IN PRACTICE MANAUSCRIPT

GREEN DESIGN AND SUSTAINABILITY IN SPORT AND RECREATION FACILITIES

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INTRODUCTION

Sport and recreation organizations have traditionally attempted to construct functional and innovative facilities to meet the needs of patrons. Over the past few decades, the concepts of green design and sustainability have evolved as a mechanism to deal with limited resources and reduce the impact on the environment (Kessenides, 2005). Architects, engineers, and consultants have begun practicing social responsibility by incorporating green design concepts and technologies for their client's projects. Sport and recreation professionals can benefit by gaining an understanding of the potential benefits of green design and sustainability. This article is an attempt to answer many of the commonly asked questions related to the design, construction, and maintenance of green facilities.

DEFINING "GREEN" AND "SUSTAINABILITY"

A "green" or "sustainable" facility is a structure designed, built, renovated, or operated in an ecologically and resource-efficient manner (Dick, 2007). These buildings often utilize energy-efficient processes to accomplish long-term cost savings (Yost, 2002) Sustainability has also been defined as a "holistic approach to protecting the environment by incorporating design practices and materials that use energy most efficiently" (Fried, 2005, p.182). Sustainable initiatives work with the environment rather than against it (Suttell, 2006). Green buildings can be designed to protect occupant health, improving employee productivity, utilize resources more efficiently, and reduce environmental impacts (Environmental Building News, 1999).

GREEN FACILITY BENEFITS

Ries and Bilec (2006) suggest three possible benefits of green facility construction: 1) conservation of natural resources, 2) increased energy efficiency and water conservation, and 3) improved indoor environment. They suggest green design can lead to substantial cost-savings over the life-span of a building and improve productivity for the building's inhabitants. These potential benefits are discussed in the following sections.

NATURAL RESOURCE CONSERVATION

The efficient use of natural resources is a fundamental tenet of green design. Conventional construction practices consume large quantities of steel, wood, plastic, cardboard, paper, water, and other natural resources that unnecessarily lead to resource depletion (del Monte, 2006). Design professionals have the option to select environmentally-conscience building materials such as recycled products. Reutilization of beams, lumber, flooring, paneling, doors, brick, steel, insulation, and other products often lend quality and durability exceeding conventional materials (del Monte, 2006). Sustainable construction products can also include recycled plastics and crushed rock aggregates (U.S. Green Building Council, 2007). The rapidly developing recycled product market is also diverting waste from landfills as mandated by the Integrated Waste Management Act (Environmental Management, 2007). Designing adequate space for recycling collection and incorporating a solid waste management program can reduce waste generation over the lifespan of facility.

ENERGY EFFICIENCY AND WATER CONSERVATION

Energy efficiency and water conservation are cornerstones of any green building project. Generation and use of energy are major contributors to air pollution and global climate change. Improving energy efficiency and using renewable energy sources are effective ways to reduce the potential of energy supply interruptions, improve air quality, and reduce the impacts of global warming (Ries & Bilec, 2006). Lowering utility expenses allows organizations to reap the financial benefits of sustainability on a continual basis. Examples of increased energy efficiency measures include installing top grade insulation, glazed and low-emissive (low-E) double-paned windows, and high-efficiency water heaters and other appliances (Ries & Bilec, 2006).

LaRue, Sawyer, and Vivian (2005) describe how the building "envelope"—the windows, doors, walls, floor, foundation, and roof—must balance requirements for ventilation with providing thermal and moisture protection appropriate to a facility's climatic conditions:

> The role of mechanical systems and purchased energy is to make up the difference between that which the envelope can provide in occupant comfort and what is required…[therefore the] quality of the envelope, then, is a major factor in determining energy used for heating, cooling, lighting, and ventilation. Improvements to the envelope can significantly reduce energy demand. (p. 172)

An optimal designed building envelope provides significant reductions in heating and cooling loads, which in turn can allow downsizing of heating, ventilation, and air-conditioning (HVAC) equipment (Loftness, Hakkinen, Ada, & Nevalainen, 2007).

Large volumes of water are often consumed at recreation and sport venues making water conservation an import issue. Builders can take advantage of a new generation of high-efficiency appliances and landscape water management systems (Dick, 2007). Dual plumbing using recycled water for toilet flushing or a gray water system that recovers rainwater or other non-potable water for site irrigation are efficient methods of water conservation. Wastewater can be minimized by using ultra low-flush toilets, low-flow shower heads, and other water conserving fixtures (Dick, 2007; LaRue et al., 2005). Additional measures such as reminding patrons to turn faucets off completely, repairing drips and leaks, and shutting down water supplies outside of operating hours can go a long way toward conservation and cost reduction (LaRue et al., 2005).

ENHANCED INDOOR ENVIRONMENT

The purpose of a building is not only to provide shelter for its occupants, but also to provide an environment conducive to high performance of all intended occupant activities (Kessenides, 2005). Recent studies reveal that buildings with good overall environmental quality can reduce the rate of respiratory disease, allergy, asthma, sick building symptoms, and enhance worker performance. High-efficiency in-duct filtration systems and heating and cooling systems that ensure adequate ventilation can have a dramatic and positive impact on indoor air quality (Fisk & Rosenfeld, 1998).

Poor indoor air quality can be caused by the off-gassing of chemicals found in many building materials as well as mold and mildew that build up in poorly designed and maintained heating and cooling systems. Selection of appropriate microbial resistant materials can prevent this indoor microbial contamination. Effective drainage from the roof and surrounding landscape, installing adequate ventilation in bathrooms, allowing for proper drainage of air-conditioning coils, and designing building systems to control humidity can also work to improve indoor conditions.

Choosing construction materials and interior finish products with zero or low emissions improve indoor air quality (Dick, 2007). One of the most common interior pollutants is formaldehyde, a suspected human carcinogen. Cabinetry, shelving, and furniture are all typically made from particleboard held together by formaldehyde-based adhesives. The formaldehyde is released into the facility for years after these products have been installed. Many building materials and cleaning/maintenance products emit toxic gases, such as volatile organic compounds (VOC) and formaldehyde. The "new building smell" is actually the odor of these VOC's off-gassing, and is a sign that there are harmful chemicals in the indoor environment detrimentally impacting occupant health and productivity (Loftness et al., 2007). The building products industry has responded to these indoor pollution problems by developing alternative paint, finish, and adhesive products. For example, solvent-free adhesives used in flooring can eliminate many of the suspected and known human carcinogens. Paints, varnishes, and cleaners that do not contain volatile compounds are now commonly available from most major manufacturers at costs comparable to conventional products (Dick, 2007).

Additional measures specific to new construction and major facility upgrades are: investigate the use of separate outside-air and conditioned-air distribution systems; ensure fresh air intakes are located away from loading areas, exhaust fans, and other contamination points; ensure parking lot and garage usage cannot generate pollutants that affect fresh air intake; investigate the use of a permanent air quality monitoring system to ensure acceptable levels of carbon dioxide (CO_2) for an indoor office environment are maintained continuously; and replace filters on a periodic basis (Loftness et al., 2007).

AUTOMATION OF BUILDING SYSTEMS

Five areas of emphasis exist to attain a Leadership in Energy and Environmental Design (LEED) certification, a benchmark for green construction created by the U.S. Green Building Council; however, two of these areas, Energy and Atmosphere and Indoor Air Quality, are heavily influenced by controls and hold more potential for cost savings due to automation than the other sections (Dorsey, 2006). In the pre-green period of commercial and institutional facility design, the building envelope drove decisions regarding lighting, temperature, and ventilation. In today's climate, "zoning" has become a key word. Zoning is defined as grouping areas of like use for to enhance comfort and cost-effectiveness (Dorsey, 2006). Green buildings take these comfort factors to the next level, demanding more personal control of systems. Such measures not only lead to greater comfort and more productivity, they also tend to use energy more efficiently and create an improved indoor air quality (LaRue et al., 2005).

Some of the automated control systems that can be incorporated into a green facility energy management plan are: *Programmed Start-Stop*, which allows the facility operator to schedule starting and stopping of equipment according to occupancy; *Energy Monitoring*, which is the systematic collection of data in order to analyze and make improvements to energy consumption; *Duty Cycling*, is the utilization of software that starts and stops equipment cycles; *Optimized Start-Stop*, which works to calculate the best times to start and stop facility pre-heating or pre-cooling; *Optimized Ventilation*, is software designed to maximize usage of blended air; *Supply Water Temperature Optimization*, which regulates chilled water and hot water supply temperatures; and *Temperature Setback-Setup*, which allows for controls to modify building temperatures according to scheduled time periods (LaRue et al., 2005).

POTENTIAL COST AND SAVINGS

Initial costs of green buildings vary significantly depending on the specific project goals. While there are many significant benefits requiring no additional cost (e.g. south facing windows), some features will cost more in both design and materials. Some aspects of design have little or no initial investment, including site orientation and window and overhang placement. Other sustainable systems that may cost more in the design phase, such as an insulated shell, can be offset by the reduced cost of a downsized mechanical system. This concept is known as “right sizing” of infrastructure and mechanical systems. Sustainable buildings can be assessed as cost-effective through the life-cycle cost method, a way of assessing total building cost over time. It consists of initial design and construction costs; energy, water and sewage, waste, recycling, and other utilities operating costs; maintenance, repair, and replacement costs; and other environmental or social benefits (impacts on transportation, solid waste, water, energy, infrastructure, worker productivity, outdoor air emissions, etc.) (Dick, 2007).

Green construction can be a beneficial collaboration between those looking for funding and those agencies willing to provide it. Grants, programs, and partnerships exist through federal, state, and local entities to assist and encourage green construction. When environmental criteria are met, support is offered from the Department of Commerce, the Department of Defense, the Department of Energy, the Environmental Protection Agency, the Office of Energy Efficiency and Renewable Energy (EERE), the Federal Energy Management Program, and the Federal Network for Sustainability, and the General Services Administration (Dick, 2007). Numerous state and local sustainable building programs exist as well, fostering green development within their communities. The Database of State Incentives for Renewable Energy (DSIRE) is an example of one state level resource. There are also a large number of local-based incentives, as well as several foundations dedicated to green construction funding (Suttell, 2006). Some of these incentives include: decreased inspection fees, free counsel and design assistance, expedited permit review, developer tax waivers, and subsidized training in green building practices (Dick, 2007).

Deciding how much to green a facility will ultimately depend on company values, as well as time and budgetary limitations (Suttell, 2006). As in all planning and design approaches, a methodical analysis must be conducted prior to construction. First, you must establish a vision that embraces sustainable principles and an integrated design approach. The vision should include a clear statement of the project’s goals, design criteria, and priorities. From the vision, a project budget that covers green building measures while allocating contingencies for additional research and analysis of specific options must be developed. Selecting a design and construction team that is committed to the project vision is paramount and facilitates the successful creation of an environmentally sound, sustainable structure.

Greening a facility as a whole rather than piecemeal will render the project much more practical and cost-effective (Suttell, 2006). Savings can only be fully realized when methods are incorporated at the project’s conceptual design phase with the assistance of an integrated team of professionals. Currently, major architectural players in sport and recreation facility design are dedicating staff committed to the new design approach of the sustainability movement. This integrated systems approach ensures the building is designed as one system rather than a collection of stand-alone systems (LaRue et al., 2005). Utilizing the holistic approach emphasizes the philosophy that all building systems are interdependent, and that these systems can either adversely or favorably impact their surroundings (Monroe, Madsem, Garris, Suttell, Gesener, & Easton, 2004).

At times, the Request for Quote/Request for Proposal (RFQ/RFP) selection process may need to be modified to make certain contractors have appropriate qualifications to identify, select, and implement an integrated system of green building measures (Dick, 2007). Ensure that the project schedule allows for systems testing and commissioning—a process to ensure buildings are designed to meet the needs of their users, and are built, operated and maintained as originally intended (Dick, 2007). Within the contract plans and specifications, ensure that the building design is at a suitable level of building performance. Last but not least, create effective incentives and oversight of the project to ensure its success.

GREEN FACILITY RATING SYSTEMS

Green facility designers exceed federal, state, and local building codes to improve overall building performance (Gowri, 2004). Currently, there are more than 80 different green building organizations and at least three different national groups promoting what constitutes a green building. The three systems that have emerged to bring about standardization within the green movement are: Building Research Establishment Environmental Assessment Method (BREEAM), The Green Building Challenge, and Leadership in Energy and Environmental Design (LEED) (Gowri, 2004).

BREEAM is the earliest building rating system for environmental performance assessment. This standard was developed by the British Research Establishment (BRE) in 1990. Since that time, BREEAM has evolved from a design checklist to a comprehensive assessment tool to be used in various stages of a building's life cycle (Gowri, 2004). The Green Building Challenge is a collaborative of more than 20 countries committed to developing a global standard for environmental assessment. The first draft of the assessment framework was completed in 1998 and a spreadsheet tool—GBTool—was developed for participating countries to adapt the framework by incorporating the regional energy and environmental priorities (Gowri, 2004).

Perhaps the best-known group in green construction is the U.S. Green Building Council (USGBC), a non-profit group that developed the LEED point rating system for commercial projects. Many consider the LEED certification as the national benchmark for green construction. The success of LEED has created demands for adapting the rating system for existing buildings, commercial interiors, and residential buildings. LEED has also been adopted by federal agencies, states, and local jurisdictions in the U.S. and Canada mandated to implement green building programs (Gowri, 2004; Yost, 2002).

IMPLEMENTING GREEN PRACTICES IN EXISTING FACILITIES

Green conversion is substantially different in older buildings as compared new construction. Facility managers have much less opportunity to change most envelope components in existing buildings. Reducing outside air infiltration into the building by improving building envelope tightness is usually quite feasible. During re-roofing, extra insulation can typically be added with little difficulty. Windows can be upgraded during more significant building improvements and renovations (Loftness et al., 2007).

Savings can also be achieved incrementally through the modification or replacement of many of the building's systems. Installing more efficient chiller systems, packing walls with better insulation, affixing reflective window film to reduce heating from the sun, introducing more efficient lighting, and equipping the building with occupancy sensors are all examples of incorporating sustainable practices into existing facilities (del Monte, 2006). High-efficiency lighting systems with advanced lighting controls, motion sensors tied to dimmable lighting controls, and task lighting reduce energy utilization. The installation of screw-in compact fluorescent lamps, hardwired fluorescent fixtures, high-intensity discharge (HID) fixtures for exterior lighting, LED Signs, high-efficiency exit signs, and the use of T-8 or T-5 lamps with electronic ballasts are all easily incorporated measures (Loftness et al., 2007).

MAINTAINING GREEN FACILITIES

Good operating and maintenance procedures can strengthen a well-planned green construction or renovation project. Effective maintenance is necessary for a sustainable-built environment to ensure equipment operates more efficiently and continues to consume less energy (LaRue et al., 2005). While maintenance personnel were once focused solely on basic upkeep, today's professional needs to be well-versed in a number of environmentally friendly techniques and materials. They must be up-to-date on the latest energy issues, toxic materials, storm water drainage methods, and the best ways to operate modern heating, ventilating, and air-conditioning systems. Finding facility managers who are familiar with green buildings can be challenging as well (Rossenfeld, 2004).

Over time, building performance can be assured through the measurement, adjustment, and upgrading processes (Dick, 2007). Aside from the financial and environmental benefits, facility managers contend most green building systems do not require an excessive amount of upkeep. A preventive maintenance schedule can be put in place with little effort and minimal expense (Rossenfeld, 2004).

SUMMARY

Every project can have sustainable aspects regardless of the budget. With construction costs almost parallel with conventional building techniques and the promise of reduced life-cycle costs, green buildings represent not only a socially responsible choice, but a smart fiscal decision (Dorsey, 2006). Improved energy usage and occupant productivity are other tremendous reasons to invest in the green movement. It is important to explore environmentally and economically feasible design and development techniques in order to create structures that are sustainable, healthy, and functional (Kessenides, 2005). Facility personnel who commit to becoming more informed can play a significant role in designing, constructing, and operating the green design facilities of the future.

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APPENDIX 1

LINKS RELATED TO GREEN DESIGN AND SUSTAINABILITY

www.managinggreen.com

www.whygreenbuildings.com

www.dgs.state.pa.us/dgs/cwp/view.asp?a=3&q=118184

www.seco.cpa.state.tx.us/re_sustain_info.htm

ciwmb.ca.gov

www.greenbuilding.com

www.usgbc.org

www.buildinggreen.com

www.epa.gov/greenbuilding

www.greenbuildingservices.com

www.letsgreenthiscity.com

www.oikos.com

www.sbicouncil.org