

# “Greening” the Construction Curriculum

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Traditionally, construction education in the United States has focused primarily on the management, materials and methods and technical aspects related to the construction of a structure. Environmental concerns have been left to the architect – after all, a construction company simply performs what the specifications require. Recently, however, it has become more apparent that construction companies and personnel can have a major impact on the environment through waste management techniques, design-build contributions and through the practices and philosophy of their company. Additionally, many governmental agencies and owners are demanding that sustainability be a key component in the design and construction of structures. In this paper, the growing trend in sustainable construction will be addressed which should provide evidence to why construction graduates must become educated in this area. There are a select group of construction programs across the country already addressing the need for sustainable construction courses. These will be identified as well as other ways sustainable courses can be incorporated into the curriculum of Associated Schools of Construction (ASC) programs.

**Key Words:** sustainable construction, construction education, green construction, environmental construction

## Defining Sustainable Construction

Many definitions exist regarding sustainability and green or environmental design. However, the most accepted and widely used definition today was that developed by the United Nations Commission on Environment and Development (the Bruntland Commission). This definition contends that sustainable development “meets the needs of the present without compromising the ability of future generations to meet their own needs” (World Commission, 1987). From this, a separate definition can be derived for sustainable construction as “those materials and methods used to construct and maintain a structure that meets the needs of the present without compromising the ability of future generations to meet their own needs”. There are many ways contractors can build in a sustainable manner. These include reuse and recycling of existing structures and materials, jobsite waste management, choosing and educating suppliers for environmental purposes and building commissioning and monitoring, among others.

## Benefits of Sustainable Construction

While only 4% of the total space built in the United States in 2001 could be considered green, this number is growing exponentially as many builders and owners are realizing green building will not only help their corporate image, but their profits as well (Freemantle, 2002). Incorporating green features into a structure can help set builders apart, and marketing incentives typically tied to green programs can increase traffic to projects and awareness of a company (Foerste, 2002). Also, in many areas of the country, substantial savings can be realized from the

reuse and recycling of construction components which can help a contractor's bottom line and project opportunities (ECCO, 1997). Additionally, owners are getting into the act as they are discovering that green structures not only reduce operating costs, but attract young, highly intelligent workers that prefer companies that demonstrate a commitment to the environment (Flanders, 2001). Companies that sell natural products such as Perrier often see green buildings as "marketable commodities consistent with its product". Reports have also shown that employee productivity can increase drastically when a building is designed and constructed in a sustainable manner (Freemantle, 2002). Finally, state and local governments are increasingly establishing requirements for their own public-sector buildings as they realize the financial and social benefits of green building (State and Local, 2002). These positives help explain why sustainable construction is becoming so popular.

### The Growth of Sustainable Construction

One of the most obvious indicators of the growth of sustainable practices in the commercial sector is the tremendous expansion of the United States Green Building Council (USGBC) and its Leadership in Energy and Environmental Design (LEED) program in recent years. LEED is a voluntary standard for sustainable buildings in which certification occurs upon meeting specified criteria to achieve one of four rating designations. Today, more than 800 structures are registered to receive LEED accreditation (Malli, 2003) with 93 already LEED certified. Additionally, the USGBC now has almost 3,600 members (USGBC<sup>3</sup>, 2003), up from approximately 250 just four years ago (Freemantle, 2002). Figure 1 below illustrates this growth, with particularly high acceleration among constructor memberships which have almost tripled, both in 2002 and 2003.

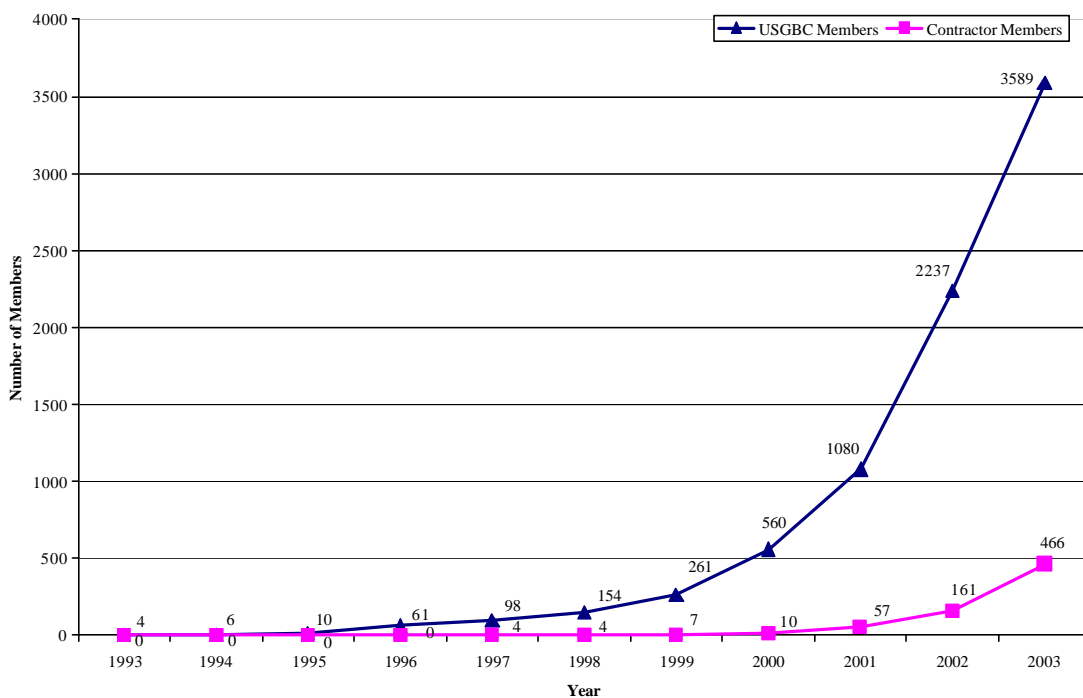


Figure 1: USGBC total membership and construction membership.

Besides creating and monitoring the LEED certification process, the USGBC is also responsible for coordinating the Green Building International Conference and Expo. This year's annual conference attracted over 5,200 professionals (USGBC, n.d.), up from 4,000 registrants in the conference's first year. Included among these were several major construction companies including Austin Commercial, Turner Construction and Centex Construction, just to name a few. Also included were a host of private owners and municipalities dedicated to implementing more sustainable construction approaches.

In addition to the explosion of sustainable construction in the commercial market, residential initiatives in green construction are growing as well. In fact, the first green rating system in the country was developed as the Austin Green Builder Program in 1990, which at the time was purely residential. Today, approximately 30 green building programs are functioning throughout the country, with more in the development stages (NAHB, 2002, Energy Efficiency, 2003). While the functions of these programs vary, the primary goals of all are to increase education and thus acceptance of green building as a necessary technique for future growth. The number of homes registered within these programs varies substantially, with over 18,000 registered in the Built Green Colorado program (BuiltGreen, 2003) to very few homes registered in the newer programs (NAHB, 2002).

To keep up with and ahead of the growing trend in sustainable construction, trade organizations are developing materials and committees that deal specifically with sustainable construction. The Associated General Contractors (AGC) has made several steps toward educating its members, including the publication of educational materials, the inclusion of environmental news and updates in its newsletter and recognizing members for participating in green construction efforts (Gaskins, 2002). The National Association of Home Builders (NAHB) has made considerable efforts towards green education, including conducting green building research, publishing sustainable construction materials and holding a national green building conference which will be in its fifth year this April (NAHB, 2002).

Government initiatives and regulations have also been established across the country that either promote voluntary participation or mandate participation in green building efforts. For instance, the City of Dublin, California requires all construction projects over \$100,000 to submit waste management plans for reducing landfill waste by 50% (California, 2002). Incentives are currently being used in most areas in lieu of regulations. Providing technical support, speedier approvals and marketing are techniques being used around the country (State and local, 2002). Tax credits are another method municipalities use to encourage environmental construction; and some city programs, such as the Seattle City Light's program, actually reimburse contractors for incorporating energy efficient products and designs in their structures (State and local, 2002).

The U.S. Army Corps of Engineers has become actively involved in promoting green construction on all projects. The sustainable project rating tool (SPiRiT) was developed to measure sustainability in military designs. It is very similar to the LEED rating system, but adds additional rating areas that apply to military facilities. It has been mandated that all Army constructions use SPiRiT to evaluate their sustainability, and currently the Army has a goal of achieving Bronze level on all new projects.

Construction research is also becoming involved in sustainable ideas as the 2003, 11th International Conference held by the Center for Construction and Environment at the University of Florida's focus was deconstruction and material reuse. The conference organizers' objectives were to address the issues required to make deconstruction and materials reuse a viable option for the construction industry. Information was backed by a four-year study of deconstruction by The International Council for Research and Innovation in Building Construction (M.E. Rinker, 2002).

Finally, many construction firms are implementing environmental initiatives. Skanska construction company, one of the three largest construction companies in the U.S., is focused on minimizing the environmental impact of construction and sees their techniques as an asset that sets the company apart from competitors (Skanska, n.d.). Affiliated Construction Services, Inc. now advertises their employment of a LEED Certified Professional on staff and the CEO of Turner Construction was quoted as saying, "Turner is enthusiastically seeking new green building opportunities, expanding our range of services and investing in our staff to ensure the success of our green building projects" (Leppert, n.d.). With two of the top five ENR contractors and others leading the way to more sustainable construction, it is certain that other companies must follow.

### **Sustainable Construction Education**

Sustainable construction is "not a fad anymore; it's a megatrend" (Freemantle, 2002). With this explosion comes an increasing need for construction managers with knowledge in the various aspects of green building. To produce construction graduates who meet this need it is necessary to retool programs so that they incorporate green philosophies and techniques. Construction students must be educated with a "whole building" mentality so they can realize the interrelatedness of building components in lieu of the current method of teaching compartmentalized information applicable only to constructors. Green education can easily be integrated into programs either by incorporating green ideas into existing courses such as materials and methods or mechanical/electrical courses or by creating new courses that focus primarily on sustainable ideas (Mead, 2001).

### **Incorporating Sustainable Issues into Construction Education Programs**

The growth and importance of sustainable construction is undeniable. Thus, to keep up with the times, construction education programs must incorporate courses in sustainability so that their students will be able to participate and be valued in the workplace. The American Council for Construction Education (ACCE), the accrediting agency for many of the higher-education construction programs around the country, now includes environmental coursework within its approved curriculum. For instance, courses in environmental sciences may be used for math and science credit hours. Additionally, courses which cover environmental issues may be used for construction science coursework. ACCE guidelines even mandate that environmental issues be covered as parameters affecting project planning (ACCE, 2002).

In order to assess efforts being made across the country in environmental construction education, a survey was issued to ASC member contacts to identify examples of how sustainable or green issues were being incorporated into the curriculum. Information on the existence of sustainable courses or the incorporation of sustainable issues into existing courses was sought specifically.

The survey found several schools currently address sustainable issues in a variety of classes. Two good examples are Colorado State University and University of Florida. Colorado State currently has three environmental courses: Sustainable Design and Construction, Appropriate Technology for Sustainable Living and Sustainable Technology in Built Environments. The Sustainable Design and Construction course is unique in that it is an interdisciplinary course in which students travel to the Virgin Islands and live and learn in an eco-camp for two weeks. The graduate course in Sustainable Technology in Built Environments covers all aspects of sustainability in construction, design and development. The Department of Manufacturing Technology and Construction Management also houses the Institute for the Built Environment which helps foster sustainable research projects among students (Colorado, 2002). Finally, two of the three graduate emphasis options, Sustainable Building and Historic Preservation, involve environmental issues (Colorado, 2004).

The University of Florida has three sustainable courses: International Sustainable Development, Principles of Sustainability, and Construction Ecology and Metabolism. The undergraduate International Sustainable Development course covers environmental trends around the globe currently being utilized to reduce the environmental impacts of construction and development. The two graduate courses investigate how the construction industry must change with the environmental movement and how environmental and industrial ecology relate and apply to the built environment. Master of Building Construction and Master of Science in Building Construction graduate students may also earn a Sustainable Construction Concentration designation which entails that students take the two sustainable construction courses mentioned above in addition to six hours of non-construction courses from a list of approved environmental electives (University of Florida, 2002).

Texas A&M University has recently added two environmentally-related courses to the graduate curriculum. These include Earth Construction and Sustainable Construction. The first course investigates various methods of earth construction and includes hands-on experience in several earth methods. Texas has a history of earth building particularly in the western part of the state and many of the graduate students of the Construction Management Program are international students from areas where earth is still considered a contemporary building material. The Sustainable Construction course covers all components of a sustainable construction project, investigates sustainable programs around the country and even included a trip to the International Green Building Conference. Additionally, a Sustainable Development emphasis is now offered through the College of Architecture.

Stanford University has a variety of courses involved in sustainable practices as well. Two undergraduate energy-related courses include Energy Efficient Buildings and Electric Power: Renewables and Efficiency. Photovoltaics, wind energy and passive systems are investigated in these courses, among other topics. Many other green courses are available through the School of Engineering which houses the Construction Engineering and Management program such as

Environmental Science and Technology, Green Architecture and Air Quality Management; however, these are not required by Construction students (Civil, 2002).

Other schools are adding or currently include sustainable construction courses as well. Temple University includes a graduate course called Sustainable Development and Industrial Ecology. The University of Nebraska at Kearney has an undergraduate course in Alternative Energy. Prior investigation has also identified environmental construction courses at other ASC member universities including an Environmental Construction course at the University of Louisiana at Monroe and a Lab for Sustainable Design and Construction at the Georgia Institute of Technology. Environmental topics were also mentioned as a portion of other courses at Virginia Polytechnic Institute and State University, Minnesota State University Moorhead, Alfred State College and Old Dominion University (Tinker & Burt, 2002).

Individual courses in sustainable construction are not the only technique to include environmental education into the construction curriculum. Sustainable ideas can be incorporated into existing classes throughout the program. Materials and methods courses can be supplemented with environmental products and techniques included in each respective CSI category. Alternate energy systems, efficient HVAC and water conservation techniques can be included in mechanical and electrical courses. Efficient material usage can be taught in estimating courses and environmental jobsite techniques can be covered in construction administration or project engineering courses.

### **Discussion**

It is clear that the construction industry is starting to turn green. This process will require many companies to modify their work and practices, particularly in the area of construction waste management. Construction educators can help this process by providing a curriculum that addresses sustainable or green issues.

There is both a moral and financial responsibility to educate future constructors in sustainable issues. Leading construction companies are becoming involved in green construction. They will be looking for graduates who are suitably prepared in sustainable ideas and practices. Additionally, if the membership in the USGBC continues to grow at the current rate, it is almost certain that all construction graduates will at some time work on a green project. For the employment futures of these students and the success of programs in placing students, it is imperative that they have the skills necessary to compete in this new job market.

Based on survey responses and prior assessment of environmentally-related construction courses among ASC member universities, it is clear that very few universities are currently educating their students on sustainable construction issues. There are a few universities that have taken a lead in this area that are offering either individual courses or incorporating green ideas into the curriculum. This is allowed and even promoted within the ACCE guidelines.

With the increased demand for knowledge on environmental issues from owners and municipalities, the growth of design/build and the increasing need for environmental initiatives

by all businesses, it is imperative that construction programs start including environmentally-related courses or adding environmental topics to existing courses in their curriculums. Only then will graduates be prepared for the future and able to make a positive difference to the environment.

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