

Using a Green Engineering Building Design Contest to Promote Sustainable Engineering

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Abstract

Students and faculty rarely have the opportunity to work together on the design of a major facility that both are going to use. When funds were appropriated to design and build an engineering annex at the University of Texas at El Paso (UTEP), faculty on the Sustainable Engineering Committee saw a golden opportunity. Committee members decided to propose the idea of a Green Engineering Building Design Contest (GEBDC) to the faculty and the administration and, once approved, to the students. Faculty and the administration have enthusiastically endorsed the undertaking largely because it will serve as a great learning experience for all. As a product, the faculty, students and architect are designing a model building that will illustrate UTEP's leadership in engineering design and sustainability concepts for the El Paso/Ciudad Juarez region. The objective of this paper is to describe and analyze the GEBDC process and its impact on the sustainable engineering initiative and engineering education at UTEP.

The College of Engineering at the University of Texas at El Paso (UTEP) has developed a program for the teaching and learning of sustainable engineering concepts in each and every engineering program. The departments impacted are Civil, Computer Science, Electrical, Materials & Metallurgy, and Mechanical & Industrial Engineering. The program is the result of self-assessment at UTEP and has the support of a National Science Foundation initiative for Model Institutions of Excellence. The program is introducing sustainable engineering concepts in the teaching of specific existing courses and developing a sustainable engineering certification program. This paper will review progress on the sustainable engineering program and present several of the exciting concepts being proposed for inclusion in the engineering annex.

Introduction

UTEP initiated green engineering and science efforts in 1997. UTEP and Virginia Tech (VT) joined forces to submit a proposal to a large energy corporation for the development of a student and faculty exchange that would initiate a greening program in the Colleges of Engineering and Science at UTEP. UTEP would build on Virginia Tech's existing green program and Virginia Tech students and faculty would have an experience at a

culturally diverse institution that has been shaped by environmental challenges and opportunities along the U.S.-Mexico border. The proposal was not funded but it sparked an interest in moving ahead with sustainable/green academic initiatives at UTEP. Funding for these initiatives was secured in the 1999 proposal to the National Science Foundation (NSF) for the second phase of UTEP's Model Institution of Excellence (MIE) program. Participants in the MIE program serve as models for improving the quantity and quality of science, engineering and mathematics (SEM) graduates and doctoral degree recipients. MIE is intended to be a catalyst for developing new approaches to higher education. As a result, the College of Engineering is developing a college-wide Sustainable/Green Engineering Initiative that will impact each of the five departments in each year of their four-year degree programs. The College of Science is implementing a Bachelor of Science degree in Environmental Science.

Ideology

Engineering education is, for the most part, limited to distinct and traditional areas of study. With the advent of ABET 2000 criteria, there is a renewed interest in developing interdisciplinary engineering curricula that focuses attention on the impact of engineering on people, society, and the environment. Since Sustainable Engineering addresses some of these issues, this field seems to be a natural choice for curriculum development. With this in mind, our primary goal is to improve the quality of engineering education by introducing experiences throughout the engineering curriculum that deal with sustainable design. These experiences can be curricular or extra-curricular. In some instances, we have developed green engineering modules to be taught in sophomore, junior, and senior courses that add value to them. In other cases, we have promoted contests that encourage students to participate in infrastructure development projects such as the design of the academic center for engineers and scientists and the engineering annex building.

The specific objectives for the green engineering building contest flow from the larger goals outlined above are as follows:

- a. Create an opportunity for students and faculty to contribute to the design of the new building that will serve as a learning experience for all.
- b. Create a model building that illustrates UTEP's leadership in engineering design and sustainability concepts for the El Paso Ciudad-Juarez region.
- c. Provide solutions to today's problems so that future generations will have at least the same opportunities to live and prosper that the present generation enjoys.

Oberlin College Example

Credit should always be given to those who help inspire others. Marci Janas, who is a staff writer for Office of College Relations at Oberlin College, took the following paragraphs from an article. Her summary is excellent and it describes the project at Oberlin, which has served as model for the work at UTEP:

The Adam Joseph Lewis Center for Environmental Studies at Oberlin College in Oberlin Ohio stands as the most advanced example of ecological architecture in

America. Steven Litt, architecture critic for the Plain Dealer, says that the Center "could be one of the most revolutionary structures of this century, or the next. It's not so much a building as it is a manifesto in bricks and mortar." President Nancy Dye calls the Center "the newest and quite possibly the most ambitious building project in Oberlin's 165-year history is a testament to the College's mission of educating students to make the world a better place."

"Many Oberlin students have already been involved in the planning and design of this building, and many more will be involved in future generations, modifying the technologies and design strategies they find here," says Dye. "All of them have and will take pride in the work of creating an ever lighter human footprint on the earth."

Writing in *The New York Times*, Jay Parini endowed Orr, chair of the Environmental Studies Program, with the apt appellation "environmental guru." Orr led more than 250 students, faculty, and town residents in discussions with national ecological designers during the building's initial design phase three years ago. He also raised most of the funds for the project.

For Oberlin, that knowledge has resulted in a 14,000-square-foot, \$6.6 million, self-sustaining structure of classrooms, laboratories, and surrounding gardens. More than a building where teaching takes place, the Lewis Center is a place that teaches. By virtue of the building's design concepts, students learn ecological competence and mindfulness of place. They learn competence with environmental technologies; analytical skills in assessing full costs over the building's lifetime; and how nature's principle that "waste equals food" can be successfully adapted for manufacturing processes and building materials.

There exists no precedent for a building such as this one that will produce its own energy and treat wastewater for reuse through a Living Machine, replicating the natural purification processes of ponds and marshes. Nontoxic materials such as brick, wheat straw, and wood purchased from certified forests meeting environmental standards were used throughout the building. Worn carpeting was sent back to its manufacturer for disassembly and reuse. The Lewis Center provides a focus of study for students in ecological engineering, architecture, city and regional planning, and more.

The project's head architect is William McDonough, who in 1996 won the first Presidential Award for Sustainable Development, the nation's highest environmental honor. Named by *Time* as "one of the most visionary of the green designers," McDonough is founding principal of William McDonough & Partners Architects and Planners. He also serves as dean of the University of Virginia School of Architecture.¹

Genesis of the Green Engineering Building Design Contest

The Sustainable Engineering Program at UTEP has been designed to provide students with a better understanding of the global impact engineering solutions have on the environment, the legal framework that guides engineering solutions that protect the environment and resources, and the need for efficient and effective resource conservation and energy utilization. These are noble words. Turning these words into reality required a down-to-earth example of what sustainable engineering is all about in order to kick off the sustainable engineering program.

As suggested above, opportunities to kick off new initiatives are not always readily available. The beginning of the Sustainable Engineering Initiative at UTEP was an exception. A new engineering annex building had been “under discussion” since 1990. Finally, in 2001, the state legislature provided six million dollars for the construction of an engineering annex at UTEP. Originally, the new building was conceived as an expansion for research lab space. Research funding has grown very rapidly at UTEP and space for research projects came at the expense of teaching lab space. Faculty offices, however, are located in the interior of the existing building without windows of any type. Faculty in all departments wanted new office space with windows, i.e., the green concept of day lighting. This actually worked well because the existing engineering building can be converted to research labs and student offices at a lower cost than a new building can be built for the same purpose. In short, office space is less expensive to construct than research space because research space at UTEP must be designed to handle heavy structural loads.

Funds actually available for design and construction of the engineering annex are four and one half million dollars after administrative expenses are deducted. Initial design estimates are that this level of funding will provide for a building with 25,600 gross square feet of which 16,600 would be “assignable square feet”.²

Steps to Contest Initiation

Seizing on an idea is a catalytic process. In this instance the catalyst was a green engineering conference sponsored by Virginia Tech University in August of 2001 at Roanoke, Virginia³. The authors and a graduate student came upon the green engineering building design contest idea while having a lively discussion one evening after a long day of attending conference sessions at which the Oberlin College experience was presented. Once the idea was generated, the process for implementation followed. This process, although obvious to some, merits outlining:

- A. Transfer the concept to paper
- B. Obtain Sustainable Engineering Committee support
- C. Secure funding
- D. Obtain departmental backing
- E. Convince the Dean
- F. Obtain support from other engineering departments
- G. Obtain higher administration support
- H. Convince the architect
- I. Implement the program

The authors wrote up the concept. Since one of the authors is the director of the NSF sponsored Model Institutions for Excellence program, getting a commitment for financial support was not difficult. Once financial support was obtained, the contest idea was presented to the Sustainable Engineering Committee (SEC). The SEC committee is responsible for the Sustainable Engineering Initiative and has representatives from each of the departments in the College of Engineering. Since this is a college wide committee, the challenge of obtaining support from the other engineering departments was made much easier. The Dean of the College of Engineering supported the idea after some discussion. Support from the administration came through a bit of good fortune. President Diana Natalicio was making a presentation to the El Paso Branch of the American Society of Civil Engineers on planned construction at the university. The Associate Vice President for Facility Services, an architect, was with the president to provide support. During the course of dinner, the Green Engineering Building Design Contest concept was presented to her and she enthusiastically supported it – as did the vice president.

Rules

All contests must have rules and prizes. The prizes generate student and faculty enthusiasm – especially since the contest was initiated mid semester when both students and faculty are thinking about midterms. The rules and prizes follow:

- The design should include sustainable engineering concepts
- The design must be representative of multiple College of Engineering disciplines.
- Groups should number 3 to 5 students with members representing at least **2** departments within the College of Engineering.
- Groups must include at least one lower division student (i.e., freshman/sophomore).
- Each group must have a faculty advisor.
- The first place winners will each receive a laptop computer.
- Second place winners will each receive a \$1,000 stipend.
- Third place winners will each receive a \$750 stipend.
- Faculty advisors for the winning teams will receive equivalent awards.
- A team of professionals from outside the College of Engineering will conduct judging.

Relationship to MIE program and goals

The primary purpose of the MIE program is to increase the quantity and quality of under-represented minorities that pursue and earn undergraduate degrees in science, engineering, and mathematics. The Sustainable Engineering Program focuses on improving the quality of engineering programs by developing activities that strengthen the skills and perspectives of our students. In this light, the Sustainable Engineering Program contributes to the overarching goal of the MIE program.

As shown in Figure 1, MIE is a comprehensive academic support model for science, engineering, and mathematics students (see <http://www.utep.edu/mie>). The Sustainable Engineering Program fits into this model as a major catalyst for engineering curriculum

reform (see <http://www.utep.edu/green>) and student development. The green engineering building design contest is a student development activity that strengthens the bond between our commuter students and the University community that serves them.

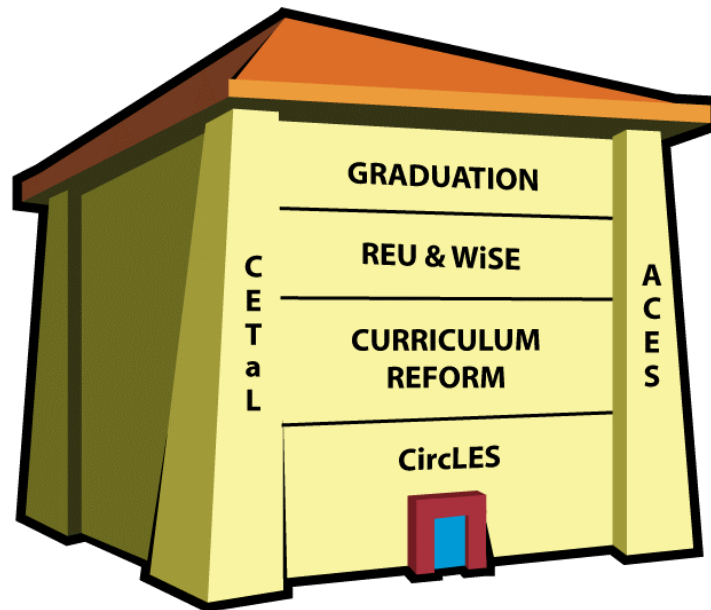


Figure1. The Green Engineering Building Contest is an example of the activities that take place in the MIE academic support model.

Impact on the design of the Engineering Annex

Since integration of green engineering concepts into the design of the Engineering Annex was a late addition to the construction project of which the budget, location, space, and building functionality were already defined and approved by the Board of the University of Texas System, only designs that would not affect the already defined building functionality and can be implemented with manageable additional costs (and with positive cost benefit) will be considered by the architect. Thus, students are encouraged to direct their designs to ideas that would enhance the functionality of the Annex and sustain the energy or other resource necessary for the operation of the Annex.

The authors envision that at least one green engineering conceptual design proposed by the student contestants will be integrated into the design of the Annex. The impact of the green engineering concepts on the design of the Annex is three-fold:

- First, the architect will be working closely with several student groups and learn from these multidisciplinary teams how the clients or the actual users of the facility perceive the building ought to be instead of taking demands from a few

- university administrators. This will greatly benefit the architect in designing a user-friendly building.
- Second, the students and their faculty mentors will acquire valuable hands-on experience of how a concept is materialized and how to work with practicing engineering professionals under a set time line and deliverables.
 - Third, the Annex will be the one of a kind building in the U.S. that bears the signature of green engineering and client involvement. Whatever green engineering concepts selected by the architect and integrated into the Annex's functionality will be visible and appreciated by the users as well as the public in the years to come.

Impact on Sustainable Engineering Initiative

The challenge for the sustainable/green engineering initiative at UTEP is to instill sustainable concepts in all students in each and every year of their degree program.⁴ The green engineering conceptual design contest provides a unique dynamic opportunity outside the student's degree plan to nurture the concepts, facilitate discussions, materialize their conceptual designs, and integrated their designs into a real world project on campus. The outcome will be clearly visible to both the students and faculty. Students are excited to talk about their experiences with their peers and interact rigorously with their mentors as well as the architect. Through the initiation of this green engineering building design contest we have been successfully increased 1) the understanding of environmental issues and the global impact of engineering solutions; 2) the understanding of the legal framework that guides engineering solutions that protects the environment and resources; and 3) the understanding of the need for efficient and effective resource conservation and energy utilization. In addition, we feel that we have broadened the students' education necessary to understand the impact of engineering solutions in a global and societal context and to assist the students to recognize the need for, and an ability to engage in life-long learning.

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Biographic Information

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