

UNIVERSITY OF COLORADO
College of Engineering
Department of Civil, Environmental, and Architectural Engineering

COURSE: **Sustainability in the Built Environment – CVEN 4700/5700**

SEMESTER: Spring 2008

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WEB SITES: Course web site: <http://ceae.colorado.edu/~amadei/CVEN4700>
CU Anywhere's Distance Learning Portal: <http://cua.colorado.edu>

LECTURES: Tuesday and Thursday equivalent.

REQUIRED READINGS:

- Wallace, W. 2005. *Becoming Part of the Solution: A Consulting Engineers' Guide to Sustainable Development*, ACEC Publisher
- Quinn, D. 1993 *Ishmael*, New York: Bantam Books.
- Various articles distributed in class and available on the course web site

SUGGESTED READINGS (BOOKS):

- Benyus, J. M. 1997. *Biomimicry: Innovation Inspired by Nature*, New York: Quill, William Morrow.
- Berry, T. 1988. *The Dream of the Earth*, San Francisco: Sierra Club Books.
- Birkeland, J. 2002, *Design for Sustainability*, EarthScan, Sterling, VA
- Chiras, D, 2000. *The Natural House: A Complete Guide to Healthy, Energy-Efficient, Environmental Homes*, Chelsea Green Publishing, White River Junction, VT.
- Diamond, J. 2005. *Collapse*, Viking Publishing
- Hawken, P. 1994. *The Ecology of Commerce: A Declaration of Sustainability*, Harper.
- Hawken, P., Lovins A. and Lovins L. H. 1999. *Natural Capitalism*, Boston: Little, Brown and Company.
- McDonough, W. and Braungart, M. 2002. *Cradle to Cradle*, New York: North Point Press.
- WCED, 1987. *Our Common Future*, Oxford University Press, NY

“We have lived by the assumption that what was good for us would be good for the world. We have been wrong. We must change our lives, so that it will be possible to live by the contrary assumption that what is good for the world will be good for us. And that requires that we make the effort to know the world and to learn what is good for it. We must learn to cooperate in its processes, and to yield to its limits. But even more important, we must learn to acknowledge that the creation is full of mystery” Wendell Berry, Recollected Essays.

“The ‘silver bullets’ to success are to know what questions to ask, in what circumstances to ask them, and under which context to find answers to them.” Marshall Costantino, President, Analysis, Research and Design, Inc.

COURSE DESCRIPTION

This course introduces undergraduate and graduate students to the fundamental concepts of sustainability and sustainable development. Emphasis is placed first on understanding natural systems, the interaction of the built environment (infrastructure) with natural systems, and the role of technical and non-technical (economic, social, ecological, ethical, philosophical, political, psychological, cultural) issues in shaping engineering decisions. Emphasis is placed on understanding the need to re-conceive and redevelop all human activity to be compatible with and enhance the natural systems of which they are a part. Integral to this, is an understanding of system science and system thinking. Another emphasis of the course is to introduce students to a range of methods: methods to identify and select sustainable solutions to design problems; methods of improving existing solutions; and methods of reasoning.

This course is designed to encourage students to think, and think from many different perspectives. Students are asked to consider many aspects of a single “project,” such as the economic, physical/scientific, social, psychological, historical, ethical, political, cultural and ecological aspects, and how each of these influences the others.

“Not only is there only one way of doing things rightly, but there is only one way of seeing them, and that is, seeing the whole of them” John Ruskin.

“Progress is not an illusion, it does happen, but it is slow and invariably disappointing” George Orwell.

“Progress means getting nearer the place you want to be. And if you take a wrong turning, then to go forward does not get you any nearer. If you are on the wrong road, progress means doing an about face and walking back to the right road, and in that case the man who turns back the soonest is the most progressive man” C. S. Lewis, Mere Christianity

COURSE GOALS

Through a combination of formal lectures, discussion periods, projects, and presentations by experts from practice, the students at the end of the course will have gained a better understanding of the importance of sustainable development in society and the need to design whole systems. They will also be able to take into account the relationships between natural and non-natural systems when creating engineering structures needed to sustain the quality of life for current and future generations while at the same time preserving and improving biotic systems.

After completing the course, the students will be expected to have: (1) a greater awareness of

their role as human beings and engineers on Earth; (2) a better understanding of natural systems and how human-made structures adapt and adjust to natural systems and vice-versa; (3) an understanding of the role of system science and engineering in design of human activity systems; and (4) new skills and tools for finding common themes, developing connections, asking critical questions, providing more holistic answers to those questions, and for integrating economic, social, and environmental aspects into decision making.

“Any time we talk about interconnectedness we are implying that boundaries exist between whatever is being connected. To more accurately view the world, one has to accept that in reality there are no boundaries, only wholes within wholes in a variety of patterns. And to understand the world, according to [Jan Christian] Smuts, we must first seek to understand the greater whole, which has qualities and characteristics not present in any of the lesser wholes that form it.” Allan Savory, Holistic Management.

“Glance at the sun. See the moon and the stars. Gaze at the beauty of Earth’s greenings. Now think.” Hildegard von Bingen

“If you cannot measure it, you cannot manage it” Anon

LEARNING OBJECTIVES

- 1) Increase awareness of the roles of humans on Earth, the professional and personal responsibilities in engineering practice, the interconnections between the natural and man-made “worlds”, and the roles played by engineers in designing, constructing, and operating the built environment.
- 2) Increase awareness of the roles of engineers in addressing poverty issues and promoting capacity building in developing communities worldwide and their roles in contributing to peace and security in an increasingly challenged world.
- 3) Increase understanding of Nature’s cycles and functions and the roles of individual living and non-living (minerals, air, water, energy) entities in those cycles. Examine the application of natural principles to human activities and society. Discuss how Nature can serve as a guide towards making engineering decisions that are more holistic and more in harmony with natural systems (biomimicry).
- 4) Understand that the built environment (buildings, roads, bridges, water, sewer, energy systems, etc.) is comprised of whole systems with both natural and human components. Identify the components of whole engineering systems. Realize that the whole is more than the sum of its parts.
- 5) Understand the multidisciplinary nature of engineering projects and the interaction between technical and non-technical disciplines. Understand system thinking and what a systems approach is.

- 6) Acquire an understanding of what makes a technology or structure sustainable, appropriate, or green that works in harmony with nature rather than in competition with nature. Realize the importance of scale (time and space) and scope (content).
- 7) Acquire an understanding of the sustainability tools that we presently have to assess qualitatively and quantitatively the interaction of infrastructures and natural systems, and consider new tools. Become familiar with several established tools such as Natural Capitalism, The Natural Step, ZERI, Cradle to Cradle, and Biomimicry.
- 8) Hone analytical and critical thinking skills. Become more adept at asking the right questions in the midst of the “system” in which we find ourselves.
- 9) Be exposed to recent business and industry leaders’ descriptions of skills and characteristics vital for current and future engineers.

If time permits:

- 10) Develop recommendations on how to integrate systems approaches and concepts such as sustainability, green design, appropriate technologies and renewable energies in engineering education, practice, and research.

“The painful truth is that the present is a relatively comfortable place for those who have reached positions of mainstream political or business leadership. This is the crux of the problem of sustainable development, and perhaps the main reason why there has been great acceptance of it in principle, but less concrete actions to put it into practice: many of those with the power to effect the necessary changes have the least motivation to alter the status quo that gave them the power” S. Schmidheiny, Changing Course

COURSE REQUIREMENTS AND GRADING

To successfully complete this course, you will read assigned material and complete all written assignments as follows:

Reading: You are expected to read the texts and articles as assigned in class. It is recommended that you set aside enough time each week to read the required material.

Grade: Your final grade will be determined as follows: 50% homework assignments, 50% term project (25% written paper + 25% oral presentation).

Term Project: Your project will consist of a written paper and an oral presentation. The project should address a topic of your choice that involves natural systems and the interaction of the built environment (infrastructure) with natural systems. The project must emphasize the role of technical and non-technical (economic, social, ecological, ethical, philosophical, political, psychological, cultural) issues in shaping decisions. It should also address the course goals listed above. Your project should provide an in-depth analysis indicating an application of many of the

class principles to the topic that you have selected. Case studies are strongly encouraged. Group projects will be allowed (no more than two persons per group). All projects must be approved by the class instructor upon submission of a one-page summary no later than **February 7, 2008**.

Each paper should not exceed 20 pages (single spaced including figures, references and bibliography). Appendices of reasonable length can be added to substantiate the text. Papers are due by 5:00 p.m. on **April 24, 2008**.

The papers will be graded on the basis of timeliness, completeness and quality of analysis, integration of concepts developed in class, how well you have addressed the course goals, how well you have demonstrated an understanding of the topic addressed, clarity, conciseness, grammar and spelling. When you refer to or quote from published works, you must use APA (American Psychological Association) or MLA (Modern Language Association) style (see <http://webster.comnet.edu/mla.htm>). The written paper represents 25% of your final grade. You will be asked to present your project starting on **April 26, 2007**. The oral presentation represents 25% of your final grade.

“Sustainable development implies a new and healthier balance in how we conduct our human affairs, one that celebrates depth along with surfaces, community along with individuality, spirituality along with materialism, art along with linear technique”, K. Frankel, In Earth’s Company

“The times call for a new humanism....We need to integrate the objective and subjective, the interior and exterior, the ethical and empirical and the qualitative and quantitative dimensions of experience. We need in other words, a new sort of integral thinking”, K. Frankel, In Earth’s Company

CLASS FORMAT

The classes will consist of a combination of formal lectures and facilitated discussion periods (plenary and group work). You will be exposed to various topics and will be asked to explore those topics with the help of the instructor. Sustainability can be approached in many different ways. There are no definite answers to the issues that will be discussed in class. Guest speakers from industry, the Boulder community, and the CU Boulder campus will provide additional expertise that will be beneficial to all.

“When there is no vision, the people perish”, Proverbs 29:18

“The significant problems we face cannot be solved by the same level of thinking that created them.” Albert Einstein

“We have become so successful at controlling nature that we have lost our connection to it”, Al Gore, Earth in the Balance

COURSE ROAD MAP

- 1) Creating Awareness (Weeks 1 – 6)

- 2) Creating a New Mindset to Solve Old Problems (Week 7)
- 3) Sustainability and Sustainable Development – The Concept (Weeks 8 - 9)
- 4) Tools for Moving Toward Sustainable Processes in Engineering (Weeks 10 –12)
- 5) Strategies and Implementation (Weeks 13 & 14)
- 6) Presentation of Term Projects (Weeks 15-16 and Final Exam Period)

“We have the capacity and ability to create a remarkably different economy, one that can restore ecosystems and protect the environment while bringing forth innovation, prosperity, meaningful work, and true security. The restorative economy unites ecology and commerce into one sustainable act of production and distribution that mimics and enhances natural systems.” Paul Hawken, The Ecology of Commerce

“We abuse land because we regard it as a commodity belonging to us. When we see land as a community to which we belong, we may begin to use it with love and respect. There is no other way for land to survive the impact of mechanized man, nor for us to reap from it the esthetic harvest it is capable, under science, of contributing to culture”, Aldo Leopold, A Sand County Almanac