Recycling a Site Planning & Design Course into a *Sustainable* Site Planning and Design Course

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Abstract:

One of the topics from our Fall 2008 paper titled Sustainable Construction - *An Education and Research Perspective*, was the integration of sustainable development methods into an existing site planning and development course. The goal of this paper is to further develop this idea of "recycling" an existing site planning and design course by establishing the following site development criteria; features that are redundant should be removed (e.g. oversized road widths), those that are compatible with our focus should be reused (e.g. locating planting islands in all areas of parking lots), and that accepted sustainable site methods should be woven into the course (e.g. use rainwater collection systems and reuse grey water for site irrigation).

Sustainable development was first defined by Gro Harlem Brundtland; then-prime minister of Norway, in his 1987 report to the United Nations General Assembly titled *Our Common Future*, as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs."[1] Sustainability/climate change is the most critical emerging concern for design professionals according to 84% of the deans and chairs of NAAB Accredited architecture programs across the United States who responded to the 2009 Design Intelligence survey. Of respondents, 72% stated that the most significant change to their programs over the past five years has been more emphasis on sustainable design. In addition 38% of architecture schools surveyed currently integrate sustainability into their coursework, 2% offer sustainability courses as separate courses and 61% offer both integrated and separate sustainability courses.[2] To achieve the goal of integrating sustainable construction methods into a site planning & design course we will examine both the site planning course descriptions of architecture programs in U.S. colleges/universities that have been recognized for their sustainable curricula and the criteria of the most well known green development design guidelines: the US Green Building Council's LEED for New Construction - Sustainable Sites, and the Environmental Protection Agency's Low Impact Development program.

Introduction:

To quote H.G. Wells "History is a race between education and catastrophe."[3] The United Nations Intergovernmental Panel on Climate Change (IPCC) recently stated that temperatures in the Northern Hemisphere have been higher over the last fifty years than during any other fifty year period on the last 500 years. They also predict that the Earth's average surface temperature could increase by up to 4° C over the next century. Increased temperatures cause ice shelves to melt thus raising the levels of coastal waters, causing drought and increased wildfire risks in some regions and even raising the specter of wars over increasingly scarce supplies of potable water. Greenhouse gases and more notably carbon emissions in the atmosphere have been widely blamed for the warming temperatures. The 2007 IPCC Assessment Report states that the

greenhouse gas emissions have increased by 70% between 1970 and 2004. These gases are mainly emitted by human behavior such as burning fossil fuels, with buildings emitting nearly half of the worldwide carbon dioxide. There are a number of sustainable site planning and design methods that if applied strategically and sufficiently could help to reduce greenhouse gas emissions; these methods include building orientation to reduce energy use, planting suitable vegetation and reducing the development of open space. [16]

Background:

In our Fall 2008 paper titled *Sustainable Construction – An Education and Research Perspective,*[4] we concluded the following:

- 46% of construction management programs offer at most two courses in sustainable construction.
- None of the construction management programs studied offer a course in sustainable site planning and design.

We recommended the integration of sustainable construction practices throughout construction management programs, as opposed to offering separate sustainable courses as electives, to reflect the standardization of "green" development.

Methodology:

This paper will examine the integration of sustainable construction methods into a site planning and design course that is offered as part of the standard curriculum to both construction management and architecture students. Essentially, our goal, as stated in the title of this paper, is to "recycle" our existing site planning and design course into a sustainable site planning and design course. Our approach to achieve this goal is to:

A. Examine site planning and design course descriptions of U.S. colleges and universities that have been recognized for their sustainable architecture curricula.
B. Incorporate the criteria of the most well known sustainable development design guidelines: Sustainable Sites and Water Efficiency sections of the following US Green Building Council's *LEED for Homes* rating system, the Environmental Protection Agency's Low Impact Development program and the *National Green Building Standard (ICC 700-2008)* Site and Lot Design and Development sections.

A. Site Planning and Design Course Description Review:

We reviewed the course descriptions of the top five National Architecture Accreditation Board (NAAB) accredited architecture schools as ranked by the 2009 DesignIntelligence survey of more than 200 leading professional practices[2] (85% of the largest architecture and design firms in the U.S.) in search of site planning courses that include sustainable criteria. The first and second ranking institutions, University of California at Berkley and the University of Oregon respectively, do not indicate sustainability within their online site planning course descriptions.

Carnegie Mellon University (third ranking) - provides a sustainable design statement for their whole program: *"Sustainable design rediscovers the social, environmental and technical values*

of pedestrian, mixed use communities, fully using existing infrastructures, including "main streets" and small town planning principles, and recapturing indoor-outdoor relationships. Sustainable design avoids the further thinning out of land use, the dislocated placement of buildings and functions."
University of Texas at Austin, (fourth ranking) - offers a graduate course titled "Topics in Sustainable Development" which is orientated toward service learning: *"This course is a trans-disciplinary graduate level seminar designed to critically explore the theory and practice of sustainable development from a variety of perspectives….The concept of sustainability is always seen through the difficult lens of "social equity.'"*

University of Virginia (fifth ranking) - offers their undergraduates a sustainable site planning course titled "Site Assembly" which has a clearly defined set of pedagogic goals including "*To adopt an eco-tech stance toward materials and assemblages that express and work in conjunction with the forces/processes of nature and microclimate."* and *"To discuss current professional trends in sustainability regarding changes in the manufacturing and building industry, emerging materials, changing professional standards, and life-cycle assessment, and green certification programs (LEED)."*

In the DesignIntelligence 2009 survey[2], the deans of NAAB accredited architecture schools, ranked California Polytechnic State University at San Luis Obispo (CalPoly) third overall for their undergraduate architecture program and cited them for their integrated curriculum and preparation of graduates to be ready for work and sustainability. It is interesting to note that Cal Poly at San Lius Obispo is the only school in the top 6 ranked schools to be cited for sustainability. In addition, the American Institute of Architects also awarded CalPoly one of three grants "as recognition of their immersion of ecological literacy concepts." One of their programs in sustainable site design "Community Design Laboratory" offers architecture students exposure to "multiple issues and techniques" in a multidisciplinary setting with landscape architecture and city & regional planning students. The course description includes *"analysis of natural features, climate, existing land uses, quality of the built environment"* and *"developing LEED-ND compliance analyses."*

Other notable architecture programs that offer courses in sustainable site planning and design topics are:

Pratt Institute, New York - the graduate program includes a seminar titled "Sustainable Development Seminar" with the following course description: "*The purpose of the Seminar is to expose Pratt Graduate Students and other interested parties to the issues of sustainable development and the interdependence and interrelationship of sustainable development to global, national, regional and local programs, policies and practices."*

SUNY Environmental Science and Forestry, Syracuse, NY - **"**Landscape Architectural Design Studio III" *"This course introduces and applies concepts of urban and regional planning, environmental planning, and landscape ecology, in the context of large-scale landscape architectural, community, and urban design. Emphasis will be placed upon the application of appropriate technologies and strategies to foster environmentally and economically sustainable*

community forms, as well as greater environmental and social equity. Occasional field trips to illustrate various design solutions."

University of Minnesota: MS in Sustainable Design - Building and Site Integration in Sustainable Design: *"The course provides students with knowledge of site design and water conservation strategies, methods and tools. Based on understanding ecological principles, students will research new approaches to integrated site and building design. Exercises, case studies, and application of tools will provide students hands-on opportunities to investigate design issues and determine outcomes. 4-Field trips to exemplary projects will be part of the class."*

Our Existing Site Planning and Design Course Description States:

"An advanced course in the utilization of engineering and architectural principles from concept through construction techniques of a site development. Computer aided programs in site design and survey data management will be introduced. Drainage, soil stabilization and erosion control parameters, and design techniques are applied to site designs. Safety and geometric standards for roadway design and construction are incorporated into the course."

B. Sustainable Development Design Guidelines within a Proposed Sustainable Site Planning & Design Course Outline:

According the U.S. Green Building Council (USGBC) there are over 70 different green building rating systems in the country. Nationally the USGBC's Leadership in Energy and Environmental Design (LEED) is the most recognized for new commercial construction (LEED-NC). The USGBC also currently has 8 other rating systems including LEED for; *Homes, Existing Buildings, Retail, Healthcare, Schools, Commercial Interiors and Core & Shell with Neighborhood Development* in pilot. The Environmental Protection Agency's *Low Impact Development* is focused on minimizing "*impacts to the landscape and preserves the natural hydrologic cycle,*" [5] and recently ANSI approved the National Association of Home Builder's and International Code Council's *National Green Building Standard (ICC 700-2008)* [7].

The following is a proposed Sustainable Site Planning & Design course outline that is broken into an average fourteen week semester, 3 credit course schedule and is composed of:

- The recycled existing Site Planning and Design course outline headings that correlate to the current textbook *Practical Manual of Site Development*.[14]
- Course outline topics within each heading are recycled topics from the existing course and sustainable site planning topics from: *LEED for Homes* 'Sustainable Sites" section[6], the ANSI approved *National Green Building Standard (ICC 700-2008)* "Site Design and Construction" section [7], the EPA's *Low Impact Development* [5] criteria and the Sustainable Site Design section of *Landscape Architectural Graphic Standards* [8]
- Sustainable site design quotes that reinforce each topic's goal

Note: Traditional site planning and design topics not included will be deemed to be discarded.

Weeks 1 & 2

1. Course Overview, Site Planning Project Introduction and Site Analysis:

- Recycle: The town planning process, environmental review, plan types, site planning project (prepare site plan drawings for an 8,000 sf commercial building on an assigned real site of 1.5-2 acres)

- Add:
  - Mass transportation, minimize street widths and build cluster developments subject to local codes [6,7]
  - Preferred Locations (Edge development/Infill/Previously Developed) [6]
  - Existing buildings preserved/reused/modified or recycled [7]
  - Access to Open Space [6]
  - Compact Development (Moderate/High/Very High Density) [6,7]

Week 3

2. Maps and Plans:

- Recycle: Types of maps and plans used in a typical building project
- Add: A review of the site design and development sections of the LEED rating system and the National Green Building Standard [6,7]

3. Preliminary Engineering:

- Recycle: Stages of design, approvals from agencies necessary, items for a preliminary cost estimate
- Add:
  - Building Orientation - 75% of buildings orientated to face within 20 degrees south [6,7]
  - Reuse existing & recycled materials used [6,7]
  - Protect environmental sensitive areas [7]
  - Promote mixed-use development [6,7]
  - Measures to protect wildlife habitats [7]
  - Nontoxic Pest Control (Pest Control Alternatives) [6,7]

Week 4 & 5

4. Earthwork and Grading:

- Recycle: Cut and fill calculations, Storm Water Pollution Prevention Plan (SWPPP), methods to remove ground water, slopes, sources of earthwork and problems of soil compaction over the whole site

- Add:
  - Minimize soil disturbance and erosion and slope disturbance [6,7]
  - Permanent erosion controls [6,7]
- *"Sediment runoff rates from construction sites can be up to 20 times greater than agricultural sediment rates and 1,000 to 2,000 greater than those of forested lands."* [10]
- *"Soils can take thousands of years to form, but land practices often degrade soils so that they erode or are blown away. By the 1970's almost one third of the topsoil in the U.S. had already been lost by erosion."* [8]

Week 6

5. Exam 1 Followed by Roadways and Parking Lots Lecture/Discussion:

- Recycle: Road/street types, curb types, accessibility requirements and local code parking regulations
- Add:
  - Permeable site materials rated by % of site area [6,7]
  - Narrower streets and road widths to reduce site disturbance and grading. In addition to reducing widths of roads at pedestrian crossings, narrower roads promote traffic calming.
  - Reduce heat island effects (roof and non-roof) [6,7]
  - Shared driveways and minimum required parking spaces [7]
- *"The Urban heat island effect, due in large part to the widespread use of low-reflectivity materials in urban areas, results in average air temperatures 3.6° F than rural areas."* [8]
- *"Placing trees and plants strategically can combat urban heat island effects and reduce energy consumption by lowering air temperatures by 5° F or more."* [8]

Week 7& 8

6. Sanitary Sewers and Storm Drainage:

- Recycle: Septic and sewer systems, and Storm Water Pollution Prevention Plan (SWPPP) and minor and major storm water systems
- Add:
  - Management of run-off from roof [6]
  - Storm water design (Quantity and Quality Control) [6,7]
  - Manage water (quantity and quality) as close to the source as possible [5]
  - Use natural drainage pathways as a framework for site design [5]
  - Utilize less complex, non-structural methods for storm water / waste water management that are lower cost and lower maintenance than conventional structural controls [5]
- *"Approximately 40% of surveyed rivers, lakes, and estuaries were not clean enough to meet basic uses such as fishing and swimming in 1996."* [11]

Week 9

7. Conserving Water Resources/Water Supply Lines:

- Recycle: Affect of building roads and site development in general on the hydrology of the area, Clean Water Act of 1979, advantages and disadvantages of types of parking lot surfaces, parking lot design for good/poor infiltration soils, types of water supply lines, and back flow prevention devices
- Add:
  - Rainwater Harvesting System [6,7]
  - Graywater Reuse System [6]
  - Use of Municipal Recycled Water System [6]
  - Reduce overall irrigation demand by at least 45% [6]
  - Employ a high efficiency irrigation system [6]
  - Third party inspection [6]
- *"Thirty-six states anticipate local, regional or state-wide shortages in the next five years."* [12]
- *"Approximately 30% of water used daily by a family of four in the US is devoted to outdoor uses such as watering lawns and gardens, landscape irrigation uses more than 7 billion gallons of water per day nationwide."* [12]
- *"Weather-based irrigation systems can reduce irrigation water use by 20% I the United States, which is 24 billion gallons per year."* [12]

Week 10

8. Parking, Pedestrian and Bicycle Circulation:

- Recycle: Discussion of local code requirements and solar reflectance for standard paving materials

- Add:
  - Locate parking lots under buildings [8]
  - Increase the number of compact spaces [9]
  - Implement shared parking [6,7,9]
  - Locate parking islands in all areas of the parking lot not occupied by cars and encourage runoff into the planting areas [9]
  - Scatter parking around the site to assist storm water surface infiltration [9]
  - Provide safe travel ways for pedestrians, wheelchairs and bicycles through the site to encourage alternatives to automobile travel [9]

Week 11

9. Landscaping and Site Lighting: (Note this section is not in the current textbook)

- Recycle: Discussion on the use of native plants, and the International Dark-Sky Association Lighting Ordinance[9]
- Add:

- No Invasive Plants [6]
- Landscape design to limit water and energy use [7]
- Native vegetation, turf & trees [7]
- Limit Conventional Turf [7]
- Drought Tolerant Plants [6,7]
- Vegetative wind breaks or channels designed for local conditions [7]
- Plants with similar watering needs are grouped (hydrozoning) [7]
- 75% min of roof is vegetated (green roof) [7]
- Light Pollution Reduction (from LEED for New Construction)
- Create a multifunctional landscape (natural drainage, aesthetics, accessible) [5]

- *"Maintenance over a 20-year span for a non-native turf grass landscape can cost almost seven times more than the cumulative costs of maintenance for native prairie of wetland".* [12]
- *"Residents of a building with greater tree and grass cover report fewer incidences of vandalism, graffiti and litter than counterparts in more barren buildings."* [13]

l Plans, Specs/Estimates:

cle: Drawing format and coordination, review of a sample specification and estimate

Include LEED for Homes or National Green Building Standard checklist/application

ction Phase:

cle: Differences between private and public construction projects, site safety, insurance ›ond types

On-site supervision & coordination [6,7]
Operation & maintenance plan [6,7]
"No disturbance" zones created to protect sensitive areas from construction activity [7]
Reduce soil compaction by distributing the weight of equipment over large areas [7]
Employ alternative means to install utilities (eg tunneling instead of trenching) [7]
Employ proper maintenance techniques [7]

npaction, caused by excessive foot or hoof traffic or use of heavy machinery during ruction, damages soil structure and reduces infiltration rates, which increases runoff ne and flooding." [15]

ntation and final exam review

Conclusion:

In addition to the proposed Sustainable Site Planning and Design outline as listed above we conclude to propose a 'recycled' course description for this course as follows:

An advanced course in the reconnection of a site to its environment and neighboring sites through the utilization of sustainable engineering and architectural principles including; site analysis, preliminary engineering, earthwork and grading, roadways and parking lots, sanitary systems, sewers and storm drainage, water conservation and supply, and landscaping. This course features a hands-on study of local and global policies and procedures, recognized sustainable rating systems, case studies, sustainable site design and construction methods. The outcome of this course is the preparation of a sustainable site plan drawing set in accordance with course topics.

Bibliography

1 Brundtland, Gro Harlem , *Our Common Future; Report of the World Commission on Environment and Development* 1987, UN General Assembly

2 DesignIntelligence *America's Best Architecture & Design Schools 2009*, Greenway Communications LLC for Design Futures Council www.di.net

3 Wells, Herbert George (1866-1946)

4 Bandyopadhyay, A, PE; LoPiccolo, O, RA,; Zoghi, Bahar, P.E. - *Sustainable Construction – An Education and Research Perspective* (http://www.stevens.edu/asee/fileadmin/asee/pdf/Bandy_-_Final.pdf)

5 *Low Impact Development* (LID), Environmental Protection Agency (www.epa.gov)

6 US Green Building Council, *LEED for Homes* 'Sustainable Sites" www.usgbc.org

7 National Association of Home Builders and the International Code Council (ICC), approved by the American National Standards Institute (ANSI) - *National Green Building Standard* (ICC 700-2008) "Site Design and Construction" section.

8 Calkins, M, RLA, ASLA, Ball State University, Sustainable Site Design, *Landscape Architectural Graphic Standards* – 2007, John Wiley & Sons

9 International Dark-Sky Association, *Lighting Ordinance* , (www.darksky.org)

10 Environmental Protection Agency (EPA) 2005

11 Environmental Protection Agency (EPA) 1996

12 Environmental Protection Agency (EPA) 2007

13 Brunson, L. 1999. *Resident appropriation of defensible space in public housing: Implications for safety and community*. Unpublished Doctoral Dissertation, University of Illinois, Urbana-Champaign, IL

14 Colley, B.C., and Colley, Barbara, *Practical Manual of Site Development*, 1986, McGraw-Hill

15 Kelling and Peterson, 1975; Hanks and Lewandowski, 2003

16 American Society of landscape Architects - *Professional Practice*, (www.asla.org)