Introduction

Traditional building practices often overlook the interrelationships between a building, its components, its surroundings and its occupants. Typical buildings consume more of our resources than necessary, negatively impact the environment, and generate a large amount of waste. In United States residential and commercial buildings together use one-third of all the energy consumed, and two-thirds of all electricity used. Further, buildings are a major source of the pollution that causes urban air quality problems, and the pollutants that contribute to climate change. They account for 49 percent of sulfur dioxide emissions, 25 percent nitrous oxide emissions, and 10 percent of particulate emissions, all of which damage urban air quality. Buildings produce 35 percent of the country’s carbon dioxide emissions – the chief pollutant for climate change. United State Green Building Council has created specific criteria for sustainable building construction and maintenance (Leadership in Energy and Environmental Design –LEED rating). This paper reviews the current status in of how LEED criteria are used in various sustainable courses in US and how it could be integrated in a construction management program. This paper specifically addresses integration of the LEED criteria for construction management program at SUNY Farmingdale. This paper also reviews scope and current research agenda in this area.

Green Buildings

Design and construction practices that significantly reduce or eliminate the negative impact of buildings on the environment and occupants in five broad areas are generally accepted as green building. These five areas are: Sustainable site planning, Safeguarding water and water efficiency, Energy efficiency and renewable energy, Conservation materials and resources, and Indoor environmental quality.

Rationale

LEED was created to facilitate positive results for the environment, occupant health and financial return. It also defined “green building” by providing a standard for measurement. It promotes whole-building integrated design processes. It is intended to be used as a design guideline. LEED established a green building market value with a recognizable national brand. It helped to raise consumer awareness.

New Construction LEED Certification

LEED certification of new buildings is based on the five broad areas mentioned earlier. These broad areas are assigned some specific “points.” Figure 1 shows the percentage distribution of points in the five areas. Based on the satisfactory performance on those areas the project might
“score” points. Cumulative score determine the level of certification based on the following scale.

- **Certified Level** 26 – 32 points
- **Silver Level** 33- 38 points
- **Gold Level** 39- 51 points
- **Platinum Level** 52-69 points

![LEED New Construction Point Distribution](image)

**Figure 1. LEED New Construction Point Distribution**

**Other Rating Systems**

The National Association of Home Builders (NAHB) recently developed “green rating” system for homes that has three levels (Bronze, Silver, and Gold) and seven general criteria. The rating is based on: 1) Lot design, preparation, and development, 2) Resource efficiency, 3) Energy efficiency, 4) Water efficiency, 5) Indoor environmental quality, 6) Operation, maintenance, and homeowner education, and 7) Global impact.

**Research Agenda**

The need for research in the area of green building is compelling and wide open. However immediate need seems to be in the areas of 1) delivery process and performance evaluation, 2) integrated building systems, 3) buildings’ interaction with local environments, and 4) buildings’ interaction with occupants.
Delivery Process and Performance Evaluation

Some of the issues in this area are building delivery and operation process, performance metrics and evaluation, and economic and financial value of sustainable buildings. Under these broad headings specific tasks could include barriers in multi-disciplinary approach in building delivery system, national building information modeling standard, identifying the costs and benefits of sustainable construction within a financial model, economic impact of policies and standards related to sustainable construction etc.

Integrated Building Systems

Research needs in this area includes building form and envelope, lighting and day lighting, passive, active and hybrid HVAC and control. At the task levels, some areas of current focus are: the developing of strategies and technologies for advanced envelope components and systems, the minimization of energy use and power demand, the testing of effective light/day light control systems, life cycle impact assessment methods for indoor air quality, land use, water use, etc.

Buildings’ Interaction with Local Environments

Ecosystems and site design, optimization of landscaping strategies for Brownfield restoration are some of the major issues in this area.

Buildings’ Interaction with Occupants

Research needs to concentrate in areas of indoor environmental quality (pollutants and stressors) and indoor environments quality (occupant health and productivity).

Educational Perspective

We reviewed a number of colleges and universities to have an idea of status of integration of sustainability in construction programs. The data for this paper was formulated by looking for sustainable construction courses in the course descriptions, and performing word search for “sustainable,” in a randomly selected set of fifteen (15) programs of a total of sixty-one (61) American Council for Construction Education (ACCE) accredited baccalaureate construction management programs.

Of the fifteen (15) randomly selected construction management programs reviewed seven (7) or 46% offer one (1) or two (2) courses in a sustainable construction topic.

A search for the word “sustainable” in the construction management course description listings of the fifteen (15) programs reviewed indicates that if a course contained sustainable subject matter it was also depicted within the name of the course.

One (1) program has a course that is based on the LEED rating system.
Two (2) of the seven (7) universities only offered sustainable construction courses in a master’s program.

Sample Courses

Colorado State University: Construction Management Program

CON 151 — Construction materials and methods
COURSE DESCRIPTION. This course will present the basic knowledge of materials and methods utilized in construction. The information covered in this course will include principle materials and methods used to design and construct most buildings and are the basis for material covered in subsequent courses in Construction Management. Two important themes will be incorporated into all sections of materials and methods presentation: sustainability and ethics in relation to the specification, ordering, and installation of construction materials.

CON 476 — Sustainable practices-design and construction (elective)
COURSE DESCRIPTION. The course will focus on the major components of sustainable design and construction, including energy, healthy buildings, cultural, natural resource use and other environmental and economic issues of sustainable built environments.

University of Florida: Building Construction Graduate Program

BCN 6587/ICM6687 – High-Performance Green Building Delivery Systems
COURSE DESCRIPTION. The purpose of the course is provide an overview of emerging delivery systems for high performance green buildings and the basis on which their sustainability can be evaluated. The U.S. Green Building Council Leadership in Energy and Environmental Design (LEED) criteria are discussed in detail.

Virginia Polytechnic Institute and State University: Master of Science in Building Construction

BC 5984 Sustainable Facility Systems
COURSE DESCRIPTION. This course provides an introduction to the means, methods, and analytical practices associated with sustainability in the built environment. Covers best practices for sustainable projects in the areas of planning/development, site design, project management, energy and water conservation and efficiency, green building materials, and indoor environmental quality. Analytical methods studied include green building assessment tools and methods such as the Leadership in Energy and Environmental Design (LEED) rating system, economic analysis of green building alternatives, and evaluation for innovation and organizational change.

BC 5984 Sustainable Infrastructure Systems
COURSE DESCRIPTION. This course provides relevant issues and state of the art technologies for sustainable civil infrastructure systems, including energy generation, water supply and treatment, wastewater systems, solid waste systems, and transportation/mobility systems. Analytical methods includes development-scale sustainability assessment tools and methods; green materials performance assessment and evaluation; economic analysis of system alternatives; demand assessment/optimization; and conceptual design approaches for different system types.
Sample Courses at Our Campus

CON 302 Soils, Foundation and Earth Structure

In this course we teach the student how to apply Sustainable Sites Prerequisite 1 which is Construction Activity Pollutant Prevention. We talk about erosion and sedimentation control and potential technology and strategy for any construction project. The plan shall describe how to prevent soil lost by storm water runoff or wind erosion during construction and how to prevent sedimentation.

ARC 363 Site Planning and Design

In this course we include Sustainable Sites Credits categories 1 and 2 and 5. In site development plan we can consider SSc1 (Site Selection) which requires developers to reduce the environmental impact from the location of a building on a site. The aim of SSc1 is to minimize the impact of the building construction on natural resources both, on-site and off-site. In SSc2 (Development Density and Community Connectivity), the objective of protecting Greenfields and preserve habitat and natural resources could be part of the plan for Site Development. SSc5 (Site Development) should also consider maintaining as much of the native or adapted biological species as possible in the region. In addition providing a high ratio of open space to development footprint should be emphasized to promote biodiversity.

CON 303 Hydraulics

In this course we include Sustainable Sites Credits category 6. SSc6 focuses in storm water management. Limiting disruption of natural hydrology by reducing impervious cover, increasing on site infiltration and managing storm water runoff using rational method to estimate runoff is the focus of this course In addition we will consider strategies of project site design to maintain natural storm water flows by promoting infiltration, minimizing impervious surfaces and trying to capture and reuse storm water volumes for non potable uses such as landscape irrigation, toilets and urinal flushing. Moreover the courses addresses the reduction or elimination of water pollutants using alternative surfaces like vegetable roofs or grid pavers and nonstructural techniques such as rainwater recycling.

Conclusion

Many (46% from our small survey) construction management programs offer one or two courses in sustainable construction. However, it appears there is a need for college/university construction management programs to follow a comprehensive integration of sustainable construction practices throughout their curricula.
Bibliography


Biography

Bandyopadhyay, Amit, SUNY Distinguished Service Professor and Chair, Architecture and Construction Management department, State University of New York, Farmingdale

LoPiccolo, Orla, Assistant Professor, Architecture and Construction Management department, State University of New York, Farmingdale

Zoghi, Bahar, Assistant Professor, Architecture and Construction Management department, State University of New York, Farmingdale