SUSTN-105
COURSE

MILWAUKEE AREA TECHNICAL COLLEGE
TECHNICAL AND APPLIED SCIENCES (MATC/T&AS)

Sustainable Facilities Operations Program

SUSTN-105 The LEED Rating System, Sustainable Building Core Concepts

National Science Foundation - National Center for Building Technician Education

Center for Energy Conservation & Advanced Manufacturing
ECAM
Milwaukee Area Technical College

BEST
Building Efficiency for a Sustainable Tomorrow

NSF

2014-05-02

THE LEED RATING SYSTEM, SUSTAINABLE BUILDING CORE CONCEPTS

Course Documentation

This material is based upon work supported by the National Science Foundation under Grant Number (DUE 1204930).

Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

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Catalog description

This 8 week accelerated course presents ideas and practices that set the groundwork for a more detailed study of green building practices for building projects ranging from new construction to operations and maintenance. Hands on exercises and class lectures will enforce core sustainable concepts as they relate to the LEED Green Building Rating Systems, while providing a solid foundation for individuals interested in pursuing the LEED Green Associate Credential.

Class hours

24 hours of lecture and 24 hours of self-directed research.

Self-directed research is part of each homework assignment, see sample in Appendix C.

Units

3 Credits

Entry skills needed

The following are required for admission to the program:

- A high school diploma or GED
- Demonstration of proficiency in basic skills through a course placement assessment

In addition, your potential for success in the program will be enhanced if you have some work experience and/or a strong interest in sustainability and facilities management. You should also possess conceptual abilities, and problem-solving, computer and organizational skills.

Syllabus

See Appendix A for sample syllabus, course schedule, and policies. For lesson topics to include in course, see Exit Skills.

Student learning outcomes

The exit skills listed in the next section support these 3 outcomes:

Sustainable building concepts

The student will understand the concepts of a sustainably built and operated building and how it is different from a conventional building, including discuss the integrated design approach.

The LEED Rating System

A student will be able to work with the various aspects of the LEED rating system including define the various levels of certification.

LEED levels of accreditation & Green Associates Exam

A student will be able to define the three levels of LEED accreditation and have the information needed to take the LEED Green Associates exam.

Exit skills

Course content to achieve outcomes listed above:

Sustainable Buildings

1. Explain the benefits of Sustainable Buildings.

Lesson Topics:

- Intro to Green Building
    - Describe green building and why is it necessary
    - Explain the triple bottom line
    - Describe how and why the green building industry rose
    - Discuss how the built environment impacts climate change
    - Describe how time effects green building projects
    - Explain why location is a critical element of green design
    - Discuss costs and savings associated with green building
    - Discuss how to go beyond green design
    - Identify the skills necessary to be a green building expert
- Sustainable Thinking
    - Describe systems thinking
    - Explain how systems work
    - Describe open and closed systems and provide examples
    - Compare and contrast positive and negative feedback loops
    - Define and identify leverage points
    - Describe life cycle approach
    - Compare and contrast Life cycle costing (LCC) and Life cycle assessment (LCA)

    - Explain integrated process
- Sustainable Thinking at Work
    - List and describe the principles that form the foundation for successful green building practice
    - Define Iterative Process and explain how to establish one
    - Identify appropriate project team members
    - Describe how to set clear project goals
    - Explain why needs assessments and observations of systems are an important part of turning goals into a concrete action plan
    - Describe evaluating strategies
    - Describe implementation steps
    - Explain the role that ongoing performance plays in a sustainable project

USGBC and Its Programs

2. Describe the LEED rating system.
   Lesson Topics:
    - Compare and contrast USGBC & GBCI
    - Certification Levels
    - Rating systems vs Reference Guides
    - Credits vs Prerequisites
    - Identify the correct rating system for specific project types
    - Describe the LEED Professional Credentials
    - Describe the intent and associated concepts for the LEED credit category:
        1. Sustainable Sites
        2. Water Efficiency
        3. Energy & Atmosphere
        4. Materials & Resources
        5. Indoor Environmental Quality

Green Associate Exam Prep

Lesson Topics:

- Describe process and eligibility requirements for obtaining the LEED Green Associate Credential.
- Identify the 7 Green Building Certification Institute (GBCI) LEED Green Associate Credential exam areas of focus.
- List the 3 things every exam candidate should know.
- Describe the 15 steps that a candidate takes while applying for a credential exam.

- Describe a minimum of 3 critical details of an approved exam application period.

Course materials

Principal text

US Green Building Council. *Green Building and LEED Core Concepts Guide, Second Edition, E-book (www.usgbc.org)*. US Green Building Council. 2009.

Lecture materials and handouts

- Presentations (PowerPoint):
    - 1 SUSTN105_GreenBuildingIntro
    - 2 SUSTN105_SustainableThinking
    - 3 SUSTN105_SustnThinkAtWork
    - 4 1 SUSTN105_USGBC&ItsPrograms
    - 4 2 SUSTN105_SustnSites
    - 5 1 SUSTN105_WaterEfficiency
    - 5 2 SUSTN105_Energy&Atmosphere
    - 6 SUSTN105_Materials&Resources
    - 7 SUSTN105_IndoorEnvQuality
    - 8 SUSTN105_LEEDGreenAssocPrep
- Group Exercises
    - 201 SUSTN105_SustnSitesGroupExercise
        - An exercise to learn about what considerations there are for different geographical site locations
    - 202 LEED Game
        - A question/answer formatted set of slides.
    - 203 10 3-2-1 PowerPoint
        - Slides discussing a reading and discussion class exercise

Other reference materials

Embedded in weekly assignments

Software needed

Access to computer with:

- Microsoft Office Programs (Word, Excel, PowerPoint, etc.).
- Adobe Reader (for pdfs). Price: Free. Source: www.adobe.com.

- Access to computer with internet access. (i.e. Internet Explorer, Mozilla Firefox, Safari, etc.).

Lab setup and materials

None required, lecture only course.

Equipment & instruments required

None required.

Sample of weekly assignments

WEEK One Homework:
Part 1: Read pages 1-16 of the Green Building and LEED Core Concepts Guide, Second Edition. Then answer the following: (25 possible points)

1) What is the term that is used to describe any environment that is manmade and provides a structure for human activity? (1 point)

2) According to the Energy Information Administration, EIA Annual Energy Outlook (EIA 2008), buildings in the United States account for what percentage of electricity consumption? (1 point)

3) Conventional practices in the building industry have profound implications on the triple bottom line. List 2 conventional building practices and the negative implications associated with each. (4 points)

4) The U.S General Services Administration conducted a survey of 12 of their green buildings (Public Building Service, "Assessing Green Building Performance: A Post Occupancy Evaluation of 12 GSA Buildings" - General Services Administration, 2008). What are the 5 measured performance areas that the government's green buildings outperformed compared to national averages? (5 points)

5) What 3 kinds of resources does the Triple Bottom Line concept incorporate a long-term view for assessing potential effects and best practices? Describe each of the 3 resources including what costs and benefits are considered. (6 points)

6) What year was USGBC formed? (1 point)

7) What does the acronym LEED stand for? (1 point)

8) What year was the first LEED green building rating system launched? (1 point)

9) Why does a building's total emissions footprint incrementally increase overtime unless care is taken to maintain the systems properly? (1 point)

Project

None required.

Assessment

Methods

- Class Participation
- Homework – electronic and/or hard copy
- Quizzes – Online using BlackBoard
- Final Exam – Online using BlackBoard

Sample test questions

From final exam:

1) Which one of the following is not one of the 6 categories used in LEED?
   a. Water Efficiency
   b. Energy Efficiency
   c. Materials & Resources
   d. Innovation in Design.

2) It has been said that occupants of green buildings typically have significantly greater satisfaction with air quality and lighting compared to conventional buildings. Case studies have shown that these benefits can translate into what percentage increase in workers' and students' productivity?
   a. 1-5%
   b. 4-18%
   c. 2-16%
   d. 0%

3) A project is in the pre-design phase and the site has already been selected. The team wants to increase the open space on the project site. Which strategies should it consider (select two)?
   a. Increase the floor-to-area ratio of the building

b. Implement a construction activity pollution plan
c. Use pervious paving materials for the parking area
d. Locate parking underground
e. Select drought-tolerant plantings

4) According to data from the U.S. EPA Green Building Working Group, cooling accounts for _____ of the energy end-use profile in a typical office building.
a. 2%
b. 5%
c. 23%
d. 25%

Adaptability to on-line format

This course can be delivered on-line due to its lecture format.

Currently the entire course is in BlackBoard online but taught in lecture / discussion format. Test including final exam are online. All homework is available online.

Students are required to search for documents online and research both the USGBC (US Green Building Council) and GBCI (Green Building Certification Institute) online.

The only item that is not online are the guest speakers from industry who come in and present on what they do and how it relates to the class and potential jobs for the students.

Appendix A – Sample syllabus

The LEED Rating Systems

The LEED Rating Systems

Syllabus

Course Information

Organization Milwaukee Area Technical College
Course Number SUSTN 105
Credits 3
Contact Hours 24
Instructor Ted Wilinski, LEED AP O&M
E-mail Address wilinskt@matc.edu
Office E108
Campus MATC South Campus, ECAM
Address 6665 South Howell Avenue
City/State/Zip Oak Creek, WI 53154-1196
Office Hours Before each class, 5pm-5:45pm in the classroom, and after class as needed.
Office Phone 414-571-4570
Beginning Date 03/25/2014
Number of Weeks 8 (*through May 21, 2014*)
Meeting Times/Location Tues. evenings from 5:45 to 8:40 p.m. plus 4 to 12 hours per week outside of class using Blackboard.

Description

This 8 week accelerated course presents ideas and practices that set the groundwork for a more detailed study of green building practices for building projects ranging from new construction to operations and maintenance. Hands on exercises and class lectures will enforce core sustainable concepts as they relate to the LEED Green Building Rating Systems, while providing a solid foundation for individuals interested in pursuing the LEED Green Associate Credential.

Prerequisites

Access to a computer each week to do online work and quizzes.
Ability to use email, Blackboard, and basic computer programs such as Microsoft Word, Microsoft Excel, and Adobe Acrobat.

Textbooks

US Green Building Council . *Green Building and LEED Core Concepts Guide, Second Edition, E-book (www.usgbc.org)*. US Green Building Council. 2009.

Learner Supplies

Writing/Note taking materials.
Access to computer with Microsoft Office Programs (Word, Excel, PowerPoint, etc).
Access to computer with Adobe Reader (for pdfs). **Price:** Free. **Source:** www.adobe.com.
Access to computer with internet access. (i.e. Internet Explorer, Mozilla Firefox, Safari, etc.).

Core Abilities

A. Communicate effectively.
B. Collaborate with others.
C. Respect diversity.
D. Demonstrate responsibility.
E. Think critically and creatively.
F. Utilize technology.
G. Apply math and science.

H. Demonstrate environmental responsibility.
I. Embrace change.

Competencies

1. **Articulate the cumulative impact that the design, construction and operation of built environments has on human health, the environment and the economy by providing a minimum of 3 examples.**

Learning Objectives

a. Describe 3 conventional development practices and their associated implications on human health, the environment and the economy.

b. Discuss the current trend in the United States toward green building and the projected market growth.

2. **Describe how green building aspires to transform the design, construction, and operation of built environments.**

Learning Objectives

a. Define sustainable as it relates to green building.

b. Define market transformation.

c. Discuss the 3 dimensions of sustainability that are often described as the triple bottom line.

d. Identify three key issues and/or approaches that should be addressed to reduce the profound implications caused by the cumulative impact of design, construction, and operation of built environments.

3. **Discuss the life cycle of built environments.**

Learning Objectives

a. Describe the extents of the life-cycle process when it is applied to the built environment.

b. Define life-cycle.

c. Discuss the benefits of conducting a life-cycle cost analysis.

4. **Discuss green building costs and benefits.**

Learning Objectives

a. Discuss a minimum of 3 ways that green buildings perform better than conventional ones.

b. Compare the actual costs of green buildings to the public's perceived costs of green building.

c. Give at least one example how integrative design balances first costs by providing other savings.

d. Summarize the overall findings of the Davis Langdon study titled "Cost of Green Revisited; Reexamining the Feasibility and Cost Impact of Sustainable Design in the Light of Increased Market Adoption."

5. **Describe the central role of the integrative design process.**

Learning Objectives

a. Compare and contrast the conventional design and construction processes to the integrative design process.

b. Define the 5 construction phases and their sub phases (if applicable).

c. Organize the construction phases into the order of their execution.

d. Identify seven typical players involved over the duration of the design and construction process.

e. Discuss the responsibilities of the seven typical players and how their partnership, communication, and integrated approach may play a role in the success of a project.

6. **Compare the roles and missions of the US Green Building Council (USGBC) and the Green Building Certification Institute (GBCI).**

Learning Objectives

a. Describe the missions of USGBC and GBCI.

b. Compare the organizational overviews of USGBC and GBCI.

c. List all of the primary functions of USGBC.

d. Describe the purpose for which the Leadership in Energy and Environmental (LEED) Rating System was developed.

e. List all of the primary functions of GBCI.
f. Define third-party verification.

7. **Identify the key components of the Leadership in Energy and Environmental Design (LEED) Rating System.**

Learning Objectives
a. Define LEED Prerequisite.
b. Define LEED Credit.
c. Describe each of the 11 LEED rating system categories.

8. **Identify the anatomy of a LEED Prerequisite and LEED Credits.**

Learning Objectives
a. Define LEED credit/prerequisite intent.
b. Define LEED credit/prerequisite requirements.
c. List the 16 components that each prerequisite and credit in the LEED 2009 reference guides contains.

9. **Describe the 4 levels of LEED Certification.**

Learning Objectives
a. Identify the point ranges associated with each level of LEED Certification.
b. Describe how a project achieves a level of certification.
c. Discuss the purpose of LEED credit weightings.
d. List the total base and bonus points available for each rating system.

03. **Differentiate between the LEED Rating Systems and the LEED Reference Guides.**

Learning Objectives
a. List the 11 LEED Rating Systems.
b. List the 5 LEED Reference Guides.
c. Describe why the LEED Reference Guides were developed.

11. **Describe what project types are eligible for LEED.**

Learning Objectives
a. Identify a minimum of one project type that is eligible for each of the LEED rating systems.
b. Define LEED Minimum Program Requirement.
c. Describe each of the 7 LEED Minimum Program Requirements.

12. **Describe the overall LEED Certification process.**

Learning Objectives
a. Describe the two steps associated with LEED Registration.
b. Describe the 4 overall steps that obtaining LEED certification entails.
c. List the three, third-party certification processes that take place once a project team submits documentation to LEEDonline for review.
d. Describe the two approaches to submitting LEED documentation for review.
e. Describe the unique certification processes associated with LEED for Homes and LEED for Neighborhood Development.

13. **Describe the general documents that are required for LEED Certification.**

Learning Objectives
a. Describe the 6 areas of documentation required to provide an explanation of your project scope and highlights.
b. Define Project Narrative.
c. Differentiate between the project boundary, LEED boundary, and property boundary.

14. **Identify the 3 LEED professional credentials and the associated specialties.**

Learning Objectives
a. Define LEED Green Associate Credential.
b. Define LEED Accredited Professional with Specialty Credential.
c. Define LEED Fellow Credential.
d. Describe what steps are required to achieve LEED Professional Credentialing at each level.
e. Describe the 5 LEED Accredited Professional areas of specialty.

15. **Describe why an individual should choose to pursue LEED Credentials.**

Learning Objectives
a. Describe 4 benefits for individuals.
b. Describe 3 benefits for an employer.

c. Describe 2 benefits for industry.

16. **Describe the intent and associated concepts for the LEED credit category: Sustainable Sites.**

Learning Objectives

a. Identify the 4 key issues that help define how a project's location affects the sustainability of a project over its lifetime.

b. Describe the profound impact that each individual key issue has on the triple bottom line.

c. Identify 15 basic metrics that are used to evaluate site-related strategies.

d. Identify a minimum of 3 green building technologies/strategies that are applicable to this LEED Credit Category.

e. Give a minimum of 1 example of synergies among the LEED Sustainable Sites category and one of the other LEED credit categories and strategies.

17. **Describe the intent and associated concepts for the LEED credit category: Water Efficiency.**

Learning Objectives

a. Identify the 3 key areas of water use for a project.

b. Describe the profound impact that each individual key areas of water use has on the triple bottom line.

c. Identify the 4 basic metrics that are used to evaluate water efficiency strategies.

d. Identify 3 green building technologies/strategies that are applicable to this LEED Credit Category.

e. Give a minimum of 1 example of synergies among the LEED Water Efficient category and one of the other LEED credit categories and strategies.

18. **Describe the intent and associated concepts for the LEED credit category: Energy & Atmosphere.**

Learning Objectives

a. Identify the 4 key interconnected elements of the strategies that are used to reduce the impacts of energy use.

b. Describe the profound impact that each individual key element has on the triple bottom line.

c. Identify the 6 basic metrics for assessment and measurement of energy and atmosphere.

d. Identify 5 strategies that are used to reduce energy demand.

e. Give a minimum of 1 example of synergies among the LEED Energy and Atmosphere category and one of the other LEED credit categories and strategies.

19. **Describe the intent and associated concepts for the LEED credit category: Materials & Resources.**

Learning Objectives

a. Identify the two primary categories that green building focuses on when considering materials and resources.

b. Describe the profound impact that each of the two primary categories that green building focuses on when considering materials and resources has on the triple bottom line.

c. Identify the 6 basic metrics that are used to evaluate materials and resources strategies.

d. Identify a minimum of 3 green building technologies/strategies that are applicable to this LEED Credit Category.

e. Give a minimum of 1 example of synergies among the LEED Materials & Resources category and one of the other LEED credit categories and strategies.

20. **Describe the intent and associated concepts for the LEED credit category: Indoor Environmental Quality.**

Learning Objectives

a. Identify the 4 critical components of the Indoor Environmental Quality category.

b. Describe the profound impact that each of the 4 critical components has on the triple bottom line.

c. Identify the 6 basic metrics that are used to evaluate indoor environmental quality strategies.

d. Identify a minimum of 3 green building technologies/strategies that are applicable to this LEED Credit Category.

e. Identify the two basic issues to pay attention to in the Indoor Environmental Quality Category.

f. Give a minimum of 1 example of synergies among the LEED Indoor Environmental Quality category and one of the other LEED credit categories and strategies.

21. **Describe the intent and associated concepts for the LEED credit category: Innovation In Design.**

Learning Objectives

a. Describe the purpose of the Innovation in Design Category.
b. Identify the two primary ways to earn an Innovation in Design Credit.
c. Describe the benefits of having a LEED Accredited Professional on a project team.

22. **Describe the intent and associated concepts for the LEED credit category: Regional Priority.**

Learning Objectives

a. Describe the purpose of the Regional Priority Category.
b. Describe how a project team determines what credits have been identified as regional priorities for their specific project.
c. Identify the maximum number of regional priority points a project can earn.

23. **Describe process and eligibility requirements for obtaining the LEED Green Associate Credential.**

Learning Objectives

a. Identify the 7 Green Building Certification Institute (GBCI) LEED Green Associate Credential exam areas of focus.
b. List the 5 things every exam candidate should know.
c. Describe the 15 steps that a candidate takes while applying for a credential exam.
d. Describe the 3 possible areas that an exam candidate can obtain experience.
e. Describe the documentation requirements necessary to confirm that the candidate does indeed have the required experience to sit for the exam.
f. Describe the 5 steps that a candidate takes to register for a credential exam.
g. Describe a minimum of 3 critical details of an approved exam application period.

GRADING INFORMATION

Grading Rationale **Please note this is subject to change.*

1. 5% Class Participation
2. 35% Homework
3. 45% Online Quizzes - using BlackBoard
4. 15% Final Exam - using BlackBoard

Guidelines for Success

Academic Honesty 1

Students are expected to do their own work unless advised that collaboration is acceptable. This means that you may use facts from other sources if you re-write them in your own words. Anytime you quote directly from another source or paraphrase substantially, you must cite the source you used. When you take a test, you are expected to keep your eyes on your own paper and protect your test paper from being copied by a classmate.

Failure to use proper citation procedure is considered plagiarism. Plagiarism will result in a grade of "0" if it is flagrant and/or deliberate. Copying from another person's paper or test is academic dishonesty and will result in a grade of "0" for that assignment. In addition, you will be referred to student services for discipline based on college policy.

ADA Statement:

If you have a disability that impacts your classroom performance and wish to request an accommodation, contact the Center for Special Needs at (414) 297-6838. They may require documentation regarding your disability to enable them to comply with your request. Admission of a disability is voluntary and will be handled in a confidential manner. MATC does not discriminate against individuals with disabilities and fully complies with the Americans with Disabilities Act.

To ensure your academic success in this program, you are strongly encouraged to provide your instructor

with a copy of the Instructor Notification Form from the Center for Special Needs.
STUDENT COMPLAINT PROCEDURE: Refer to the student handbook which can be found at http://www.matc.edu/

Attendance

Plan your schedule so that you can be present for scheduled class sessions and manage your time so that you can complete your assignments and assessments on or before the date they are due. If you do miss a class session, identify what you have missed and obtain handouts or other learning materials that were distributed during your absence.
Contact your instructor in person, via email, or via voicemail message, explaining how you intend to make up missed work. Complete all work missed due to an absence within one week after your return.
If you know you will miss a class session, notify your instructor prior to the absence. Plan ahead to submit assignments or complete assessments that will be due during your absence prior to your absence. (Refer to Blackboard and the syllabus schedule.)

Online - Attendance

In an online course, you are not required to show-up in at a particular location and at a particular time. However, you are expected to show-up online. You should plan to log on and participate in the course at least 1-2 times each week.
Please do not "drop out" for a period of time and then expect to "drop back in." If your business/personal obligations or illness require you to be absent for a week, please contact me and arrange to make up the work you will miss. Since you can access this online course from anywhere in the world, there should be little likelihood "absence."

Digital Courtesy

Many students like to tape lectures but it is important to obtain the instructor's permission before doing so. If you obtain permission to tape, you should do so in an unobtrusive manner to avoid distracting your classmates. Copyrighted material cannot be taped, e.g. videotapes, etc. If you carry a cell phone to class, convert it to vibration mode or turn it off for the duration of the class. This is especially critical during tests.

How To Get The Most Out Of This Learning Experience

Take charge of your own learning. Raise questions, probe, explore, and go after what you need.
Be open. Use your imagination, consider new possibilities, and create something new for yourself.
Give as well as receive. Give liberally to co-learners and be prepared to receive a great deal from them.
Have fun. Plan to thoroughly enjoy this opportunity to learn and to grow in your professional competence and satisfaction.

Non-discrimination

Milwaukee Area Technical College does not discriminate on the basis of age, race, sex, color, national origin, religion or disability in admission to, access to, or operations of its programs, services, or activities. Milwaukee Area Technical College does not discriminate in its hiring or employment practices.

Schedule

Session	Notes
03/25/2014 - Tuesday 5:45-8:40 PM	Week 1 - class time (Topic: Green Building Introduction)
Before Next Class	- anticipate 4 to 12 hours of self-directed course focused online and desk time
04/01/2014 - Tuesday 5:45-8:40 PM	Week 2 - class time (Topic: Putting Sustainable Thinking to Work)
Before Next Class	- anticipate 4 to 12 hours of self-directed course focused online and desk time
04/08/2014 - Tuesday 5:45-8:40 PM	Week 3 - class time (Topic: Sustainable Sites & Water Efficiency & Guest Speaker from Industry)
Before Next Class	- anticipate 4 to 12 hours of self-directed course focused online and desk time
04/15/2014 - Tuesday 5:45-8:40 PM	No class – Spring Break
04/22/2014 - Tuesday 5:45-8:40 PM	Week 4 - class time (Topic: Energy & Atmosphere & Guest Speaker from Industry)
Before Next Class	- anticipate 4 to 12 hours of self-directed course focused online and desk time
04/29/2014 - Tuesday 5:45-8:40 PM	Week 5 - class time (Topic: Materials & Resources & Guest Speaker from Industry)
Before Next Class	- anticipate 4 to 12 hours of self-directed course focused online and desk time
05/06/2014 - Tuesday 5:45-8:40 PM	Week 6 - class time (Topic: Indoor Environmental Quality, Regional Priority & Innovation in Design)
Before Next Class	- anticipate 4 to 12 hours of self-directed course focused online and desk time
05/13/2014 - Tuesday 5:45-8:40 PM	Week 7 - class time (Topic: LEED Green Associate Credential)
Before Next Class	- anticipate 4 to 12 hours of self-directed course focused online and desk time
05/20/2014 - Tuesday 5:45-8:40 PM	Week 8 - class time (Topic: LEED Green Associate Credential & Guest Speaker from Industry)
DUE Wednesday, 05/21/2014	- Final Exam administered via Blackboard

Appendix B – Sample Power Point

SUSTN 105:
THE LEED™ RATING SYSTEM

Sustainable Facilities Operations Certificate

Topic: Introduction to Green Building

Green Building and LEED Core Concepts. 2nd Edition. Washington,DC: U.S. Green Building Council, 2009. 117 pages. Print.

FCAM
Milwaukee Area Technical College

Instructor

FCAM

Instructor Name
Phone
Email

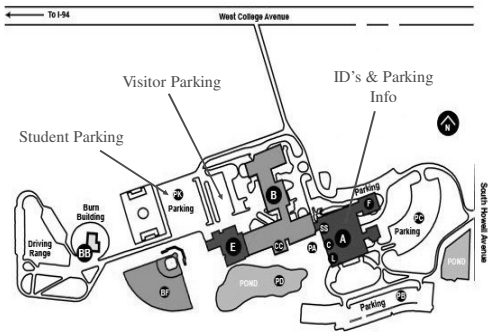
- Office Hours will be held in our classroom starting at 5:00 p.m. I will also stay after class as needed.
- Best way to contact me is via email.
- Do NOT email me your homework. Assignments will only be accepted via Blackboard or hard copy.

Milwaukee Area Technical College

Parking

- You should get a parking permit for next class. Parking passes are available in room A103 open until 6 PM
- If you get a ticket, I cannot get you out of it.

Parking



Accelerated Course

- The SUSTN105: The LEED Rating systems course is an accelerated course.
- This means that students will be here for three hours each of the eight weeks.
- You will spend another four hours of time, say on Thursday nights, working on the course each of the eight weeks.
- You are solely responsible for your success in this course.
- The required text is *Green Building & LEED Core Concepts, Second Edition*.

Blackboard

- Get on Blackboard and figure it out. It will be critical to doing well in this class.
- Link to Blackboard is located on the MATC homepage on the left-side margin.
- Blackboard will be where:
  - All quizzes and exams will be given
  - Reference materials available
  - Assignments and deadlines can be found
  - Course Calendar
  - Announcements
  - Etc, etc, etc

Topic: Intro to Green Building

Learning Objectives:

- Describe green building and why is it necessary
- Explain the triple bottom line
- Describe how and why the green building industry rose
- Discuss how the built environment impacts climate change
- Describe how time effects green building projects
- Explain why location is a critical element of green design
- Discuss costs and savings associated with green building
- Discuss how to go beyond green design
- Identify the skills necessary to be a green building expert

Intro to Green Building

- Green Building is a process
- It requires continual improvement
- Movement strives towards a permanent shift in prevailing design
- Lower impact, more sustainable and ultimately regenerative built environments

Intro to Green Building

Built Environment – Any environment that is manmade and provides structure for human activity.

Environmental Impacts of Buildings

Why is Green Building necessary?

The design, construction and operations of the built environment have profound implications on:

- Environment
- Economy
- Human Health

In the U.S., people spend, on average, 90% or more of their time indoors*

* Source: The Total Exposure Assessment Methodology (TEAM) Study. EPA 600/S6-87/002. U.S. Environmental Protection Agency. 1987.

Environmental Impacts of Buildings

- Green Building practices can:
  - Minimize human use of natural resources
  - Generate economic benefits
    - Lower operational costs
    - Higher human productivity
  - Provide a better quality of life, including improved health

Environmental Impacts of Buildings

- In the U.S. buildings account for the following:
  - 14% of potable water consumption[1]
  - 30% of waste output
  - 38% of CO2 emissions
  - 40% of raw materials use[2]
  - 24-50% of energy use
  - 72% of electricity consumption[3]

[1] *J.F. Kenny, N.L.Barber, S.S.Hutson, K.S. Linsey, J.K. Lovelace, & M.A. Maupin. Estimated use of water in the United States in 2005: U.S. Geological Survey Circular 1344, (2009).*
[2] *D.M. Roodman & N. Lenssen "A Building Revolution: How Ecology and Health Concerns Are Transforming Construction," Worldwatch Paper 124 (Worldwatch Institute, 1995).*
[3] *Energy Information Administration, EIA Annual Energy Outlook (EIA 2008)*

Environmental Impacts of Buildings

- Energy Use in buildings
  - 9% Other
  - 1% Office Equipment
  - 3% Personal Computers
  - 3% Cooking
  - 3% Refrigeration
  - 7% Ventilation
  - 7% Cooling
  - 8% Water Heating
  - 20% Lighting
  - 38% Space Heating

Total Consumption: 5.820 Trillion BTU!!!

**Distribution of Building Energy Use (Source: U.S. DOE, Energy Information Administration)*

Environmental Impacts of Buildings

The cumulative effect of conventional development practices include:

- Clearing of land for development
  - Destroys wildlife habitat
- Extracting, manufacturing, and transporting materials
  - Water and air pollution
  - Release of toxic chemicals
  - Emission of greenhouse gases
- Building operations
  - Large inputs of energy and water
  - Substantial waste streams
- Building related transportation (commuting & services)
  - Impacts associated with vehicle use and energy consumption

Environmental Impacts of Buildings

U.S. General Services Administration surveyed 12 green buildings in its portfolio:

- 26% less energy usage
- 27% higher levels of occupant satisfaction
- 13% lower maintenance costs
- 33% lower emissions of carbon dioxide (CO_2)

The study concluded that the federal government's green buildings outperform national averages in all measured performance areas.

Environmental Impacts of Buildings

Building green can reduce environmental damage and enhance the health of the environment and the people who use them.

What is Green Building

What is the definition of Sustainability?

Sustainability is meeting the needs of the present without compromising the ability of future generations to meet their own needs. ~ Brundtland Commission

What is Green Building

- Sustainability is <u>not</u> a one-time treatment or product
- Green Building is a **process** that applies to buildings, their sites, their interiors, their operations, and the communities in which they are situated.

What is Green Building

What is the difference between Green and Sustainability?

There really isn't one. USGBC uses both words interchangeably.

Both terms mean creating places that are environmentally responsible, healthful, just, equitable, and profitable.

It is important to remember that it is not just about environmental impacts!!!

What is Green Building

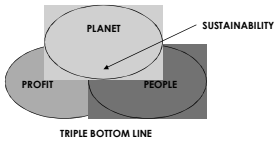
There are three basic dimensions to sustainability:

1. **People (Social Capital)** All the costs and benefits to the people who design, construct, live in, and constitute the local community and are influenced, directly or indirectly, by a project.
2. **Planet (Natural Capital)** All the costs and benefits of a project on the natural environment, locally and globally.
3. **Profit (Economic Capital)** All the economic costs and benefits of a project for all the stakeholders (not just the project owner)

These are most commonly referred to as the **Triple Bottom Line** or the **Three Legged Stool**

What is Green Building

Greening the built environment means looking **holistically** at natural, human, and economic systems and finding solutions that support quality of life for all.



It's about finding the "Sweet Spot" . . .

What is Green Building

- Green Building is a **holistic** approach
- A truly green building focuses on ALL of these issues through
  - Location
  - Design
  - Construction
  - Operations and Maintenance

What is Green Building

Triple Bottom Line requires a shift in perspective about both costs and the benefits of our decisions.

Green building processes and rating systems are beginning to encourage new metrics that quantify externalities.

Externalities: costs or benefits incurred by parties who are not part of a transaction.

What is Green Building

What is a High-Performance Green Building?

It is a structure designed to:

- conserve water and energy;
- use space, materials, and resources efficiently;
- Minimize construction waste; and
- Create a healthful indoor environment

What is Green Building

Green Building transforms the way buildings are designed, built, and operated:

- Create environments that are more comfortable, sustainable, and healthy
- Reduce energy consumption, greenhouse gas emissions, water consumption, and solid waste generation
- Reduce costs, reduce liability, increase value, and achieve more predictable results in the design, construction, and operation of built environments.

What is Green Building

Rise of Green Building

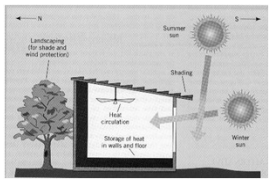
These are not new idea folks . .

- Most elements of green building are not new or even unique
  - Energy Efficiency
  - Smart growth
  - Indoor Air Quality
  - Water conservation

Passive Design: capturing sunlight and wind for natural lighting, heating, and cooling.

Rise of Green Building

- Find the best combinations of solutions
  - Low-tech solutions
    - Building orientation, window placement, landscaping
  - High-tech solutions
- Be intelligent and creative



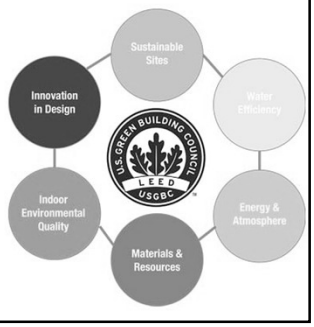
Rise of Green Building

- In 1992 the green building field was really beginning to define itself
- US Green Building Council (USGBC) formed with a mission "*to transform the way buildings and communities are designed built and operated, enabling an environmentally and socially responsible, healthy and prosperous environment that improves the quality of life*"

Rise of Green Building

Leadership in Energy and Environmental Design (LEED) Rating System

- Developed to rate and certify sustainability of buildings in the US
- First version of LEED was launched in 1999
- Expanded since to include systems that rate the entire life-cycle of the built environment
  - Land use
  - Planning
  - Design
  - Operations



Rise of Green Building

Leadership in Energy and Environmental Design (LEED) Rating System

- Addresses multiple building types
- Adopted as sustainable building practices and policies
- Incentive programs are available
- Addresses complete building life-cycle

Rise of Green Building

Leadership in Energy and Environmental Design (LEED) Rating System

- Certification honors a project's level of achievement in areas such as water efficiency, Energy Efficiency, CO2 Emissions reduction, improved Indoor Air Quality, and stewardship of resources.
- LEED goal is to fundamentally change how we design, build, and operate buildings and communities
- Market Transformation – systematic improvements in the performance of a market or market segment

Green Building & Climate Change

Global CO_2 Emissions by Sector

#1. Buildings

#2. Transportation

#3. Industry

Source: Energy Information Administration (2006). Emissions of Greenhouse Gases in the United States.

Green Building & Climate Change

- Green Building is not enough to lessen the effects that humans have on climate change.
- We must prepare and create a built environment that will deal with the consequences of climate change.
  - Higher sea levels
  - Higher temperatures
  - Longer droughts that are more widespread
  - More intense flooding
- Flexibility and adaptability are important attributes of green projects.

Green Building Over Time

- Green building must be prepared to adapt to future change and be designed and operated to the test of time.
- Continuous monitoring to identify needed improvements and user changes
- Project teams need to look far ahead and anticipate future stressors

Green Building Over Time

- Building systems degrade with time
  - Emissions will increase over time
  - Proper maintenance is crucial to maintain this
- Building Commissioning helps ensure that systems are designed and operate as intended.
- Commissioning – process of verifying and documenting that a building and all its systems and assemblies are planned, designed, installed, tested, operated, and maintained to meet the owner's project requirements.

Green Building Over Time

- Retrocommissioning – a tune-up that identifies inefficiencies and restores high levels of performance.
- It's all about continuous improvement
- Monitoring and verification help identify and resolve issues that arise
- Adaptive Reuse – designing and building a structure in a way that makes it suitable for future and different than its original use
  - Designs should avoid future obsolescence
  - Flexible floor plans
  - Meet current and evolving needs

Green Building & Location

- Location is a critical element of green building
  - Location defines appropriate strategies
  - It can limit how green a project can be.
  - Local environmental issues can influence priorities
  - Factors:
    - Natural Context: Climate, sun, wind, orientation, soils, precipitation, local flora and fauna
    - Infrastructural Context: Available resources, materials, skills, and connections to utilities, roads and transit
    - Social Context: Connections to the community and other destinations, local priorities, cultural history and traditions, local regulations and incentives

Green Building & Location

- To design for place:
  - Start with a project site and determine what uses are most appropriate there
    OR
  - Start with a building function and figure out the best place to put it
- Project teams pursuing sustainability need to develop a deep understanding of the place and context of their location

Green Building Costs & Savings

- In 2003 a US Commercial Building Energy Consumption Survey found the following:
  - U.S. has 4.9 million commercial buildings with 71.6 billion square feet of floor space
  - The buildings used 6,500 trillion BTUs of energy
    - 55% Electricity
    - 32% Natural Gas
  - 36% of that energy was used for space heating; 21% was lighting
  - Owners and Operators spent $92 billion on energy, not including transportation costs
  - 13,000-square-foot building spent $20,000 per year on energy or $1.43 per square foot.

**2003 Commercial Building Energy Consumption Survey.*
http://www.eia.doe.gov/emeu/cbecs/cbecs2003/detailed_tables2003/detailed_tables_2003.html#consumexpen03c&e.html

Green Building Costs & Savings

PERCEIVED BUSINESS BENEFITS TO GREEN

- **8-9%*** operating cost decreases
- **7.5%*** building value increases
- **6.6%*** return on investment improves
- **3.5%*** occupancy ratio increases
- **3%**** rent ratio increases

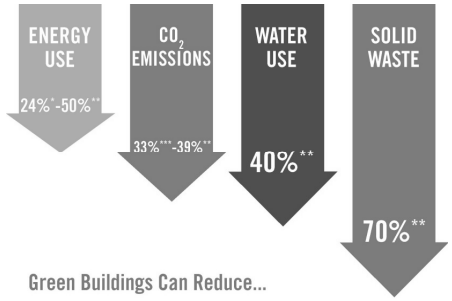
* Source: McGraw-Hill Construction, Key Trends in the European and U.S. Construction Marketplace SmartMarket Report, 2008
** Source: McGraw-Hill Construction, Greening of Corporate America SmartMarket Report, 2007

Green Building Costs & Savings

- In 2005 a US Residential Energy Consumption Survey found the following:
  - Collected data from 4,381 households to statistically represent the 111.1 million households in the US
  - Households spent a total of $201 billion on energy
  - That's $1,810 per household or $0.83 per square foot

**2005 Residential Energy Consumption Survey.*
http://www.eia.doe.gov/emeu/recs/recs2005/c&e/detailed_tables2005c&e.html

Green Building Costs & Savings



Green Building Costs & Savings

- Market for Green Building is projected to increase to $60 billion by 2010
- Federal, Local and State governments are adopting sustainable building practices
- Govt, utilities and manufacturers are offering financial incentives

Think about it

- Conventional Building Practices are not sustainable. They use too much energy, create too much waste, and sometimes even undermine the health and comfort of occupants. Recognizing the problem, however, is only the first step toward a solution.
- What might the built environment of 2030 look like? How can we break from the status quo and achieve results at scale?

Beyond Green

- Green Building's were intended to reduce impact on the environment and human health
- Less damage is not enough when it comes to a sustainable built environment
- Focus is now gearing towards regenerative built environments
- **Regenerative** – sustainable environments that evolve with living systems and contribute to the long-term renewal of resources and life.

Beyond Green

- Regenerative projects
  - Support health of local community and regional ecosystems
  - Generate electricity and send excess to the grid
  - Return water to the hydrologic system cleaner than it was before use
  - Serve as locations for food production and community networking
  - Regenerate biodiversity
  - Promote relationships that link the projects to the whole system of life around them

Beyond Green

- Regenerative projects strive towards:
  - Net-zero energy – projects use no more energy from the grid than they generate on site
  - Carbon Neutrality – emitting no more carbon emissions than they can either sequester or offset
  - Water balance – they use no more water than that which falls on site as precipitation
  - Zero Waste – through recycling, reusing, or composting all materials

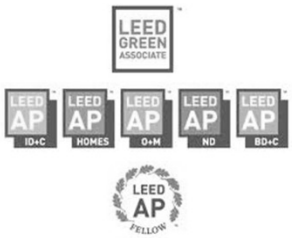
Not all projects can achieve those levels of performance.

Beyond Green

- Going beyond green requires much more than
  - Learning about new technologies
  - LEED rating system checklists
- To achieve true sustainability a new approach is required to create and care for the built environment.

Green Building Expertise

- Green Building requires
  - New skills
  - New knowledge
  - New attitudes
  - New mindsets



Green Building Expertise

- Green Building Experts need to know
  - New strategies
  - Materials
  - Equipment
  - How teams work
  - How to facilitate or participate in a productive discussion
  - How to work with people with different backgrounds and skills
  - How to think outside their normal comfort zones when developing ideas
- These are not typical skills received by practitioners during most professional training

HOMEWORK Due NEXT WEEK

- **Go to BlackBoard to find homework each week**
  - **Homework is due at the start of our next class period – a folder will be on the front table**
  - **Emailed homework will not be accepted**
- **Visit USGBC and GBCI websites and register as a user:**
  - www.usgbc.org
  - www.gbci.org

QUIZ Due for next week

- **Go onto blackboard and take Quiz**
  - This will help you get used to Blackboard and taking quizzes online.
  - Quiz questions will be on content from today's lecture and the assigned reading
- **Quizzes will be posted on Friday morning of each week and must be completed by the start of the following class.**

Appendix C – Sample Research & Homework

SUSTN 105 The LEED Rating Systems

Name:_____Score:_____/82 Possible

Introduction to Green Building Homework:
The assignment is due at the start of the next face-to-face class. You may submit a hard copy at the start of class or submit an electronic version via Blackboard. Assignments emailed to the instructor will NOT be accepted.

Part 1: Read pages 1-16 of the Green Building and LEED Core Concepts Guide, Second Edition. Then answer the following: (25 possible points)

1) What is the term that is used to describe any environment that is manmade and provides a structure for human activity? (1 point)

2) According to the Energy Information Administration, EIA Annual Energy Outlook (EIA 2008), buildings in the United States account for what percentage of electricity consumption? (1 point)

3) Conventional practices in the building industry have profound implications on the triple bottom line. List 2 conventional building practices and the negative implications associated with each. (4 points)

4) The U.S General Services Administration conducted a survey of 12 of their green buildings (Public Building Service, "Assessing Green Building Performance: A Post Occupancy Evaluation of 12 GSA Buildings" - General Services Administration, 2008). What are the 5 measured performance areas that the government's green buildings outperformed compared to national averages? (5 points)

5) What 3 kinds of resources does the Triple Bottom Line concept incorporate a long-term view for assessing potential effects and best practices? Describe each of the 3 resources including what costs and benefits are considered. (6 points)

6) What year was USGBC formed? (1 point)

7) What does the acronym LEED stand for? (1 point)

8) What year was the first LEED green building rating system launched? (1 point)

9) Why does a building's total emissions footprint incrementally increase overtime unless care is taken to maintain the systems properly? (1 point)

10) Regenerative projects strive towards using no more resources than they can produce. List 4 "net-zero" strategies that project teams can work towards to accomplish this. (4 points)

Part 2: Read Cost of Green Revisited, by Davis Langdon. (You will find the link to the document at Source: Malin, N., Integrated Design, Environmental Building News. 13(11) (2004), http://www.buildinggreen.com/auth/article.cfm/2004/11/1/Integrated-Design) Then answer the following: (31 Possible Points)

11) What metric is used in this paper as a parameter for determining level of sustainable design? (1 point)

12) What were the 3 main findings of the paper? (3 points)

13) List the 5 building types that were analyzed in the study. (5 points)

14) How many buildings were analyzed in the study? (1 point)

15) How many of the analyzed building projects did not have a goal of sustainable design? (1 point)

16) List the 4 key conclusions that can be drawn from the analysis of construction costs for LEED-seeking versus non-LEED seeking projects. (4 points)

17) What is one of the most common methods used to establish the cost of green? (1 point)

18) According to the study, do the findings suggest that the cost per square foot for buildings pursuing LEED far exceeds the existing range of costs for buildings of similar program type? (1 point)

19) Can a building project achieve sustainable design within their original budget? (1 point)

20) When considering cost and feasibility for pursuing LEED certification for any building, it is extremely important that the owner understand what 2 things? (2 points)

21) What 4 things should be done to establish a budget for a green project? (4 points)

22) What 4 things need to be done to align your budget with your program? (4 points)

23) What are the 3 steps for staying on track with a project budget? (3 points)

Part 3: Vocabulary – each answer is worth up to 2 points. (26 possible points)

Term	**Definition**
Green Building	
Sustainability	
Triple Bottom Line	
Externalities	
Passive Design	
Market Transformation	

Building Commissioning	
Retro Commissioning	
Adaptive Reuse	
Regenerative	
Net Zero Energy	
Carbon Neutrality	
Water Balance	

Appendix D – Sample Quiz

Q1 Intro to Green Building & Communities Quiz

- Timed Test: This Test has the time limit of 1 hour and 5 minutes. This Test will save and submit automatically when the time expires.
- Warnings appear when half the time, 5 minutes, 1 minute, and 30 seconds remain.
- Multiple Attempts Not allowed. This Test can only be taken once.
- Force Completion Once started, this Test must be completed in one sitting.

1) What are the three dimensions of sustainability often described as the triple bottom line or the three-legged stool?
   a. Economic theory, cultural agendas, and global variety
   b. Energy efficiency, water efficiency, and indoor environmental quality
   c. Natural capital, social capital, and economic capital
   d. Government standards, building codes, and building practices

2) Man-made environments that provide a structure for human activity are referred to as what?
   a. Built environment
   b. Natural environment
   c. Sustainable environment
   d. Manufactured Environment

3) According to the EIA Annual Energy Outlook (EIA, 2008) in the United States, buildings account for what percentage of electricity consumption?
   a. 27%
   b. 64%
   c. 72%
   d. 17%

4) What constitutes the largest use of energy in buildings in the United States?
   a. Water heating
   b. Space cooling
   c. Electric lighting
   d. Space heating

5) It has been said that occupants of green buildings typically have significantly greater satisfaction with air quality and lighting compared to conventional buildings. Carnegie Mellon University shows that these benefits can translate into what percentage increase in workers' and students' productivity?
   a. 2-16%
   b. 3-12%
   c. 16-32%
   d. 1-7%

6) The acronym LEED stands for what?
   a. Leadership in Energy and Environmental Design
   b. Leadership in Environmental and Energy Design
   c. Leaders in Environmental and Energy Decisions
   d. Leaders in Energy Efficient Design

7) A study conducted by the U.S. Environmental Protection Agency (EPA) found that people in the United States spend, on average, what percentage of their time indoors?
   a. 94%
   b. 43%
   c. 90%
   d. 77%

8) Economists use what term to describe costs of benefits incurred by parties who are not a part of a transaction?
   a. Equity
   b. Indicators
   c. Budget
   d. Externalities

9) Name the process of verifying and documenting that a building and all its systems and assemblies are planned, designed, installed, tested, operated, and maintained to meet the owner's project requirements.
   a. Adaptive Reuse
   b. Commissioning
   c. Adaptability
   d. Energy Modeling

10) Sustainable environments that evolve with living systems and contribute to the long-term renewal of resources and life are referred to as what?
   a. Sustainable
   b. Green
   c. Carbon Neutral
   d. Regenerative

BEST Center Curricula, Resources & Recordings

Academic Programs
Georgia Piedmont Technical College - Building Automation Systems
Milwaukee Area Technical College - Sustainable Facilities Operations
Laney College - Commercial HVAC Systems
City College San Francisco - Commercial Building Energy Analysis & Audits

Professional Development Materials, Presentations & Videos
National Institutes
Building Automation Systems Instructor Workshops
Webinars (e.g., BEST Talks)

Faculty Profile Videos
Reports & Case Studies
Marketing Resources

BEST
Building Efficiency for a Sustainable Tomorrow

NSF National Science Foundation