Creative Course Design: A Study in Student-Centered Course Development for a Sustainable Building/BIM Class

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Course development for construction management (CM) programs, and arguably all of higher education, is difficult to keep up with, let alone to create. This study describes the use of creative strategies for course design testing the utilization of student involvement as an effective approach in the design process. CM students were directly involved in the creation and development of a new and potentially required course at Brigham Young University in Sustainable Building and Building Information Modeling (BIM). This paper discusses how students involved in the course development effectively worked through the process to develop the new class. Techniques in qualitative research and course design along with the current and crucial topics of Sustainable Building and BIM are emphasized.

Key words: Creative Course Design, Building Information Technology (BIM), Sustainable Design

Introduction

Much of the construction industry is redirecting their focus from traditional production methods to environmentally friendly, cost-efficient technologies. As Americans become more concerned about energy conservation and eco-friendly building construction, companies are taking notice.

Changes in construction practices have created a need for new education courses. Recent demand for green or sustainable construction practices has compelled the construction industry to embrace sustainable design and BIM (Building Information Modeling), a design and planning process on the forefront of construction technology. BYU's Construction Management Department needed to create new coursework to update the core curriculum or graduate students unprepared. Curriculum and/or coursework that would assist students in the undergraduate construction management program at Brigham Young University to learn about sustainable design and BIM was limited. In the CM Architectural Drafting course limited exposure to BIM is currently being implemented. Building upon and enhancing this basic introduction was identified as a direction for the new course. Due to the still emerging nature of sustainable design and BIM technology, BYU's new course must create a balance between including instruction of proven methods while also continuing to address novel changes in industry trends.

When the need for a new course in green building concepts and BIM became apparent, the timing was ripe to not only create a course, but also create a change in the curriculum development process, thus, adding not only updated courses to the curriculum, but also updated teaching strategies focused on giving students increased control over their own learning.

Instead of developing the course solely as faculty, a professor felt it would add additional value to the course to include students and industry professionals in the process. The students are the ones who take the classes; they are the ones who are going to work in the industry. Incorporating their input is the best way to assure that the curriculum group created a course tailored to their interests, needs, and abilities. Not only would future CM students benefit from their efforts, but the students participating would perhaps gain even greater knowledge through the research and development process.

Review of Literature

Facilitating increased student learning should be the focus of any educator. Teachers often seem to get caught up in the frenzy of a multitude of academia demands, drastically lacking the time and energy to do much else, and finding themselves moving along in the education fast lane. Thus, teaching/learning techniques seldom change, courses are seldom retrofitted, and, despite rapid adjustments in technology and social change, new courses and curriculum restructuring seldom keep pace.

For generations, not only higher education, but most of education in general, sees students in classrooms where teachers "teach" and students "get." As Cohen and Brawer (1989, p.155) put it, this still has not changed much,

"It is reasonable to assume that in an institution dedicated since its inception to 'good teaching,' new instructional forms will be tried. However . . . traditional methods of instruction still flourish. Visitors to a campus might be shown mathematics laboratories, the media production facilities, and computer-assisted instruction programs. But on the way to those installations, they will pass dozens of classrooms with instructors lecturing and conducting discussions just the way they and their predecessors have been doing for decades."

Currently, much of the way that college professor's approach education is still based upon the lecture transfer tradition of stated curriculum objectives and instructor-centered teaching, even though strict adherence to such teaching methods is known to limit critical thinking and student retention. In general, college students retain little of what they supposedly have learned. "Although a very few studies report exceptionally high values, such as students retaining 50% of the course content, studies more commonly report a retention of 20% or less" (Gardiner 1998).

The University of Arizona (Stover , etal, 2007), however, is undertaking an ambitious restructuring of the undergraduate experience with the goal of creating a more student-centered university, of which a defining characteristic is that its "undergraduates are actively engaged in their education … Meaningful involvement can be achieved by offering them roles in course and curriculum development." Also, at the University of Helsinki (2008), students have played an active role in curriculum development.

"In the 1990's the initiative for renovating the curriculum … was presented by them. Thus, the students have been active agents in development of the entire medical and dental curricula in Helsinki. In this process they have provided new ideas, given good feedback and brought up the important experiential point of view of learning and studying."

In fact one Helsinki professor declared (2008), "Allowing students to take responsibility for their learning and for course design and delivery has in the past fostered an 'uncovering' style of learning, high student motivation, and excellent attendance, even in the academic's absence. Some learning theorists have suggested that supplemental instruction - that is, teaching others a subject - helps to promote a higher level of learning."

The Case Study

Given then that an environment where students could assist and participate in the development of curriculum has been identified as a potential positive and given the need for including coursework in BIM and sustainable design, the professor recognized an opportunity to begin creating the needed new course by facilitating more student-centered practices within the process Although often limited by time constraints, the professor is a practitioner and firm believer in experiential education. For the upcoming spring term, the professor gained permission to offer a project spring term class with the specific purpose of creating a sustainable building, BIM course, combining two topics identified as needed to address current trends, linked also by the fact that BIM can also be used as a process that enhances sustainable building. The course would be integrated into the core curriculum as a choice, allowing students to now choose between this new course and the statics class. Being assigned the challenge of creating this course, the professor took the opportunity to make use of the granted autonomy and flexibility. The professor was eager to begin what the department now deems as the process of "creative course design." The professor wanted to see what effect on the creation of a course student participation could render. The creation of the new class, therefore, would essentially become also a qualitative study in course design.

Qualitative research as defined by Merriam (1998) is a method of interpreting data in a subjective way in order to assign an explanation for the outcome. The author suggests that through qualitative research six assumptions can be made: (1) Qualitative research focuses on the process and not solely the outcome or product. (2) This type of research is more focused on lived experiences and the meaning of those experiences. (3) The researcher is the primary instrument for data collection and analysis. (4) Qualitative research usually involves fieldwork. (5) It is descriptive in describing events, attitudes, and outcomes. (6) And it requires some deductive reasoning by the interpreter of the data.

The professor implemented Merriam's methods into a qualitative case study approach to research a student-centered course development process. As the researcher, the professor wanted to find out what could or would be gained when engaging students in the process of course development. Would the process be effective in providing a viable

pathway for professors to follow in the future and would student time be effectively used to facilitate individual learning? The professor also wanted to know how difficult it would be to use students to create educational objectives and design reliable and effective assessments. And when addressing a brand new and highly dynamic aspect of the construction industry, could a student group put together a course that would adequately address the topic in a limited about of time?

Methodology

The students, who signed up for the (sustainable building/BIM) course or course creation class, knew that they would be involved in the creation of the new course. Each of the ten students had a sincere personal interest in sustainable design and building and also BIM. "*With the industry shifting toward green building, there is a high demand for students who understand green building practices," said a student in the control group. "This is a unique opportunity to make ourselves more marketable in the industry."*

As the facilitator of this group, the professor functioned as a researcher personal observer. The professor actively participated in the development of the course with the students and provided direction as needed while also guiding discussions, organizing concepts to be considered for implementation, and finalizing curricular categories. The professor kept a log of progress, pertaining to the course development process as the group worked together during the term. The professor also employed a teaching assistant for the class who acted as an outside observer. The TA participated in more administrative duties such as keeping the discussion topics organized and published, keeping track of small group goals, helping maintain the direction of goals and objectives, and keeping his own journal or assessment.. The students themselves also tracked and logged personal reflections and group findings. These documentations provided at the end of the process, a triangulation of data that was used in assessing and evaluating the validity of the study as well as the success and legitimacy of a student-centered course development process.

Part of the course development process was to organize course goals and objectives. The students worked on a problem statement, something that was to be the unknown. The problem statement became the guiding factor as the group worked toward creating the entire course to solve the unknown. It read as follows:

Problem Statement – The construction industry has evolved in recent years by embracing Sustainable Design and BIM Technology. In response to this, the Brigham Young University Construction Management Department must create a construction education course that appropriately reflects these trends. Part of the course must be constantly evolving, addressing new industry ideas. Unless efforts are made to create this course, students will enter the workforce unprepared to meet the needs of the industry.

Process of the Study: Creative/Student-Centered Course Design

The group went through a strategic planning process to select textbooks, supplemental readings, lecture materials, application assignments, and tests. Students examined other universities' programs. Input from industry professionals was also essential to create this intensive course. Some of the most important initial research the students did was talking to industry professionals, both local, national, and international through interviews, site visits, emails, and phone calls. "It's been interesting to see how contacts in the industry are so eager to help us develop this course," said one student in the group. "It must be important."

The students were divided into two groups, either BIM or sustainable building, based upon interest. Later, an additional group was formed for the purpose of researching and presenting case studies and relevant articles on both topics. Sub-groups continued to form throughout the term to investigate other needs as they developed.

About one week into the development of the course, several of the students through their research found an upcoming conference promoting most of the issues that were being studied by the group to be presented in Anaheim California. This was a very timely find because this conference addressed the specific topics of sustainable design and BIM and was to occur during the short time period of the spring term of eight weeks, and the conference was within a feasible price range and distance. The students felt very strongly that they should send representation to the conference. The group solicited a few local companies that had interest in sustainable building and also BIM, and asked if they would help sponsor some of the group to go to this conference. The description to these companies as to what the group was doing (using students as a catalyst for creating the course for the class), proved the tipping point for local industry support. With the help of several companies and some help from the department, six students and the professor were sent to the conference. While there, expert information was gathered regarding BIM and the future direction of green building and sustainable design. One point that was emphasized to the group as they attended many different sessions is that there are numerous approaches to BIM, and as yet no clear cut advantage from one approach to another. The group recognized that the course would need to limit the multitude of different

aspects and philosophies of BIM to those they felt would be the most beneficial to particular needs of Brigham Young University students and focus on those only.

The conference attendance represented much more than just a casual interest or a visit, rather the students were on a mission taking copious notes, gathering data, talking to every industry professional they could engage, and absorbing all that they could learn to take back and share with the rest of the class.

A shared online 'Google documents' was set up for continuous communication among members of the group. The shared Google documents illustrated the students' passion for the material gained at the conference and the class beginnings. Following are typical examples of what students shared on Google documents with peers in this group:

"What I didn't know, that I know now (AH-HA) - BIM is a technology used to improve sustainable and green building, and one that will eventually make it possible to know how a building will perform even before it is built."

"What I didn't know, that I know now (AH-HA): What I didn't know, that I know now (AH-HA - I was not aware that Autodesk had such broad range of curriculum available to educate students about their software--and all free of charge. Students and educators can download and use fully functioning versions of Autodesk software (i.e., Revit Architecture 2008 and 2009, etc.) for 14-month trials. Students and educators can take advantage of Autodesk's tools by creating a profile on Autodesk's website."

"My suggestions for the BIM Lab - The particular Autodesk curricula that I suggest for use in the Sustainable Design and BIM class is: (1) Building Information Modeling Curriculum and the (2) Sustainable Design Curriculum. Both of these curriculum have well-written and useful instructor lecture notes, student workbooks, and datasets. The Building Information Modeling Curriculum is a 20-unit program that teaches basic and advanced skills using Revit Architecture. The Sustainable Design Curriculum is a 10-unit program that assumes that students understand how to use Revit Architecture. Alternatively, the BIM lab could use a CD that would have all of the datasets and workbook files copied to it, or have those files more readily available for downloading from a www.et.byu.edu/cm web page."

"The following can serve as both an "Ah-ha" and a conclusion - The industry has many definitions of what BIM exactly entails and could entail in the future. Some spoke on how they did not consider BIM as a process of construction, only as the technology used for the process. Instead, they called the process Virtual Design & Construction. "

"Findings (Ah-Ha's) - With respect to the saying, "Throwing drawings over the fence: Does BIM eliminate the fence? No. The fence remains and can be seen as a safety barrier if you equate the fence with your Digital Data Disclaimer. A properly written disclaimer ensures that the design team is merely sending a better and more complete representation of the design intent. The BIM data does not imply means and methods of construction and is being shared as a courtesy to the other project team constituents. Results of estimates, schedules and analyses derived from the Architect's or Engineer's 3D model are still the responsibility of the contractors, fabricators and estimators. The design/build or Project Alliance approach eliminates the fence, thus the data is more closely integrated.

Using the information gathered from the conference, texts, journals, research, and industry input, the class developed a day by day, unit by unit outline for a professor to follow, implemented BIM tutorials for student practice as well as application assignments, and added case studies and articles that would in their words assist a professor's "bringing it to reality."

The group looked at many different possibilities for text books, but given the newness of the subject line, text books about these topics were scarce. They reviewed abstracts of texts on-line, sample book copies, and finally researched books available on the topics within the campus library. Ultimately, the book *Sustainable Construction: Green Building Design and Delivery*, from Wiley Publishers was selected. This book, most likely written for the purpose of enlightening current industry professionals on sustainable design and its connection to LEED (Leadership in Energy and Environmental Design), proved to be the most comprehensive and applicable. Case studies would be used to supplement the implementation of the BIM tutorials.

Results: Evaluation of Student/Centered Course Creation Process

Several aspects of the study led the professor to conclude that the process of using students in the development of the course was a successful proposition. The professor's observations, student logs, and the journal of the teaching assistant joined together to form the conclusions for the effectiveness of this strategy. The professor used his own data gathering, analysis and assessment system that has roots from Creswell's (1998) spiral system and ideas from

computer tools suggested from Creswell (1998), and Wolcott (2002). The professor was able to gather data from all triangulated sources and organize then into files and folders in MS Word, and the data was then transcribed into tables. By using different colored highlighter tools, the professor was then able to select and pluck common data and identify themes that emerged from the study and then place the common data into other tables. This process was repeated several times until the more pure data from the study was acquired. The quotes and other observations contained within this running prose are reflections of these pure data commonalities that are representative of the findings of this study.

As students reflected on their individual learning or the amount of knowledge they gained from participating in this course creation evolution through their logs, the professor and outside observer identified a definite increase in personal motivation as a dominant theme. As a participant observer in this process, the professor was also able to witness first hand the enhanced motivation level of the students creating the course. The stakes were higher, the learning of future students depended upon their efforts. Another common thread highlighted in many student journal entries was that the research process augmented the overall breadth of material examined and the trial and error method allowed for expanded critical thinking using evaluation, synthesis, and analysis of data, far more than the typical, traditional classroom setting of simply downloading information presented. One of the student participants said, *"I learned in a different way because I knew my research was important to organizing a class. Everything I researched was to be reported, documented, discussed in class, and possibly implemented in a future class. I approached my research with ideas of why I thought learning the information was valuable and what information I studied would be most valuable to students. If this class was taught by a professor, I would have learned blindly. If the course was already organized, I would have assumed the importance of the lessons taught and probably not researched on my own all the different BIM programs or what employers are actually looking for."*

These realizations were shown to be what led to the students considering the implementation of learning segments to be built into the course that recreated this hands-on-process of experiential learning. For example, one of the elementary BIM exercises created by the students for the course was to choose one of the major buildings on the Brigham Young University campus and create a 3-D image of that building using Google Sketchup. With Google Earth, students would zoom into campus and then take a picture of the flat image of their particular building, using that 2-D image as a template to create their 3-D image. This simple activity would allow future students the opportunity to actually experience one of the BIM programs recommended by the course development team. Another assignment example used to reinforce sustainable sites for LEED used a description of a known site in Dallas, TX. Future students would be asked to evaluate that actual site and find as many LEED credits as possible.

At the end of the process, the professor reflected. *"I observed the development of an unusual flow of classroom time. While there were students specifically designated to lead certain classroom sections, the class time evolved as an open-forum meeting."*

From personal observations, the professor was amazed at the quantity and quality of discussions that were held in the open forum class design. The in-class group discussions were highly informational as they progressed through the course development process. The professor was absolutely amazed at the vigor the students assumed during this process. The adage that a person learns more about a subject that they are preparing to teach was proven true. To reiterate one student's observation, *"If this class was taught by a professor, I would have learned blindly."*

The professor also noted, *"I found that the course development was significantly enhanced by the curiosity of students. Pre-existing trends in Sustainable Building education never dominated the class. Instead, students studied from a wide variety of sources and were able to draw their own conclusions about the future issues that may change the construction industry. The students addressed BIM theory in a similar manner. Even though Brigham Young University has long been a school that focuses on Autodesk software, the students ventured out and sampled from a variety of software options, compared each system's usability, and analyzed construction market share of each system. Freedom enhanced problem solving and critical thinking."*

The Test: Evaluation of the New Course Implementation into the Classroom.

When the time came for the first class using the new course curriculum to commence in the fall semester 2008, the trial of the new course began with thirteen students enrolled. The professor was able to employ two teaching assistants for the class who had been involved in the course development the spring term before. These teaching assistants took on the role of co-instructors. As the class proceeded, the professor and TAs continued the collaboration process as they discussed and adapted and as they actually implemented the new curriculum into a real course situation. At mid-term, as another piece of the qualitative study, they developed a survey to measure the enrolled students' perceptions and reactions to the class up to this point, thus, continuing and enlarging the process of implementing student input into the course development process. Following is the survey developed using the five degrees of choice Lykert scale with the average responses for each question shown at the end.

Sustainable Building/BIM Class Utility Assessment Survey					
Question:	1 *strongly disagree*	2 *disagree*	3 *no opinion*	4 *agree*	5 *strongly agree*
This class represents what I had believed it would have to this point.				4.0	
Sustainable building ideas and concepts are important for designers and builders to understand.					4.9
BIM is important for builders and designers to understand.				4.5	
The concepts covered in this class are important for me to understand as a student of the construction industry					4.7
I believe that I have a fair understanding of sustainable building as to how it relates to the purpose of this class thus far.					4.9
Laboratory time is sufficient to be able to do all of the BIM tutorials.		2.1			
The BIM tutorials provide enough hands on experience to sufficiently learn the necessary aspects of BIM for this class.			3.4		
The way this class is set up makes a good approach to both sustainable building and BIM.				4.0	
There should be more emphasis on BIM in lectures.			3.2		
There should be more emphasis on sustainable building in lectures.		2.9			

The survey then asked for a written response as to the best part of the class and suggestions for improvement. Without exception, the students' responses to the best part of the class addressed the current nature of the topic.

"The best part of this class has been building a foundation for the theories and principles of green building especially in increasing my appreciation for environmental thinking."

"The major benefit of this class would be the experience and increased marketability. I have found what we are learning highly applicable giving me a competitive advantage in the field."

Also, without exception, the suggestions for improvement had to do with the broad scope of the class being addressed within in a limited time frame.

"The only downfall is that it seems like there is too much info to cover in one semester. It would be nice to have a Part I and Part II."

The findings in this survey were primarily positive. A key concern was in question #8, as the students did not think that the time allotted for lab of BIM projects was sufficient. Because the class was new (the first time offered) the time distribution for lecture and lab was not clearly considered earlier when class schedules were due for the university. So, this was an easy problem to fix, at least for next semester. The next semester more lab time will be allotted for lab. At a future date, separating the two concepts the course tries to cover will ultimately provide a better time frame.

However, the survey results and student feedback was a good indicator that the course developed was effective and additional student input will be solicited as the course continues to evolve. Especially as these topics are so dynamic, the course will need to be reevaluated on a regular basis. Given the history of CAD and its evolution into BIM today, as a technology BIM will surely change.

Conclusion

One advantage of this process that the professor had failed to fully anticipate was his own accelerated learning. Professors face a continual challenge to remain current in their fields while simultaneously maintaining the demands

of the classroom and other academic demands. If the professor would have created this course on his own, the process would have required and extended period of time to study and research and acquire the amount of information gathered by this spring semester class. Nevertheless, it was not just the informational and time-saving aspects, but the creativity, the discussion, the opinions, and the insights collectively obtained that truly represented the enhanced benefits of this course development process.

However, student-driven curriculum development, or a general student driven course may only be suitable for students that demonstrate a marked interest in the subject matter; otherwise the freedom offered by the independent work and decreased structure may end up limiting rather than fostering ideas. The researcher's recommendation is that the process of course design and curriculum development can be improved when students that come from within the program and have an interest in the topics being developed are involved. The professor found, as did Nortcliffe (2005), that when students are allowed, "to take responsibility for their learning … that is, teaching others a subject - helps to promote a higher level of learning." The class experience in creative course development can be not only successful, but also doubly so as it enhances both the students and the professor's acquisition of knowledge.

References

Cohen, A., & Brawer, F. (1989). The american community college. San Francisco: Josey Bass.

Creswell, J. (1998). Qualitative inquiry and research design: Choosing among five traditions. California: Sage.

Gardiner, L. F. (1998). Why we must change: the research evidence. Thought and Action 14: 71-88.

Kibert, C. J. (2008). Sustainable construction: green building design and delivery. Wiley Publishers

Nortcliffe, A. (2005). Student-driven module: promoting independent learning. International Journal of Electrical Engineering Education. Citing online sources. [WWW document]. http://findarticles.com/p/articles/mi_qa3792/is_200507/ai_n15639396

Merriam, S. B. (1998). Qualitative research and case study applications in education. San Francisco, CA: Jossey-Bass Publishers.

Stover, L. A. Story, K. A., Skousen, A. M., Jacks, C. E., Logan, H., and Benjamin T. Bush, B. T. (2007). The teaching teams program: empowering undergraduates in a student-centered research university. Anker Publishing

University of Helsinki (2008). Student involvement in curriculum development at the university of Helsinki. Citing online sources. [WWW document]. http://www.med.helsinki.fi/tuke/tutkimus/AMEE_2007_Opiskelijat.pdf

Wolcott, S. K. and C. L. Lynch. (2002). Developing Critical Thinking Skills: The Key to Professional Competencies. A faculty handbook and tool kit. Sarasota, FL: American Accounting Association.

Apendix A

CM 494 – Course Syllabus
Sustainable Building and BIM

Text:

Sustainable Construction: Green Building Design and Delivery – Kibert (2008), Wiley Publishers

Supplementary Texts:

New Construction & Major Renovations Reference Guide Version 2.2 - USGBC
(Other references may be given for student resource during the course of the semester.)

Course Description:

Recent demand for more efficient construction practices has led the construction industry to embrace Sustainable Design and Building Information Modeling Technology. To effectively supply the construction industry with qualified graduates, the BYU Construction Management Department has created a curriculum

that reflects these trends. Due to the emerging nature of Sustainable Design and BIM technology, BYU's curriculum balances the instruction of proven methods while responding to the continued development of innovative techniques.

Course Objectives:

1. Students will learn to define sustainable building with a variety of national and international rating systems with a focus on the USGBC's LEED rating system.
2. Students will be able to identify and understand sustainable building principles which will be applicable to a wide range of types of construction.
3. Students will become familiar with the sustainable construction delivery method and each member of the project team's individual responsibilities with a focus on the construction manager's responsibilities.
4. Students will analyze the economics of buildings with sustainable features using the first cost and life-cycle cost approaches.
5. Students will become proficient with Revit Architecture, Structure, and MEP and familiar with other BIM software including Navisworks and Sketch-up.

****Note: While teaching the principles behind sustainable rating systems such as the USGBC's LEED rating system, this class generally will not focus on the individual credit requirements of such systems.

Course Organization:

Each class will be divided into two 40 minute blocks. This will effectively give us four 40 minute blocks each week. At least one of these blocks will be used as TA/Professor lead BIM instruction in the computer lab each week. Any BIM assignments that cannot be completed during this time will be completed on your own time. The TA's will also have lab hours during which you may ask for help and complete assignments.

Reading assignments are to be completed before the next scheduled class period. There will be reading quizzes during the first five minutes of class to test knowledge of previous reading assignment. All assignments are due when indicated. Sequence will follow the enclosed daily class agenda.

Grading Procedures:

Sustainability chapter tests	15%	BIM project:	32%
Sustainability assignments	10%	Revit architecture	10
Research paper	10%	Revit structure	7
Article reviews	10%	Revit MEP	8
Sketchup assignment	03%	Navisworks	7
		Final Exam Project	20%

Final grades will be given based upon the student's performance with the preceding criteria and will be issued according to the following guideline:
94% - 100% = A, 90% - 93% = A-, 87% - 89% = B+, 84% - 86% = B, 80% - 83% = B-, 77% - 79% = C+, 74% - 76% = C, 70% - 73% = C- 67% - 69% = D+, 64% - 66% = D, 60% - 63% = D-, and Below 60% = Failing.

Sustainable Research Paper – Choose one of the following topics:

Green Building Assessment
Benefits and Challenges of Green Building
Green Building Process
Any of the topics listed on pages 30-38
Any other topic must be approved by the Professor

You will write a research paper **no more** than eight pages. The professor requires **at least** seven references from peer-reviewed periodicals, books, or professional interviews. The minimum length of the paper will be dictated by what you judge to be sufficient to include seven well developed references and your supporting information. The paper will include an introduction establishing your topic and a thesis sentence, the body which will explain and further develop your thesis, and last, a conclusion complete with implications and recommendations concerning your topic.

*Assignments and readings due on the day indicated.
**Additional assignments and exams will be announced in class.
***Lab days occur on the last class day of the week and run for two hours, TAs will be available. During lab days in the sustainable building section of the semester, tours will be arranged and field trips will occur to sustainable building sites.

Day	Subject	Reading	Assignment
1	Syllabus/ Introduction, Background of Sustainability; Advantages and Challenges of Sustainable Construction	Read Chapters – 1,2	Assigned Research Paper
2	Green Building Assessment (Rating Systems), Green Building Process	Read Chapters – 3,4	
3	Green Building Process cont.	Read Chapter – 5	
4	**TEST Ch. 1-5.** Sustainable Sites and Landscaping	Read Chapter 6	
5	Sustainable Sites and Landscaping cont.		
6	Energy and Atmosphere	Read Chapter 7	**Research paper due,** Article Review #1
7	Building Hydrologic System	Read Chapter 8	
8	**TEST Ch. 6-8.** Closing Material Loops	Read Chapter 9	**Article Review #1 due**
9	Closing Material Loops cont.		Article Review #2
10	*Indoor Environmental Quality*	Read Chapter 10	
11	*Construction Operations*	Read Chapter 11	**Article Review #2 due**
12	*Building Commissioning*	Read Chapter 12	Article Review #3
13	*Economic Analysis of Green Buildings – Quantifying Green Building Benefits*	Read Chapter 13	
14	The Cutting Edge and Beyond	Read Chapter 14	**Article Review #3 due**
15	**TEST Ch. 9-14. -- BIM.** Sketchup - discussion		Sketchup Assignment
16	Revit Architecture - discussion		Begin Revit architectural assignment **Sketchup Assign Due.**
17	Cont.		
18	Revit Structures - discussion		Begin Revit Structures assignment. **Revit Architecture Complete**
19	Cont.		
20	Revit MEP - discussion		Begin Revit MEP assignment. **Revit Structures Complete**
21	Cont.		
22	Navisworks - discussion		Begin Navisworks assignment. **Revit MEP Complete**
23	Cont.		**Navisworks Complete**
24	Final Exam Project - discussion		**Total Project Complete.** Final project will be explained, begin final exam project
25	Cont.		
26	Cont.		
27	Cont.		
28	Cont.		
29	Cont.		
30	Final Exam Day		**Final Exam Project due** by 5:00 pm to the office