CEE 4803 Building Information Modeling (BIM)

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Instructor
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TA/Lab Assistants
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Catalog Description
Theory and Application of Building Information Modeling (BIM) Concepts to Construction Engineering Practices.

Class Schedule
- Lecture: Tuesday: 6-8 p.m. (Mason 142).
- Lab: Wednesday and Thursday: 6-9 p.m. (all labs will be in the computer rooms of SEB).

Class Website
- T-Square (https://t-square.gatech.edu/portal).

Textbook
- BIM Handbook (Wiley: Chuck Eastman).
- Online readings posted in T-Square.

Course Objectives and Outcomes
The main objective of this course is to introduce students to Integrated Project Delivery (IPD)/Constructability concepts and the model based workflows in the construction industry using Building Information Modeling (BIM) technology. Students in this class will learn the concept of Front-End Planning and aiding technologies for designing successful construction projects. They will effective communication and leadership skills from the perspective of project stakeholders and project teams that are necessary for project success. Students will be able to understand the design for constructability and safety, and how emerging technologies (e.g. Building Information Modeling, 3D Laser Scanning, pre-fabrication and modularization techniques for rapid construction, risk assessment strategies) can help improve design work as well as construction productivity. Students will use industry best practices, BIM software, and three-dimensional laser sensing technology (for acquiring 3D as-built data) on a case study (renovation of Mason Building). Using the Tekla CM/BIM software, major concepts and functionalities of BIM for construction engineering will be covered in lectures, including construction planning and supply chain management in the field. Lab hours will extensively introduce students to hands on data acquisition techniques and modeling of construction engineering and management activities.

Prerequisite Course(s)

Course Size
Max. 50 students (undergraduate or graduate), divided up into 2 lab sections, each 20-25 students).

Course Composition
Each week, classes consists of (1) two hour lecture by instructor; (2) one hour TA demonstration of lab work (student observing); (3) independent lab work by each student (each lab not less than 2 hours, max. 25 students per lab for effective learning and problem solving). Homework in the form of reading assignments will be assigned frequently throughout the semester. Modeling assignments in the lab sections will be an essential part of understanding the lecture material. Lab work will require a weekly report to be submitted by each student. Students are expected to form groups of two and perform a semester project. The project work requires students to submit (1) a two page project outline (abstract, methodology, expected results), (2) conduct lab work, (3) a presentation, and (4) a final report. There will be two midterms and one final exam. The second midterm will have components involving lab work.

Homework Policy
Homework will be assigned frequently throughout the semester and is an essential part of understanding the lecture material. The homework will be collected at the due day at the beginning of the class. Homework will be graded and returned. Solutions will be discussed in class or handed out. Late homework is not accepted unless specific arrangements are made with Dr. Teizer prior to the deadline.

Exam Policy
Exams will cover material given in the textbook, in-class (lecture, notes, handouts, overheads, etc.), homework, and projects. Exams are closed book and closed note exams. Exam dates are listed in the Course Schedule and will not be changed. Exams must be taken as scheduled. Only university excused circumstances will be considered. A grade of zero will be assigned for missed exams. The final exam will be given on the day assigned by the university and will be comprehensive. In addition, personal trips must be scheduled around exams. Exams will not be rescheduled to accommodate early trips home or any other trips of a personal nature. The final exam will not be returned. Bring to exams only the required resources (pen, pencil, ruler, calculator, etc.). Nothing else will be allowed, e.g. bags or cell phones are not allowed with the person or underneath the table (they will need to be stored at the front desk if brought to exam). Bring your Student ID with you to the exam. The seating diagram needs to be followed during exams.

Attendance Policy
Regular attendance is expected and encouraged. Each student is responsible for all material and administrative instructions given during the lecture period. Instructions will not be repeated outside of class. Attendance may be taken periodically throughout the semester. Eating, chewing, sleeping, talking, cell phone use or working on other assignments is inappropriate, discourteous, and inexcusable.

Academic Accommodations for Students with Disabilities:
Reasonable accommodations are provided to self-identified students with disabilities who meet the academic and technical requisite to admission or participation in the program of study. Incoming students with apparent course work deficiencies due to a disability should contact the coordinator for Students with Disabilities at 404-894-2564. Consideration may be given to the substitution or modification of certain course requirements – within the limitations imposed by the accreditation criteria for the degree program in which the student is enrolled – and to the extent that such substitutions or modifications of the course or curriculum do not have a net effect of detracting from the quality of the educational experience implied by the course or curriculum designation. Such substitutions or modifications must be approved by the school chair, department head, or college dean, and the Undergraduate Curriculum Committee and/or the Graduate Committee. Additional information can be obtained from the Access Disabled Assistance Program for Tech Students (ADAPTS), Student Service Building, Georgia Institute of Technology, Atlanta, GA, 30332-0285 or call 404-894-2564 (voice), or 404-894-1664 (TDD), or visit www.adapts.gatech.edu.

Course Evaluation

Attendance and participation	5%
5 one-page reports (3% each)	15%
Midterm 1 (2 hours)	15%
Midterm 2 (2 hours)	15%
Final Exam	20%
Final Project (abstract 5%, final presentation 10%, project report 15%)	30%
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Total	100%

Students will have to work independently in the SEB computer lab. Note that as the number of students grows larger, we can subdivide each lab session into Sessions D1, D2, i.e., total two lab sessions each with 3 contact hours. (CEE 4803-D1 and CEE 4803-D2).

Schedule
The tentative schedule is as follows:

	Tuesday	Thursday
Week 1	Lecture 1	TA Demo D1, D2
Week 2	Lecture 2 ***Report 1due***	TA Demo D1, D2
Week 3	Lecture 3	TA Demo D1, D2
Week 4	Lecture 4 ***Report 2 due***	TA Demo D1, D2
Week 5	Lecture 5	***Midterm 1***
Week 6	Lecture 6	TA Demo D1, D2 ***Report 3 due***
Week 7	Lecture 7	TA Demo D1, D2
Week 8	Lecture 8 ***Project Abstract due***	TA Demo D1, D2
Week 9	Lecture 9	TA Demo D1, D2 ***Report 4 due***
Week 10	Lecture 10 (A/E Industry Perspective and Presentation)	***Midterm 2***
Week 11	Spring Break Week	
Week 12	Lecture 12 (Contractor Perspective and Presentation) ***Report 5 due***	TA Demo D1, D2
Week 13	Lecture 13 – Demonstrations in Class	TA Demo D1, D2
Week 14	Lecture 14	Preparations of final project
Week 15	***Final Project Presentations (Industry Jury will be attend)***	
Week 16	***Final Exam***	

Course Outline

Dates	Topics	Assignments
Week 1	*Lecture 1:* Course Overview, grading criteria, reading assignments, lab work, and final project. Introduction to CII Best Practices: Front-End Planning, Constructability, Interoperability. *Lab 1:* Introduction to BIM tools for Construction Engineering and Management	Reading: CII – FEP material
Week 2	*Lecture 2:* Construction job site productivity, lean management *Lab 2:* Introduction to Tekla Structures, user interface, basic tools and commands	Reading: Lean principles **Report 1**: One page reading report on lean management and productivity
Week 3	*Lecture 3:* Introduction to Building Information Modeling. BIM platforms, model checking, interoperability. *Lab 3:* Pop quiz on Tekla, Tekla Structures engineering module – Modeling basics	Reading: BIM Handbook – Chapter 1
Week 4	*Lecture 4:* Integrated Project Delivery (IPD) *Lab 4:* Tekla Structures engineering Module – Modeling advanced - Creation and Review of constructible structural building components of reinforced concrete and steel	Reading: Technical Report on IPD **Report 2**: One page reading report on BIM and IPD due by next lecture
Week 5	*Lecture 5:* BIM for Engineers – Structural Design, Constructability **Midterm 1** *Lab 5:* Preconstruction- bringing in a model, classifying models, investigating models, hints & tips, interoperability challenges	Reading: BIM Handbook- Chapters 5, 6
Week 6	*Lecture 6:* BIM for Construction Management –I *Lab 6:* Model based quantity take-offs and estimating (Lab 6)	**Report 3**: Lab report due by next lecture
Week 7	*Lecture 6:* BIM for Construction Management –II, Case Study - Georgia Tech indoor football practice facility *Lab 7:* Model based scheduling and reports	
Week 8	*Lecture 8:* Future spotlight: Current and future development in BIM (clash detection, rule checking, IFC, interoperability) Discussion of project ideas, form groups of two *Lab 8:* Review of fabrication submittals, supply chain management tasks field layout using Trimble, activities using model organizer	**Project abstract** due by next lecture
Week 9	*Lecture 9:* BIM for Facilities Management, Case study- Maryland hospital *Lab 9:* Linking product data to model, operations manager field integration. Use of Tekla BIMSight for review and coordination	**Report 4**: Lab report due by next lecture
Week 10	*Lecture 10:* BIM perspectives – Architect and Engineer – Presentation *Lab 10:* **Midterm 2 (in lab)**	
Week 11	**Spring Break** (no class)	
Week 12	*Lecture 12:* BIM perspectives – Contractor – Presentation *Lab 11:* Taking advantage of point clouds to create models, simulations for construction	**Report 5**: One page report on BIM perspectives by Architect, Engineer, and Contractor by next lecture
Week 13	*Lecture 13:* Virtual Design and Construction. Introduction to laser scans, robotic total stations, GPS. *Lab 13:* Complex Problems/Industry Case Studies	
Week 14	*Lecture 14:* BIM for safety, site layout, material tracking *Lab 14:* Final Q&A for final project presentation and report	
Week 15:	Lecture 15 and Lab 15: Final Presentations (Industry jury will attend)	**Final project report** due
Week 16:	**Final Exam**	

DRAFT PROJECT REQUIREMENTS AND DELIVERABLES DOCUMENT

As part of the final project students are required to address a topic or problem area in construction and show how BIM can be used to improve the current industry approaches. **(Sample from Spring Semester 2011)**

Objectives:
You can choose the theme for your final project from: (1) a case study/existing problem in the industry, or (2) a problem that relates to your work/research. The main objective is to generate a non-trivial BIM project which is closely related to current use or future applications in BIM. Graduate students are encouraged to closely align their projects with their research focus. A few sample case studies using Tekla will be posted on T-Square to help you find a topic and choose a proper level of complexity for your project. The TA will assist you and help you solve any technical issues you might have.

Project Track 1:
The first track is to implement one of the known functionalities of BIM for a construction process. An example is schedule or cost estimating. Since you are using an existing functionality, you are required to implement the details as close to a real project as possible. Some of the other project ideas for track one are listed below. This is only a sample list and you can either take up one of these or come up with your own idea.

- Constructability Review
- Clash check and co-ordination
- RFIs and change order management
- Quantity take-off and estimating
- Model based scheduling
- Workflow management
- Any other existing BIM functionalities

Please take a further look at the case studies posted on T-Square. (Please note: graduate students cannot take Track 1 as project option).

Project Track 2:
The second track will involve novel areas of BIM which are still under development. You will be required to identify a problem area in construction engineering and show conceptually how BIM can address this problem. Implementation of the functionality of your work through a demo within Tekla software is required for graduate students. For undergraduate students who take up this track as their final project, the requirements will be slightly different as we will work with you to see what is realistic/possible in the time/course we have available. Some of the ideas for projects in track two are:

- BIM integration with total station
- Integration with laser-scan point clouds
- BIM for safety
- BIM for supply chain management (RFID tagging)
- Crane and erection sequencing (there is a crane console available as Tekla extension)
- Any Tekla Open API based applications (.NET framework) (please take a look at the application development package on T-Square)

Deliverables

1. Abstract (Due February 25, in class; 5% of total grade)
This submission should outline the topic you are planning to address, and the types of issues you wish to study within the area. This submission is restricted to two pages or less. The purpose of this submission is to start you thinking about a realistic scope for this project. Instructor and TA will provide feedback. Please refer the sample abstract posted on T-Square.

The abstract should have the following content:

- **Title:** The title of the project must be brief, scientifically or technically valid, intelligible to a scientifically or technically literate reader, and suitable for use in the public areas.
- **Author Information & Affiliation**: Following the title should be the name and affiliation of the authors (project team).
- **Project Summary:** You are required to explain in a few paragraphs 'what construction engineering/management topic you want to address in your project?' A clear definition of the problem or the functionality is important at this stage. This should be followed by an explanation on how you think BIM will be helpful in this case.
- **References:** You should provide a list references following theASCE publication format (available on the ASCE website).
- **Keywords:** Three to four key words relevant to your project should be mentioned.
- **Format:** Times New Roman, single-spaced, 11 font size, 1" margins. Maximum 2 pages length.

2. Project Presentation (Due: April 26, in class; 10% of total grade)
You will provide the presentation of your project to the instructor/TA along with the results/conclusions.

3. Final Report (Due April 27, in class; (10% of grade)
A project report is due towards the end of class. A grade will be based on the following criteria (the report submission template provided on T-Square needs to be strictly followed): (1) the report should have an abstract, problem statement/introduction, literature review, methodology, results, potential/future work, and conclusion. You results or conclusions should show how your BIM approach benefits/impacts the industry. References should be provided within the text and also at the end of paper. The overall length cannot exceed 10 pages, including the text, figures, tables, references. A discussion of the preliminary versions and outlines with the instructor/TA are strongly encouraged.

Model/Application/Data Requirements:
You can either build your own model for this project or import an existing one. We might be able to provide you with a model if your project needs one. If you cannot build your own model, you must show substantial amount of work/effort else-where. To evaluate and receive full score for your report, you need to turn in to the TA your final model, application, and data that you used to generate the project on a .ZIP file.