Course Description:
Currently, the building industry is facing enormous technological and institutional changes and challenges. Among these are globalization, specialization, and virtual collaboration. One very important instrument to such change is the use of information technology. The 21st century engineers and construction managers must be able to deal with a rapid pace of technological change, a highly interconnected world, and complex problems that require creative solutions. Building Information Modeling (BIM) is argued to be a catalyst for change poised to reduce industry’s fragmentation, improve its efficiency, effectiveness and lower the high costs of inadequate interoperability. Students will learn BIM authoring and specialty applications for construction management functions including construction simulation (4D scheduling), model-based estimating, interference checking and code compliance.

Students will work in project teams to simulate engineering and construction processes for a real world project. Students will focus on collaboratively modeling a building in BIM, and preparing BIM-informed schedules and cost estimates by utilizing advanced BIM solutions and their individual strengths. By working together in a team environment and simulating real world working practices, students will be able to test BIM practices in the way to become creative and innovative practitioners. Each team will include team members from the University of Texas at Austin, exploring geographically dispersed BIM-based project collaboration and role-based learning.

Students should have familiarity with BIM software environments or willingness to learn them. All students enrolled in the course are expected to attend special skill building lab sessions. This course is not intended to make students completely proficient in BIM. Instead, it aims to demonstrate how construction management functions are impacted by new technologies and helps students understand the fundamentals and practical uses of the state of the art BIM solutions in the building industry.

Objectives:
(1) Students will gain experience in how to work in teams, in which they are exposed to holistic view of the building industry;
(2) Students will have hands-on experience with advanced BIM solutions, which support collaborative and concurrent teamwork;
(3) Students will learn different aspects of collaborative modeling, BIM-based scheduling and estimating;
(4) Students will learn how to integrate personal and group knowledge to achieve positive results in complex engineering and construction tasks.

Methods of Teaching:
A combination of software tutorials, lectures, peer-to-peer learning and discussions. Additional out of class time required for directed self learning, seminar assignments, teamwork and reviewing relevant material.

Learning Objectives:
- Application of BIM skills/knowledge to construction domain knowledge;
- Teamwork and team building essentials;
- Understanding of the requirements needed for successful collaboration to build BIM informed
schedules and estimates as well as schedule/cost informed BIM models.

**Roles & Responsibilities:**
Teamsof students will work on a real world construction project. Each group will have students from the University of Texas, Austin (UT) as a collaborator. Your peers at UT will act as schedulers/estimators and prepare the schedule and estimate. USC students will be responsible for modeling and coordinating with the scheduler and estimator on the UT side. USC students will continuously provide quantity take offs to the UT students and update the model based on the estimator’s needs. USC students will also work closely with the scheduler and incorporate the scheduler’s needs to the model and develop the 4D schedule by using schedules developed at different stages during the semester.

**Guest Speakers:**
Experts from practice will participate either remotely or visit the class.

**Office Hours:**
Tuesdays 9-11am. Students are advised to make appointments with the professor ahead of time and be specific with the subject matter to be discussed. Students should also be prepared for their appointment by bringing all applicable materials and information.

**Assignments:**
Students will work in groups. There is no midterm assignment. Instead, there will be 5 assignments and a final report due at the beginning of the class as specified in the class schedule below. The details for the assignments will be provided during the semester. Teams will present their findings in each integrated project session.

Guidelines and additional information will be developed, which will provide a common vernacular for the assignments. It is crucial that students turn in whatever they have on the due date. NO assignment will be accepted late. An incomplete grade will only be issued when a student is unable to complete the work because of documented illness. A letter from a physician will be required documentation.

**Assignment #1:**
- **Model:** Review drawings and program (USC)
- **Schedule:** Total construction duration, phasing of major elements (UT)
- **Estimate:** Compile conceptual cost data: e.g., example $/sf of floor area, assumptions on future content (UT)
- **Team Charter:** Establish group roles and responsibility: contract/memo of understanding between team members; procedures for non-performing team members; communication/collaboration procedures (USC/UT)

**Assignment #2:**
- **Model:** Create architectural and structural models– LoD200 (approximate geometry): Generic elements, max size, purpose. E.g., A generic interior wall, modeled with an assumed nominal thickness. Properties such as cost, U-value maybe included as a range (USC)
- **Schedule:** Prepare the schedule: time-scaled, ordered, appearance of major activities (UT)
- **Estimate:** Estimated cost based on measurement of generic elements (e.g. generic interior wall (UT)
- **Coordination between team members:** Continuous coordination between scheduler/estimator and modelers. Modelers must understand the estimator’s needs and model accordingly and provide quantity take offs to the estimator. Modelers must also understand scheduler’s needs and incorporate them in the modeling procedures. (USC/UT)

**Assignment #3:**
- **Model:** Keep working on your architectural and structural models– LoD300 (precise geometry): Specific elements, confirmed 3D geometry, dimensions, capacities, and connections. E.g., A specific
wall type modeled with actual thickness of the assembly. Properties such as cost, and U-value are specified (USC).

**Schedule:** Prepare fast track version of the schedule based on assignment #2 (UT)
Implement 4D in Navisworks (USC)

**Estimate:** Estimated cost based on measurement of specific assembly (e.g. specific wall type) (UT)

**Coordination between team members:** Continuous coordination between scheduler/estimator and modelers. Modelers must understand the estimator’s needs and model accordingly and provide quantity take offs to the estimator. Modelers must also understand scheduler’s needs and incorporate them in the modeling procedures. (USC/UT)

**Assignment #4:**
- Complete clash detection in Solibri (USC)
- Complete rule checking in Solibri (USC)
- Change Management: discuss the impact of change, from design coordination (based on clash detection and rule checking results), on the overall project schedule and estimate and how to better control these changes (UT)

**Assignment #5:**
- Complete 4D scheduling in Synchro (USC)
- Finalize schedule and estimate (UT)
- Finalize the integrated model (USC)

**Final Report:**
Each group will deliver a report on their findings at the end of the class. Some of the areas to be covered in this report are lessons learned, interoperability issues, value propositions, best practices for “how to work collaboratively” in a BIM environment. The details for the report will be provided during the semester.

**Industry Mentors:** Teams are encouraged to work with their mentors from the industry. Mentors should have experience with BIM concepts and tools we are using in this course. Industry professionals may help teams with information needed at each stage, LoD, liability issues, quality control, standards, etc. Students may take advantage of the construction projects in and around the university. Teams should provide a list of industry professional that they have incorporated to their teams as mentors (if teams identified additional mentors).

**Course Software:**

**BIM Authoring:**

**BIM Specialty:**
Navisworks - [http://navisworks.com/](http://navisworks.com/) (model review & clash detection)
Autodesk QTO - FREE for students: [http://students5.autodesk.com/](http://students5.autodesk.com/)
Horizontal Glue: [http://www.horizontalsystems.com](http://www.horizontalsystems.com)

**Surveys:**
Students will fill out surveys for the class to provide feedback on teamwork and the course.

**Class Communication:**
Blackboard will be used for class communication, assignment submissions and reading materials. USC team members will be responsible for sharing the files with their peers at UT. Adobe Connect will be used for sharing presentations and desktops.

**Grading Schema:**
Software Assignments: 60% (12% for each assignment)
Final Report: 30%
Participation in class discussions/attendance: 10%

*For software assignments, 80% of the grade will be based on instructor evaluation and 20% of the grade will be based on peer evaluation.

**Recommended Readings:**

*Web Sites & Blogs:*
Analysis, Research and Reviews of AEC Technology - AECbytes - http://www.aecbytes.com/
Building Smart Alliance - http://www.buildingsmartalliance.org/
FIATECH - http://www.fiatech.org/
Eat your CAD - http://www.eatyourcad.com/
BIM Forum - http://www.bimforum.org/
All Things BIM - http://allthingsbim.blogspot.com/
All Roads Lead to BIM - http://www.digitalvis.com/allroads

*Books:*
Building Information Modeling: A Strategic Implementation Guide for Architects, Engineers, Constructors, and Real Estate Asset Managers - Dana K. Smith and Michael Tardif
Building Information Modeling: Planning and Managing Construction Projects with 4D CAD and Simulations - Willem Kymmell
BIM and Construction Management: Proven Tools, Methods, and Workflows - Brad Hardin

**Class Structure & Schedule:**
Class sequence, dates topics and guest speakers are subject to change as the semester proceeds. Please note that we might have additional sessions or rescheduling depending on the availability of the software vendors. Any revisions will be noted and announced in class.

<table>
<thead>
<tr>
<th>Week</th>
<th>Date</th>
<th>Topic</th>
<th>Assignment Due</th>
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| 1    | 08/28 | **INTRODUCTIONS**  
Instructors, class members and course  
Assignments; introduction of the collaborative project |               |
| 2    | 09/04 | **INTEGRATED PROJECT SESSION #1**                                        | Assign # 1 Due |
| 3    | 9/11  | **Additional LAB Class: 10am-1pm (Location TBD)**  
Review of Revit  
How to accommodate/integrate needs of schedulers/estimators in the modeling process – do’s and do not’s)  
Estimating model, scheduling model, design model, construction model  
Level of Detail and how it impacts estimates/schedules |               |
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<tr>
<th>Date</th>
<th>Event</th>
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<tbody>
<tr>
<td>09/11</td>
<td><strong>LAB: BIM authoring tutorial - Revit</strong></td>
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<td>How to collaborate in a BIM environment (linking files and work-sharing)</td>
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<td>Structural modeling in Revit</td>
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<td>09/18</td>
<td>Guest Lecture – Hensel PhelpsConstruction Co.</td>
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<td>4D BIM and 5D BIM (Best Practices and Lessons Learned)</td>
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<td>09/25</td>
<td><strong>LAB: BIM authoring tutorial - Revit</strong></td>
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<td>Workflow/process of modeling for 4D simulation</td>
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<td>Revit to Navisworks for 4D sequencing</td>
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<td>Navisworks functions for construction managers</td>
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<td>Quantity take off</td>
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<td>Paths from BIM to cost estimating (different methods)</td>
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<td>10/02</td>
<td><strong>Guest Lecture (FIATECH: specifications as a tool for collaboration, integration and coordination)</strong></td>
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<td><strong>Guest Lecture (Assemble Systems and S&amp;P Contractors)</strong></td>
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<td>10/09</td>
<td><strong>INTEGRATED PROJECT SESSION #2</strong></td>
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<td>Assign # 2</td>
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<td>10/16</td>
<td><strong>Guest Lecture (Autodesk 360)</strong></td>
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<td>10/23</td>
<td><strong>LAB: Solibri</strong></td>
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<td>Space analysis and measurement</td>
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<td>Interference/deficiency checking</td>
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<td>Rule checking</td>
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<td>10/30</td>
<td><strong>INTEGRATED PROJECT SESSION #3</strong></td>
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<td>Assign # 3</td>
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<td>11/06</td>
<td><strong>LAB: Solibri</strong></td>
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<td>Model analysis and checking</td>
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<td>Quantity take off</td>
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<td>Conformity between Architectural and Structural models</td>
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<td>11/13</td>
<td><strong>INTEGRATED PROJECT SESSION #4</strong></td>
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<tr>
<td>11/20</td>
<td><strong>LAB: Synchro</strong></td>
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<td>Linking BIM to project schedule</td>
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<td>Excavation, site infrastructure, foundation, superstructure</td>
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<td>Growth simulation, 3D subdivision, creating 3D objects</td>
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<td>11/27</td>
<td><strong>LAB: Synchro</strong></td>
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<td>Synchronizing models/schedules</td>
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<td>Presentation/Animation</td>
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<td>Spatial coordination</td>
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<td>12/04</td>
<td><strong>INTEGRATED PROJECT SESSION #5</strong></td>
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<td>Assign # 5</td>
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<td>12/11</td>
<td>Final project/report delivery</td>
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<td>Final Report Due</td>
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**Academic Responsibilities:**

**Students with Disabilities**
Any student requesting academic accommodations based on a disability is required to register with Disability Services and Programs (DSP) each semester. A letter of verification for approved accommodations can be obtained from DSP. Please be sure the letter is delivered to me as early in the
semester as possible. Your letter must be specific as to the nature of any accommodations granted. DSP is located in STU 301 and is open 8:30 am to 5:30 pm, Monday through Friday. The telephone number for DSP is (213) 740-0776.

Academic Integrity
The University, as an instrument of learning, is predicated on the existence of an environment of integrity. As members of the academic community, faculty, students, and administrative officials share the responsibility for maintaining this environment. Faculties have the primary responsibility for establishing and maintaining an atmosphere and attitude of academic integrity such that the enterprise may flourish in an open and honest way. Students share this responsibility for maintaining standards of academic performance and classroom behavior conducive to the learning process. Administrative officials are responsible for the establishment and maintenance of procedures to support and enforce those academic standards. Thus, the entire University community bears the responsibility for maintaining an environment of integrity and for taking appropriate action to sanction individuals involved in any violation. When there is a clear indication that such individuals are unwilling or unable to support these standards, they should not be allowed to remain in the University.” (Faculty Handbook, 1994:20)

Academic dishonesty includes: (Faculty Handbook, 1994: 21-22)
Examination behavior – any use of external assistance during an examination shall be considered academically dishonest unless expressly permitted by the teacher.
Fabrication – any intentional falsification or invention of data or citation in an academic exercise will be considered a violation of academic integrity.
Plagiarism – the appropriation and subsequent passing off of another’s ideas or words as one’s own. If the words or ideas of another are used, acknowledgment of the original source must be made through recognized referencing practices.
Other Types of Academic Dishonesty – submitting a paper written by or obtained from another, using a paper or essay in more than one class without the teacher’s express permission, obtaining a copy of an examination in advance without the knowledge and consent of the teacher, changing academic records outside of normal procedures and/or petitions, using another person to complete homework assignments or take-home exams without the knowledge or consent of the teacher.

The use of unauthorized material, communication with fellow students for course assignments, or during a mid-term examination, attempting to benefit from work of another student, past or present and similar behavior that defeats the intent of an assignment or mid-term examination, is unacceptable to the University. It is often difficult to distinguish between a culpable act and inadvertent behavior resulting from the nervous tensions accompanying examinations. Where a clear violation has occurred, however, the instructor may disqualify the student’s work as unacceptable and assign a failing mark on the paper.

Return of Course Assignments
Returned paperwork, unclaimed by a student, will be discarded after a year and hence, will not be available should a grade appeal be pursued following receipt of his/her grade.