

# CE 570: DESIGN, ENGINEERING, CONSTRUCTION TECHNOLOGIES IN AEC PRACTICES

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*Fall 2018 Syllabus*

## **COURSE DESCRIPTION**

The architecture, engineering and construction (AEC) industry is facing enormous technological and institutional changes and challenges. One very important instrument to change is the use of technology. The 21st century designers, engineers and construction managers must be able to deal with a rapid pace of technological change, a highly interconnected world, and complex projects that require creative solutions. Technology is argued to be a catalyst for change, poised to reduce the industry's fragmentation, improve its efficiency, effectiveness and increase productivity. Students will learn about the state-of-the-art technologies and their applications in design, engineering and construction management functions including automation, optimization, visualization, productivity, management, foresight and so on. The emphasis is on understanding the capabilities of available and developing technology so that the appropriate tools, systems, equipment, and methods that can be selected for a particular AEC project.

All students enrolled in the course are expected to attend lectures and discussions. This course is not intended to make students proficient in any specific AEC technology or software. Instead, it aims to demonstrate how design, engineering, and construction management functions are impacted by new technologies and aims to help students understand the fundamentals and practical uses of the state-of-the-art technology in the architecture, engineering, and construction (AEC) industry. The course is structured through a series of technological topics and AEC professional practices inclusive of a series of external experts bringing in their perspectives and experiences from practice across the AEC value chain.

## **COURSE OBJECTIVES**

- To learn more about the fast growing fields and technologies used in the AEC industry
- To become familiar with the potential of AEC automation and potentially implement it in current and existing projects
- To become familiar with state-of-the-art technological advancements and their impact in the AEC industry

## **METHODS OF TEACHING**

A combination of lectures, peer-to-peer learning and discussions. Additional out of class time required for seminar assignments and reviewing/reading relevant material.

## **ATTENDANCE**

Continuous attendance is critical for your success in this class as the class topics build on each other and attendance is part of the evaluation criteria. If you miss a class, it is your responsibility to ask at the next class what you missed or find out about topics covered. If you are late for class and miss roll, it is your responsibility to make sure we check you present; if not you will not get credit for attendance.

## **CLASS PARTICIPATION**

Your participation in the class is part of the evaluation criteria. This is a highly interactive class. There is continuous interchange between the instructor and students. Questions and participation in discussions are highly encouraged.

## **GUEST SPEAKERS**

Experts from practice and academia will participate remotely and locally. These speakers include professionals from the wide variety of disciplines that make up the AEC.

## **TEACHING ASSISTANT**

To be confirmed:

## **OFFICE HOURS**

Office hours by appointment only. 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**

It is crucial that students turn in the assignments 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.

### **Weekly Readings:**

It is expected that students prepare for class through a weekly set of readings.

### **Midterm Assignment:**

Students will perform review and critical analysis of an *existing example* of state-of-the-art technology in the AEC industry through a search in literature, web, etc. The presentation/report will include the following elements:

- Description of the problem to be solved
- Selection of an existing example of technology in the AEC to solve the problem
- Description of the operation prior to automation
- Description of automation: components, control strategy, etc.
- Discussion and evaluation of the automation's performance (robustness, reliability, user satisfaction, etc.)
- Critical review of the automation and suggestions to improve the automation

Students will prepare a report that is around 3000-4000 words, not including figures and/or tables. Reports will be in PDF format. The midterm assignment report is due March 5<sup>th</sup> 2018. Each student will prepare and deliver about a 20 min presentation about their midterm during that week of the class.

**Final Assignment:** Students will develop a case study; in which they propose a new automation system to address an issue in an AEC project. The project will follow a Minimum Viable Product (MVP) or agile product development approach to the development of a solution. More specifically, students will:

- Select an AEC task to be automated and provide justification for their selection
- Analyze current practice for the AEC task
- Design a schematic AEC project to automate the AEC task
- Propose conceptual designs of several automation systems that could improve the task
- Select the components and perform an analysis to carry out an assessment for technical and economical feasibility
- Make recommendations for future work

Students will prepare a report that is around 3000-4000 words, not including figures and/or tables. Reports will be in PDF format. The final assignment report is due April 16th. Each student will prepare and deliver a 15-20 min presentation about their project during the that week of the class (see class schedule).

## EVALUATION AND GRADING SCHEMA

Grades will be based on completeness and quality of assignments, attendance and participation. Additional breakdown for grading for each assignment will be provided in assignment descriptions that will be handed out during the semester.

- Midterm: 35%
- Final Assignment: 45%
- Participation in discussions and discussions about readings: 20%
- TOTAL: 100%

Grade breakdown by percentage of possible 100 total points:

- A 100 - 90% Work exceeds expectation, always attends class
- B 80 - 89% Very good work, almost always attends class.
- C 66 - 79% Good work, good attendance
- D 65 - 50% Late, incomplete, or sloppy work, infrequent attendance
- F 49% or less Missing or copied work, poor attendance

## CLASS STRUCTURE & SCHEDULE

\* Class sequence and dates are subject to change. There might be guest speakers via WebEx or similar.

DATE	TIME	TOPICS
Aug 23	14:00-16:50	<b>Course Introduction</b> <b>The Need for Construction Automation, Prospects &amp; Obstacles</b>
Aug 30	14:00-16:50	<b>MVP Workshop: Scan Focus Act</b>  <i>Exercise and Discussion</i>
Sept 6	14:00-16:50	<b>Virtual Reality/Augmented Reality</b> Use of VR/AR in construction: VR/AR and BIM Research in VR/AR <b>Simulation</b> From design to construction management to energy analysis  <i>Discussion (Check reading assignments)</i>
Sept 13	14:00-16:50	<b>Construction Robotics</b> Construction robots From assistive robots to robot inspectors to robot construction workers Technical and social issues
		<i>Discussion (Check reading assignments)</i>
Sept 20	14:00-16:50	<b>Guest Lecture: Winston Khan BIM, ARUP TBC</b>  <b>3D Printing/Additive Manufacturing</b> Current status; opportunities & limitations 3D printing in different scales 3D printing and BIM 3D printing and modular construction/mass customization

		<b>Guest Lecture:</b> Jamey Lyzun, Mechanical Engineering, ARUP TBC
		<i>Discussion (Check reading assignments)</i>
Sept 27	14:00-16:50	<b>Big Data &amp; Analysis</b> Big data in civil engineering Application areas & challenges  <b>Guest Lecture:</b> Brian Ringley, WeWork Research <b>Guest Lecture:</b> Murat Melek, Structural Engineer ARUP
		<i>Discussion (Check reading assignments)</i>
Oct 4		<b>Big Data &amp; Analysis</b> Big data in civil engineering Application areas & challenges  <b>Guest Lecture:</b> Danil Nagy, Autodesk, Research <b>Guest Lecture:</b> Bruce Danziger, Structural Engineer ARUP
		<i>Discussion (Check reading assignments)</i>
Oct 11	14:00-16:50	<b>Ubiquitous Connectivity and Tracking (IoT)</b> Smart construction objects Construction material/equipment monitoring Worker productivity & safety Equipment productivity Supply chain monitoring  <b>Guest Lecture:</b> Russell Fortmeyer, Sustainability, ARUP
		<i>Discussion (Check reading assignments)</i>
Oct 18	14:00-16:50	<b>Machine Learning in Construction</b> Data fusion Vision based systems Pattern recognition  <b>Guest Lecture:</b> Winston Khan BIM 2, ARUP TBC
		<i>Discussion (Check reading assignments)</i>
Oct 25	14:00-16:50	<b>MID TERM PRESENTATIONS</b>  <b>Guest Lecture:</b> Forest Flager, Katera, TBC
		<i>Discussion (Check reading assignments)</i>  <b>*** MIDTERM PAPERS ARE DUE</b>

Nov 1	14:00-16:50	<b>Building Automation</b> What is building automation? Why is it important? Types of building automation? Barriers & opportunities for building automation  <b>Guest Lecture:</b> Ayesgul Gogus, Structural Engineer, ARUP, TBC
		<i>Discussion (Check reading assignments)</i>
Nov 8	14:00-16:50	<b>LIDAR/Drones</b> Scan to BIM Construction safety Construction quality  <b>Guest Lecture:</b> Nate Witasek, SGH, TBC
		<i>Discussion (Check reading assignments)</i>
Nov 15	14:00-16:50	<b>Engineering Design Technologies</b> Structural Design Methods Structural Design Tools Cases from Practice
		<i>Discussion (Check reading assignments)</i>
Nov 22	14:00-16:50	<b>Thanksgiving Holiday</b>
Nov 29	14:00-16:50	<b>STUDENT PRESENTATIONS (Final)</b>
Dec 6	14:00-16:50	<b>*** FINAL REPORTS DUE (Final)</b>

## 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. 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)

1. **Examination behavior** – any use of external assistance during an examination shall be considered academically dishonest unless expressly permitted by the teacher.
2. **Fabrication** – any intentional falsification or invention of data or citation in an academic exercise will be considered a violation of academic integrity.
3. **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.
4. **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.

## Statement on Academic Conduct and Support Systems

### Academic Conduct:

Plagiarism – presenting someone else’s ideas as your own, either verbatim or recast in your own words – is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in *SCampus* in Part B, Section 11, “Behavior Violating University Standards” <https://policy.usc.edu/scampus-part-b/>. Other forms of academic dishonesty are equally unacceptable. See additional information in *SCampus* and university policies on scientific misconduct, <http://policy.usc.edu/scientific-misconduct>.

### Support Systems:

*Student Counseling Services (SCS) - (213) 740-7711 – 24/7 on call*

Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention. <https://engemannshc.usc.edu/counseling/>

*National Suicide Prevention Lifeline - 1-800-273-8255*

Provides free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week. <http://www.suicidepreventionlifeline.org>

*Relationship and Sexual Violence Prevention Services (RSVP) - (213) 740-4900 - 24/7 on call*

Free and confidential therapy services, workshops, and training for situations related to gender-based harm. <https://engemannshc.usc.edu/rsvp/>

*Sexual Assault Resource Center*

For more information about how to get help or help a survivor, rights, reporting options, and additional resources, visit the website: <http://sarc.usc.edu/>

*Office of Equity and Diversity (OED)/Title IX Compliance – (213) 740-5086*

Works with faculty, staff, visitors, applicants, and students around issues of protected class. <https://equity.usc.edu/>

*Bias Assessment Response and Support*

Incidents of bias, hate crimes and microaggressions need to be reported allowing for appropriate investigation and response. <https://studentaffairs.usc.edu/bias-assessment-response-support/>

*The Office of Disability Services and Programs*

Provides certification for students with disabilities and helps arrange relevant accommodations. <http://dsp.usc.edu>

*Student Support and Advocacy – (213) 821-4710*

Assists students and families in resolving complex issues adversely affecting their success as a student EX: personal, financial, and academic. <https://studentaffairs.usc.edu/ssa/>

*Diversity at USC*

Information on events, programs and training, the Diversity Task Force (including representatives for each school), chronology, participation, and various resources for students. <https://diversity.usc.edu/>

*USC Emergency Information*

Provides safety and other updates, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible, <http://emergency.usc.edu>

*USC Department of Public Safety – 213-740-4321 (UPC) and 323-442-1000 (HSC) for 24-hour emergency assistance or to report a crime.*

Provides overall safety to USC community. <http://dps.usc.edu>