USC School of Architecture

PRELIMINARY

(in-progress, last updated 10/19/2023)

Architecture 507-517: Theories of Computer Technology

Arch 507, Spring Semester, Units: 3 – all semester Arch 517, Spring Semester, Units: 1 - meets only until February 23th, 2024

Fridays: 9 am - 11:50 am, WPH B36 - this is Waite Phillips Hall, basement computer classroom

Instructor: Karen Kensek Office: Watt 309 Office Hours: send email for appointment, live or Zoom; happy to talk with you! Contact Info: <u>kensek@usc.edu</u>

Class Assistant: TBA Office Hours: TBA Contact Info: TBA

A computer-aided design system is most useful when the structured design inside the computer can be used for something besides merely producing a picture. As soon as the process of computer-aided design is considered as building a description of the object being designed rather than as a process of simply drawing the object, horizons become tremendously expanded.

Ivan E. Sutherland (1973)

What remains hard is modeling. The structure inherent in three-dimensional models is difficult for people to grasp and difficult too for user interfaces to reveal and manipulate. Only the determined model threedimensional objects, and they rarely invent a shape at the computer, but only record a shape so that analysis or manufacturing can proceed. The grand challenges to three-dimensional graphics are to make simple modeling easy and make complex modeling accessible to far more people.

Robert Sproull (keynote speech, SIGGRAPH 1990)



Images from students rendering homework assignment: Ji Wu, JaeYong Suk, Michael Makris

Course Description and Learning Objectives

Architecture 507 is a three unit course that meets once a week for three hours for fifteen weeks (3 units). Architecture 517 is a one unit course that meets once a week for three hours for six weeks (1 units). The courses will focus on the quote from Ivan E. Sutherland. Essentially what Sutherland was proposing is a system similar to a fairly recent development in computer software called building information modeling (BIM). By combining 3d geometry with data into parametric components, it changes not only how buildings are described digitally, but the processes in an office to design, document, and eventually construct buildings. Learn what it is, how to apply it, innovative uses, and how it relates to the current state of work processes in the AEC profession.

In order to effectively learn about BIM, it is important that you go to class and keep up with the required readings. You are required to attend all the lectures and complete all the assignments on-time. In addition to many hands-on computer sessions by the instructor, there will also be guest lecturers from the profession. They have spent considerable time and effort to come talk with the class. Listen, be attentive, and ask appropriate questions. They are valuable resources.

In this class, you will

- Learn what BIM is and how it has changed the AEC industry
- Become reasonably proficient in Revit Architecture
- Understand what is virtual reality and apply it to your project using Enscape
- Learn the basics of visual programming using Dynamo
- Explore other BIM related software programs such as Navisworks depending on class time

Prerequisite(s): upper division standing or graduate student Co-Requisite (s): none

Recommended Preparation

Basic understanding of 2D CAD and 3D digital modeling. Although this course is offered in the School of Architecture, the techniques taught are equally applicable to others with an interest in the applications of building information modeling. Building science majors, structural engineering students, construction management students, and others are strongly encouraged to enroll. Please contact the instructor if you have questions.

Graduate Certificate: the course applies to the MBS graduate certificate if you are a graduate student.

Software Required

A USC e-mail account is required for this course. Verify that your USC account and Blackboard is working. Call 1-213-740-5555 if you have problems accessing your account. Read your e-mail at least once a day! You will also need an **Autodesk account** to download software: students.autodesk.com.

Download Autodesk Revit 2024 from <u>http://students.autodesk.com</u>. Also download the Revit content libraries. <u>https://knowledge.autodesk.com/support/revit-products/learn-</u>explore/caas/sfdcarticles/Sfdcarticles/Where-to-find-Revit-Content-Libraries-to-download.html

See additional instructions, last page of the syllabus.

You will also be using Dynamo, Navisworks, and Enscape and perhaps Twinmotion. Dynamo is part of Revit; Navisworks can be downloaded from Autodesk; and you can get a free educational version of Enscape (it works with both Rhino and Revit). Contact Dipak if you have problems (dshirke@usc.edu). These software programs are also available on computers in the University labs and in the School of Architecture. These programs only run under Windows and are free for student use. You can also access them through the USC Cloud Apps on a Macintosh, but it is a bit annoying. <u>https://itservices.usc.edu/vdi/</u>

Required Readings and Supplementary Materials

Specific due dates for the readings are listed on the syllabus. You are required to have read the material **before** class. There may be in-class quizzes on the readings. There will be other readings posted on Blackboard or put on reserve in the AFA library as necessary. Books maybe available at other locations (e.g. amazon.com).



THE DYNAMO REFERENCE MANUAL INCHEAT SHEET FORMAT

Required – Arch 507 and 517 students should buy immediately

Technical Design Series: Building Information Modeling Karen M. Kensek, LEED AP BD+C, Assoc. AIA

http://www.routledge.com/books/details/9780415717748

Introduction Chapter 1: BIM Overview Chapter 2: Stakeholders and BIM's Many Roles Chapter 3: Data Exchange and Interoperability Chapter 4: BIM Implementation Chapter 5: Beyond Basic BIM Application: Project Case Studies Conclusion

Optional– buy before March 29, 2024 if you want it Not needed for Arch 517 students

The Dynamo Reference Manual Marcello Sgambelluri

https://www.simplycomplex.org/dynamo-reference-manual https://www.aeccheatsheets.com/

This book is a series of instructions for programming actions in Dynamo. Numerous example files are provided with it.



BUILDING INFORMATION MODELING





Optional

Building Information Modeling: BIM in Current and Future Practice Editor: Karen M. Kensek, LEED AP BD+C, DPACSA Editor: Douglas E. Noble, PhD, FAIA

http://www.wiley.com/WileyCDA/WileyTitle/productCd-111876630X.html

Each chapter is a stand-alone topic on research areas in BIM. I recommend looking at the table of contents and reading about those areas that interest you the most.

Required Reference Documents on Brightspace

There are many files on Blackboard including the syllabus, homework assignments, and readings. Please download all of them.

Optional readings on Brightspace

aiab095712 - AIA BIM contract documents.pdf National Building Information Modeling Standard (NBIMSv1_p1.pdf) AECbytes -Got Macros.pdf (on Blackboard)

Optional References On-Line (cut and paste the links)

LinkedIn Learning

Accessable from Blackboard; hundreds of useful courses. Try searching under Revit or Dynamo.

Dynamo – extremely useful for homeworks 7 and 8

Dynamo Primer - https://primer.dynamobim.org/

Dynamo - http://dynamobim.org/

Colin McCrone's Dynamo Language Guide - <u>http://dynamobim.org/wp-content/uploads/forum-assets/colin-mccroneautodesk-com/07/10/Dynamo language guide version 1.pdf</u>

UNC Professor Jeremy Roh is teaching similar concepts in his course and records himself (scroll down a bit to see him explore solar facades – he actually covers these over a few classes): https://www.youtube.com/user/zedjr01/videos.

Zach Kron - https://www.youtube.com/watch?v=h0Sk1w7xU4Q

<u>https://www.youtube.com/watch?v=HWI1KUhhaJs</u> (Vasari, Dynamo adaptive louver) <u>https://github.com/DynamoDS/Dynamo/wiki/How-To-Create-Your-Own-Nodes</u> (custom nodes)

Interesting blogs about BIM and Revit

Marcello Sgambelluri - http://therevitcomplex.blogspot.com/ http://therevitcomplex.blogspot.com/2012/07/creating-walls-that-follow-site.html Phil Lazarus - http://bintroublemaker.blogspot.com/ Zach Kron - http://buildz.blogspot.com/ LA RUG (Revit User Group) - http://losangelesrevitusersgroup.blogspot.com/ Jeremy Tammik - http://thebuildingcoder.typepad.com/blog/

Not BIM, but interesting tools - http://andrewmarsh.com/

Autodesk

Glenn Katz - http://www.bimtopia.com/ https://www.autodesk.com/certification/overview http://students.autodesk.com/ https://www.revitcity.com/downloads.php http://www.augi.com

Interoperability

Rhino.Inside.Revit - <u>https://www.rhino3d.com/inside/revit/1.0/</u> Exchange Connector Rhino/Revit - <u>https://blogs.autodesk.com/revit/2022/09/22/data-exchange-connector-for-mcneel-rhino-now-in-public-beta/</u> Proving Ground Conveyor – <u>https://provingground.io/tools/conveyor/</u> Speckle - <u>https://speckle.systems/</u> Marcello Sgambelluri - <u>https://www.aeccheatsheets.com/downloads</u>

Attendance

The University of Southern California recognizes the diversity of our community and the potential for conflicts involving academic activities and personal religious observation. The University provides a guide to such observances for reference and suggests that any concerns about lack of attendance or inability to participate fully in the course activity be fully aired at the start of the term. As a general principle, students should be excused from class for these events if properly documented and if provisions can be made to accommodate the absence and make up the lost work. Constraints on participation that conflict with adequate participation in the course and cannot be resolved to the satisfaction of the faculty and the student need to be identified prior to the drop/add date for registration. After the drop/add date the University and the School of Architecture shall be the sole arbiter of what constitutes appropriate attendance and participation in a given course.

Please contact Karen Kensek at <u>kensek@usc.edu</u> by the end of the second week of class if you anticipate conflicts with religious holidays including missing lectures, inability to finish homework assignments on-time, or other items that may hinder your work in this class.

Religious Holidays and other Important Life Events

The University of Southern California recognizes the diversity of our community and the potential for conflicts involving academic activities and personal religious observation. The University provides a guide to such observances for reference and suggests that any concerns about lack of attendance or inability to participate fully in the course activity be fully aired at the start of the term. As a general principle students should be excused from class for these events if properly documented and if provisions can be made to accommodate the absence and make up the lost work. Constraints on participation that conflict with adequate participation in the course and cannot be resolved to the satisfaction of the faculty and the student need to be identified prior to the drop/add date for registration. After the drop/add date the University and the School of Architecture shall be the sole arbiter of what constitutes appropriate attendance and participation in a given course.

Please contact Karen Kensek at kensek@usc.edu by the end of the second week of class if you anticipate conflicts with religious holidays including missing lectures, inability to finish homework assignments on-time, or other items that may hinder your work in this class.

Classroom Norms

Sharing our work with others and opening ourselves to critique (or peer feedback) can be a vulnerable process. To model the expectations of a professional work environment in our field, and promote a respectful classroom environment, we agree to the following.

- Do not interrupt when someone else is speaking
- Critique design work, not people
- Support critique with evidence or speak from personal experience
- Allow everyone to critique (i.e., don't dominate or remain silent)
- Keep a positive tone when offering critique and responding to it
- Accept critique in the positive spirit with which it is given as a means of development
- When Zooming, have an appropriate background, preferably an image of you for non-video and a background image for you to use in video mode.







Spring 2019: Visitor center renderings in Enscape and Revit (hwk 6). (Gaorge Yang)

Description and Assessment of Assignments

Homework assignments are usually one or two weeks in length. If an assignment is two weeks in length, it is because it is a longer assignment, and you need the additional time to complete it. Late assignments will not be accepted; turn in what you have on the due date at the beginning of class (9:00 AM). You will receive partial credit. Successful students read the entire homework assignment before starting, read it again as they are working on it to refresh their memory, and read it yet again to verify that they have the correct elements to turn in. There is also a final project and required questions on the readings. Grades will be posted on Brightspace.

LATE ASSIGNMENTS WILL NOT BE ACCEPTED; TURN IN WHAT YOU HAVE

ON THE DUE DATE. There are no "make-up" assignments or extra credit. Do the absolute best that you can on each assignment and turn it in on time. Usually you will be uploading files on Blackboard before class at 9 am and sometimes turning in a printout. Turn in what you have done for partial credit.

PLEASE NOTE THAT YOU ARE EXPECTED TO COMPLETE ALL HOMEWORK ASSIGNMENTS BY YOURSELF USING THE SOFTWARE THAT HAS BEEN ASSIGNED. COPYING OTHER PEOPLE'S FILES OR TURNING IN WORK THAT YOU DID NOT COMPLETE YOURSELF WILL RESULT IN A FAILING GRADE.

Make backups of everything!!! These should be in different locations (e.g. multiple flash drives, hard drive, portable hard drive, the cloud) and under different names. Keep older files in case the newest version somehow becomes corrupted (this has happened to me). Losing your files will not be an excuse for late or missing assignments.

| | Percentage of Grade | Assignments | Number of points |
|----------------------|------------------------|---|----------------------|
| Homeworks | 75% | Homework 1 – Introduction to BIM | 20 – time consuming |
| | | Homework 2 – Understanding Families | 20 |
| | | Homework 3 – 2D / 3D Coordination | 20 – difficult |
| | | Homework 4 – Schedules and Details | 10 |
| | | Homework 5 – Rendering and VR | 10 – fun |
| | | Homework 6 – Conceptual Modeler and Adaptive Components | 10 – detailed |
| | | Homework 7 – Introduction to Dynamo (solar) | 10 |
| | | Homework 8 – Dynamo (geometry) | 10 |
| Final Project | 20% | Final Project | 100 – mind expanding |
| Participation | 5% | Questions on readings | varies |
| | | In-class exercises, e.g. Construction Sequencing and Clash Detection | varies |
| | | Pop quizzes | varies |
| | | Other | varies |

Grading Breakdown (highlighted yellow required for Arch 517 students)

| | Lecture | Homework | Required Readings & References |
|--------------------------|--|-----------|--|
| | | | LinkedIn Learning has many teaching videos available through Brightspace. |
| Week 1 Jan. 12 | Introduction to Arch 507 Introduction to BIM and Revit "dumpy house" Site, contour labeling Perspective, section box, "explode" Introduce building choice | | Learning Revit folder on Brightspace in homework 1 zip file |
| Week 2 Jan. 19 | Discuss building choice Introduction to Families Instances and types System, loadable, in-place Title block | | Routledge – Introduction http://www.nationalbimlibrary.com/find-bim- objects https://bimsmith.com/ |
| Week 3 Jan. 26 | Creating Loadable Families Loadable Parametric Components Massing / conceptual mass What is LOD? | HWK 1 due | Routledge – <i>Chapter 1</i> BIMForum_LOD-Spec-2020 |
| Week 4 Feb. 2 | Understanding Families Parametric Components (overhang) Symbolic lines Massing / conceptual mass Scaling a drawing Curved beam, tilted wall (both ways) | | Routledge – Chapter 2 |
| Week 5 Feb. 9 | Construction phasing Clash detection Navisworks | HWK 2 due | Routledge – Chapter 3 |
| Week 6 Feb. 16 | BIM as a Database Schedules Annotation and Detailing | | Routledge – Chapter 4 |
| Week 7 Feb. 23 | Introduction to Revit Structure Introduction to Revit Mechanical End of Arch 517. | HWK 3 due | Routledge – Chapter 5 |
| Week 8 Mar. 1 | Rendering Animation Introduction to VR / AR Introduction to Enscape | HWK 4 due | Routledge – <i>Chapter 6</i> <u>http://therevitkid.blogspot.com/2020/04/how-</u> <u>to-use-physically-based-rendering.html</u> (PBR materials for rendering in Revit) |
| Week 9 Mar. 8 | Virtual Reality Game Engines Digital Twins | HWK 5 due | Routledge – Chapter 7 |

Course Schedule: A Weekly Breakdown: readings are due by the beginning of the class

| Week 10 Mar. 15 | Spring Break | | | |
|--------------------|---|---|--|--|
| Week 11 Mar. 22 | Conceptual Modeler Adaptive Components Pattern based Non-pattern based Parameters distance, offset, rotate, material | Routledge – <i>Chapter 8</i> Marcello Sgambelluri mass family handout.pdf http://therevitkid.blogspot.com/2013/07/revit- | | |
| | visibility, reporting | tutorial-massing-and-adaptive.html | | |

| Week 12 Mar. 29 | Discuss final project requirements Introduction to visual scripting Introduction to Dynamo Dynamo applications Packages Visual Scripting DesignScript and Examples | HWK 6 due | Routledge – <i>Chapter 9 and Conclusion</i> Dynamo Visual Programming for Design Overview.pdf Dynamo_language_guide_version_1.pdf Marcello Sgambelluri - <u>https://www.aeccheatsheets.com/downloads</u> | |
|----------------------------------|--|------------------------|---|--|
| Week 13 Apr. 5 | Visual Scripting – attractors | FP1 due | The Dynamo Reference Manual, Marcello Sgambelluri (optional) Dynamo Primer - http://dynamoprimer.com/ Dynamo - http://dynamobim.org/ Dynamo - http://dynamobim.org/ https://www.simplycomplex.org/dynamo- reference-manual | |
| Week 14 Apr. 12 | Visual Scripting DesignScript and Examples Description of final project – examples | HWK 7 due FP2 due | https://www.youtube.com/watch?v=h0Sk1w7 xU4Q Colin McCrone's - <u>http://dynamobim.org/wp- content/uploads/forum-assets/colin- mccroneautodesk- com/07/10/Dynamo_language_guide_version_ 1.pdf</u> | |
| Week 15 Apr. 19 | Meet with students about final projects Rhino to Revit Guest? | HWK 8 due Start FP3 | https://www.rhino3d.com/inside Rhino to Revit Points Export Handout.pdf RhinoToRevit_MethodList_Gayathree.pdf Rhino.Inside.Revit | |
| Week 16 Apr. 26 FINAL P | Conclusion BIM in the Profession PRESENTATIONS | | | |
| FP3 – Friday, May 3rd, 8 – 10 am | | | | |

Course Expenses: approximately \$100 - \$150.

Statements on Academic Integrity, Course Distribution, and Support Systems

Academic Integrity

The University of Southern California is foremost a learning community committed to fostering successful scholars and researchers dedicated to the pursuit of knowledge and the transmission of ideas. Academic misconduct is in contrast to the university's mission to educate students through a broad array of first-rank academic, professional, and extracurricular programs and includes any act of dishonesty in the submission of academic work (either in draft or final form).

This course will follow the expectations for academic integrity as stated in the <u>USC Student Handbook</u>. All students are expected to submit assignments that are original work and prepared specifically for the course/section in this academic term. You may not submit work written by others or "recycle" work prepared for other courses without obtaining written permission from the instructor(s). Students suspected of engaging in academic misconduct will be reported to the Office of Academic Integrity.

Other violations of academic misconduct include, but are not limited to, cheating, plagiarism, fabrication (e.g., falsifying data), knowingly assisting others in acts of academic dishonesty, and any act that gains or is intended to gain an unfair academic advantage.

The impact of academic dishonesty is far-reaching and is considered a serious offense against the university and could result in outcomes such as failure on the assignment, failure in the course, suspension, or even expulsion from the university.

For more information about academic integrity see the <u>student handbook</u> or the <u>Office of Academic</u> <u>Integrity's website</u>, and university policies on <u>Research and Scholarship Misconduct</u>.

Course Content Distribution and Synchronous Session Recordings Policies USC has policies that prohibit recording and distribution of any synchronous and asynchronous course content outside of the learning environment.

Recording a university class without the express permission of the instructor and announcement to the class, or unless conducted pursuant to an Office of Student Accessibility Services (OSAS) accommodation. Recording can inhibit free discussion in the future, and thus infringe on the academic freedom of other students as well as the instructor. (Living our Unifying Values: The USC Student Handbook, page 13).

Distribution or use of notes, recordings, exams, or other intellectual property, based on university classes or lectures without the express permission of the instructor for purposes other than individual or group study. This includes but is not limited to providing materials for distribution by services publishing course materials. This restriction on unauthorized use also applies to all information, which had been distributed to students or in any way had been displayed for use in relationship to the class, whether obtained in class, via email, on the internet, or via any other media. (Living our Unifying Values: The USC Student Handbook, page 13).

Support Systems

Student Health Counseling Services - (213) 740-7711 – 24/7 on call engemannshc.usc.edu/counseling

Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention.

National Suicide Prevention Lifeline - 1 (800) 273-8255 – 24/7 on call suicidepreventionlifeline.org

Free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week.

Relationship and Sexual Violence Prevention Services (RSVP) - (213) 740-4900 – 24/7 on call engemannshc.usc.edu/rsvp

Free and confidential therapy services, workshops, and training for situations related to gender-based harm. *Office of Equity and Diversity (OED)* | *Title IX - (213) 740-5086* equity.usc.edu, titleix.usc.edu

Information about how to get help or help a survivor of harassment or discrimination, rights of protected classes, reporting options, and additional resources for students, faculty, staff, visitors, and applicants. The university prohibits discrimination or harassment based on the following protected characteristics: race, color, national origin, ancestry, religion, sex, gender, gender identity, gender expression, sexual orientation, age, physical disability, medical condition, mental disability, marital status, pregnancy, veteran status, genetic information, and any other characteristic which may be specified in applicable laws and governmental regulations.

Bias Assessment Response and Support - (213) 740-2421

studentaffairs.usc.edu/bias-assessment-response-support

Avenue to report incidents of bias, hate crimes, and microaggressions for appropriate investigation and response.

The Office of Disability Services and Programs - (213) 740-0776 <u>dsp.usc.edu</u>

Support and accommodations for students with disabilities. Services include assistance in providing readers/notetakers/interpreters, special accommodations for test taking needs, assistance with architectural barriers, assistive technology, and support for individual needs.

USC Support and Advocacy - (213) 821-4710

studentaffairs.usc.edu/ssa

Assists students and families in resolving complex personal, financial, and academic issues adversely affecting their success as a student.

Diversity at USC - (213) 740-2101

diversity.usc.edu

Information on events, programs and training, the Provost's Diversity and Inclusion Council, Diversity Liaisons for each academic school, chronology, participation, and various resources for students.

USC Emergency - UPC: (213) 740-4321, HSC: (323) 442-1000 – 24/7 on call dps.usc.edu, emergency.usc.edu

Emergency assistance and avenue to report a crime. Latest updates regarding safety, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible.

USC Department of Public Safety - UPC: (213) 740-6000, HSC: (323) 442-120 – 24/7 on call dps.usc.edu Non-emergency assistance or information

Accreditation Statements

The USC School of Architecture's five year BARCH degree and the two year M.ARCH degree are accredited professional architectural degree programs. All students can access and review the NAAB Conditions of Accreditation (including the Student Performance Criteria) on the NAAB Website, http://www.naab.org/accreditation/2009 Conditions.aspx .

The Master of Landscape Architecture degree program (for USC's +3 students with no prior design education, and our +2 for students admitted with advanced standing) is accredited by the Landscape Architecture Accreditation Board. All students can access and review the LAAB accreditation standards/process at http://www.asla.org/Education.aspx .

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