USC School of Architecture

PRELIMINARY
(in-progress, last updated 12/8/2021)

Architecture 507-517: Theories of Computer Technology

Spring Semester, Units: 3 (507) – all semester
Spring Semester, Units: 1 (517) - meets only until February 18ᵗʰ, 2022
Fridays: 9 am – 11:50 am, WPH B36 – this is Waite Phillips Hall, basement

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

Class Assistant: Shaobo Kevin Yang and Haotian Wu
Office Hours: to be announced; additional hours available by email, live or Zoom
Contact Info: shaoboya@usc.edu and hwu01382@usc.edu

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 three-dimensional 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 course 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 decribed 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, Insight, and Fuzor 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 2022** from http://students.autodesk.com . Download the Revit content libraries. https://knowledge.autodesk.com/support/revit-products/learn-explore/caas/sfdcarticles/sfdcarticles/Where-to-find-Revit-Content-Libraries-to-download.html

See additional instructions, **NOTES** section near end of the syllabus.

You will also be using Dynamo, Navisworks, and Enscape. 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 even on a Macintosh. https://itservices.usc.edu/vdi/

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).

Required – buy now

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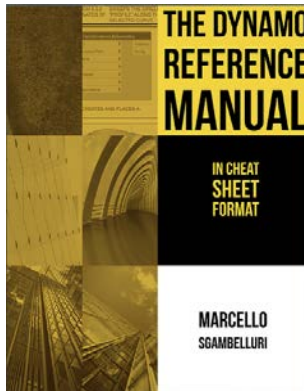Chapter 2: Stakeholders and BIM's Many Roles
Chapter 3: Data Exchange and Interoperability
Chapter 4: BIM Implementation
Chapter 5: Beyond Basic BIM
Application: Project Case Studies
Conclusion

Required – buy before April 8, 2022
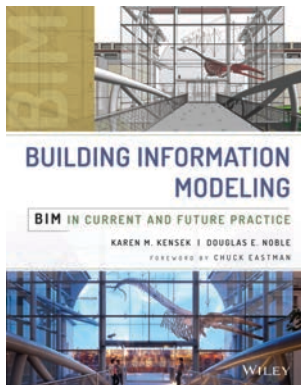**Not needed for Arch 517 students**

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.

Optional

Building Information Modeling:
   BIM in Current and Future Practice
Karen M. Kensek, LEED AP BD+C, Assoc. AIA
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 Blackboard
There are many files on Blackboard including the syllabus, homework assignments, and readings. Please download all of them.

Optional readings on Blackboard
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, formerly Lynda.com
Accessable from Blackboard; hundreds of useful courses. Try searching under Revit or Dynamo.

Dynamo – **extremely useful for homeworks 8, 9, and the final project**
Dynamo Primer - https://primer.dynamobim.org/
Dynamo - http://dynamobim.org/
Colin McCrone's Dynamo Language Guide - http://dynamobim.org/wp-content/uploads/forum-assets/colin-mccroneautodesk-com/07/10/Dynamo_language_guide_version_1.pdf
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 .
Automatic shading design - http://autodesk.typepad.com/bpa/2013/08/more-fun-with-dynamo-for-bpa-automatic-shading-design.html
Zach Kron - https://www.youtube.com/watch?v=h0Sk1w7xU4Q
http://www.youtube.com/results?search_query=dynamo+autodesk
https://www.youtube.com/watch?v=HWI1KUhhaJs (Vasari, Dynamo adaptive louver)
https://github.com/DynamoDS/Dynamo/wiki/How-To-Create-Your-Own-Nodes (custom nodes)
Rhynamo by Nathan Miller is a class library for reading and writing Rhino files in and out of Dynamo and Revit. https://www.youtube.com/watch?v=rJVMm-d3PwE
Nate's blog for more about Dynamo and Rhino: http://www.theprovingground.org/

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://bimtroublemaker.blogspot.com/
Zach Kron - http://buildz.blogspot.com/
Nathan Miller - http://wiki.theprovingground.org/revit-api
LA RUG (Revit User Group) - http://losangelesrevitusersgroup.blogspot.com/
Jay Zallan - http://cad-vs-bim.blogspot.com/
Troy Gates - http://revitcoaster.blogspot.com/
Jon Mirtschin - http://geometrygym.blogspot.com/
Jeremy Tammik - http://thebuildingcoder.typepad.com/blog/

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

Autodesk
Glenn Katz - http://www.bimtopia.com/
http://bimcurriculum.autodesk.com/
http://students.autodesk.com/
http://www.revitcity.com/index.php
http://autodesk-revit.blogspot.com/
http://www.augi.com

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 Blackboard.

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 9 am on Mondays and turning in a printout.

> 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 orrupted (this has happened to me). Losing your files will not be an excuse for late or missing assignments.

Grading Breakdown

	Percentage of Grade	Assignments	Number of points
Homeworks	75%	Homework 1 – Introduction to BIM	20 – time consuming
		Homework 2 – Understanding Families	10
		Homework 3 – 2D / 3D Coordination	20 – difficult
		Homework 4 – Schedules and Details	10
		Homework 5 – Rendering and VR	20 – fun
		Homework 6 – Construction Sequencing and Clash Detection	10
		Homework 7 – Conceptual Modeler and Adaptive Components	20 – detailed
		Homework 8 – Introduction to Dynamo (solar)	10
		Homework 9 – Dynamo (geometry)	10
Final Project	20%	Final Project	100 – mind expanding
Participation	5%	Pop-quizzes	varies
		Questions on readings	varies
		Other	varies

Assignment Submission Policy

Assignments will usually be turned in both on Blackboard as pdfs and application specific file formats. Often you will be turning in printouts also. The are due **before the beginning** of class, 9 am. There are **no make-ups** on assignments, quizzes, or participation responses. Turn in what you have done for partial credit.

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

	Lecture	Homework	Required Readings & References **LinkedIn Learning has many teaching videos available through Blackboard.**
Week 1 Jan. 14	Introduction to Arch 507 Introduction to BIM and Revit "dumpy house" Site, contour labeling Perspective, section box, "explode" Introduce building choice		hwk1 GSG_Revit_Architecture_2015.pdf
Week 2 Jan. 21	Discuss building choice Introduction to Families Instances and types System, loadable, in-place Title block		Routledge – *Introduction* Marcello SSgambelluri Revit hardscape handout.pdf http://www.nationalbimlibrary.com/find-bim-objects https://bimsmith.com/
Week 3 Jan. 28	Creating Families Loadable Parametric Components Massing / conceptual mass What is LOD?	**HWK 1 due**	Routledge – *Chapter 1*
Week 4 Feb. 4	Understanding Families Parametric Components Symbolic lines Massing / conceptual mass Scaling a drawing Curved beam, tilted wall (both ways)	**HWK 2 due**	Routledge – *Chapter 2*
Week 5 Feb. 11	Introduction to Revit Structure Introduction to Revit Mechanical (if time)		Routledge – *Chapter 3*
Week 6 Feb. 18	BIM as a Database Schedules Annotation and Detailing	**HWK 3 due**	Routledge – *Chapter 4*
Week 7 Feb. 25	Rendering Animation	**HWK 4 due**	Routledge – *Chapter 5* http://therevitkid.blogspot.com/2020/04/how-to-use-physically-based-rendering.html (PBR materials for rendering in Revit)

Week 8 Mar. 4	Virtual Reality Game Engines		Routledge – *Chapter 6*
Week 9 Mar. 11	Construction phasing Clash detection Navisworks	**HWK 5 due**	Routledge – *Chapter 7*
Week 10 Mar. 18	**Spring Break**		

Week 11
Mar. 25
	Conceptual Modeler
	
	Adaptive Components
	    Pattern based
	    Non-pattern based
	
	Parameters
	  dist, offset, rotate, material
	  visibility, reporting
		HWK 6 due	Routledge – *Chapter 8*
			Marcello Sgambelluri mass family handout.pdf
			
			http://therevitkid.blogspot.com/2013/07/revit-tutorial-massing-and-adaptive.html

Week 12
Apr. 1
	Discuss final project requirements
	
	Introduction to visual scripting
	    Introduction to Dynamo
	    Dynamo applications
	    Packages
	
	Visual Scripting
	    DesignScript and Examples
		HWK 7 due	Routledge – *Chapter 9 and Conclusion*

Week 13 Apr. 8	Visual Scripting – attractors	**FP1 due**	**The Dynamo Reference Manual,** Marcello Sgambelluri (purchase this) Skim through the Dynamo portion. https://www.simplycomplex.org/dynamo-reference-manual
Week 14 Apr. 15	Visual Scripting DesignScript and Examples Description of final project – examples	**HWK 8 due** **FP2 due**	Dynamo Visual Programming for Design Overview.pdf Dynamo_language_guide_version_1.pdf https://www.youtube.com/watch?v=h0Sk1w7xU4Q Dynamo Primer - http://dynamoprimer.com/ Dynamo - http://dynamobim.org/ Dynamo - http://dynamobim.com/learn/ Colin McCrone's - http://dynamobim.org/wp-content/uploads/forum-assets/colin-mccroneautodesk-com/07/10/Dynamo_language_guide_version_1.pdf
Week 15 Apr. 22	Meet with students about final projects	**HWK 9 due** **Start FP3**	

Week 16 Apr. 29	**BIM in the Profession** **Conclusion**		https://www.rhino3d.com/inside Rhino to Revit Points Export Handout.pdf RhinoToRevit_MethodList_Gayathree.pdf
FINAL PRESENTATIONS **FP3 – Friday, May 6th, 8 – 10 am**			

NOTES

Download **Autodesk Revit 2022** from http://students.autodesk.com . Download the Revit content libraries. https://knowledge.autodesk.com/support/revit-products/learn-explore/caas/sfdcarticles/sfdcarticles/Where-to-find-Revit-Content-Libraries-to-download.html
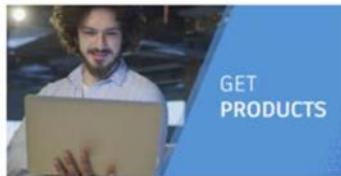
Student product download
Have your student watch the following videos from the Support page on our Autodesk Education Community website.

Get started

CREATE **ACCOUNT** AND CONFIRM **ELIGIBILITY**

Create an account and confirm eligibility
Learn how to create an Educational account and confirm eligibility.
▶ Watch video (3:08 min.)

GET PRODUCTS

Get products
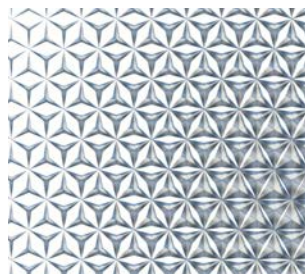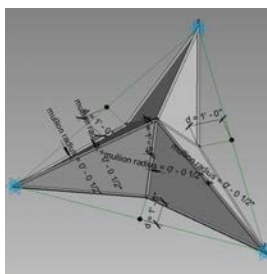Learn how to download Autodesk products.
▶ Watch video (1:13 min.)

Revit product download videos
Download Revit Product
Revit Installation Trouble Shooting

Other Hints:
We have noticed recently that a few students were not able to download Revit product because they have NOT disabled pop-up blockers in their web browser.

Parametric panel responding to the position of the sun using Dynamo (hwk 8). (Ilaria Toldo and Dennis Chow)

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

Religious Holidays

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.

Accreditation Statement

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 currently in "Candidacy Status" for accreditation by the Landscape Architecture Accreditation Board. All students can access and review the LAAB accreditation standards/process at http://www.asla.org/Education.aspx .

Other notices

The estimates for the books and printing costs for this course are approximately $100 - $150.

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

Sp22 Arch 307 syllabus.docx
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