

USC School of Architecture

PRELIMINARY

(in-progress, last updated 6/14/19)

Architecture 507: Theories of Computer Technology

Fall Semester, Units: 3

Mondays: 9 am – 11:50 am in WPH B36

Instructor: Karen Kensek

Office: Watt 309

Office Hours: send email for appointment

Contact Info: kensek@usc.edu

Class Assistants: Zhihe (Janet) Wang and Zhiyi (Nicole) Liu

Studio: MBS second year, third floor Watt Hall

Office Hours: to be announced

Contact Info: zhihewan@usc.edu; liuzhiyi@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. 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 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, Insight, and Fuzor depending on class time

Prerequisite(s): upper division standing or graduate student

Co-Requisite (s): none

Concurrent Enrollment: none

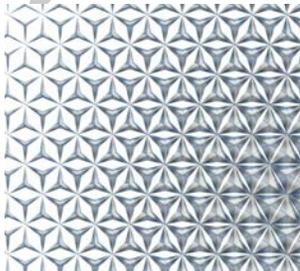
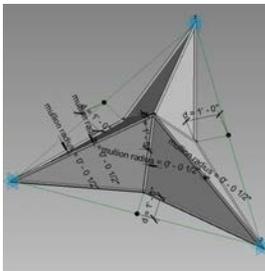
Recommended Preparation: basic understanding of 2D CAD and 3D digital modeling. Although this course is offered in the School of Architecture, the techniques taught are equally applicable to others with an interest in the applications of building information modeling. Building science majors, structural 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

Download **Autodesk Revit 2020** from <http://students.autodesk.com> . You will also be using Dynamo, Navisworks, and Enscape. More instructions will be provided on how to access them later in the semester. Contact Prakash if you have problems (sda.support@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.

A USC e-mail account is also required for this course. Go on-line and 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 .



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

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.

There are one required textbook for this course. Please buy the Routledge book at the bookstore or order it on-line immediately from the publishers or any other place (like amazon.com). The **Routledge** book is critical for understanding the professional issues of BIM. You will be reading most of this entire book.

Required



ROUTLEDGE

Technical Design Series: Building Information Modeling (Routledge 2014)

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

Karen M. Kensek, LEED AP BD+C, Assoc. AIA

Introduction

Chapter 1: BIM Overview

Parametric modeling and the virtual building model, BIM "dimensions," Level of development, Summary

Chapter 2: Stakeholders and BIM's Many Roles

Architects, engineers, consultants, Construction managers, contractors, sub-contractors, Fabricators, Facilities managers and owners, Summary

Chapter 3: Data Exchange and Interoperability

Interoperability, Data exchange workflows, Single model and federated model systems, Data and communication formats, Summary

Chapter 4: BIM Implementation

Transforming the office to BIM, Delivery methods, Legal issues, Office standards, BIM Execution Plan (BEP), Metrics for BIM maturity, Summary

Chapter 5: Beyond Basic BIM

BIM analytics, Cloud computing, Computational design, Increased sophistication of owners, Summary

Application: Project Case Studies

designLAB architects: Small BIM Tames Big Brutalism

ZGF: BIM in Transition: Making the Leap at a Large Firm

CASE: Building Information Coordinators

Mortenson Construction: Outstanding Project Success Through Collaboration

Conclusion

Required Reference Documents on Blackboard

Please download all the files in the Content section on Blackboard.
the syllabus, all the homework assignments, and the final project

Optional readings on Blackboard

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

Optional References On-Line

Dynamo – extremely useful for homeworks 8, 9, and the final project

Dynamo Primer - <http://dynamoprimer.com/>
Dynamo - <http://dynamobim.org/>
Dynamo - <http://dynamobim.com/learn/>
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=HW11KUhhaJs> (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>
Sign up to participate in the private beta: <http://content.case-inc.com/rhynamo>
Nate's blog for more about Dynamo and Rhino: <http://www.theprovingground.org/>

Interesting blogs about BIM and Revit

Phil Lazarus - <http://bimtroublemaker.blogspot.com/>
Zach Kron - <http://buildz.blogspot.com/>
Nathan Miller - <http://www.theprovingground.org/> , <http://wiki.theprovingground.org/revit-api>
LA RUG - <http://losangelesrevitusersgroup.blogspot.com/>
Marcello Sgambelluri - <http://therevitcomplex.blogspot.com/>
<http://therevitcomplex.blogspot.com/2012/07/creating-walls-that-follow-site.html>
<http://therevitkid.blogspot.com/2013/07/revit-tutorial-massing-and-adaptive.html>
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/>

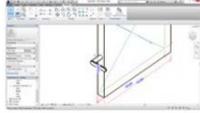
A community-driven collection of apps for the AEC industry - <https://aec-apps.com/>
Not BIM, but interesting tools - <http://andrewmarsh.com/>

Autodesk

<http://sustainabilityworkshop.autodesk.com/>
Glenn Katz - <http://www.bimtopia.com/>
<http://bimcurriculum.autodesk.com/>
<http://students.autodesk.com/>
http://resources.autodesk.com/Architecture/Revit_Architecture/Webcasts
<http://www.revitcity.com/index.php>
<http://autodesk-revit.blogspot.com/>
<http://www.augi.com>
<http://designreform.net/tag/revit-families/>

Optional Teaching Videos: Lynda (accessible from Blackboard)

<http://www.lynda.com/Revit-Architecture-2011-tutorials/essential-training/62086-2.html>



VIDEO

What is a Revit family? (3m)

From: Revit: MEP Families

- Let's get started by explaining what a **Revit family** actually is. For you AutoCAD users, it's a block that you insert into a drawing. Basically,...



COURSE

Revit: Families with Eric Wing

Covers the process of creating a family and adding parameters, 3D elements, symbolic lines, and materials.

2h 4m Intermediate Views: 139,727

[See Related Courses](#)

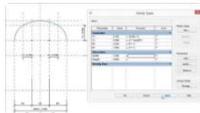


VIDEO

Understanding Revit families (3m 39s)

From: Revit Structure 2013 Essential Training

A **Revit family** is an object that has information built into it. Some will people define this as being an intelligent component, because it has...



COURSE

Revit: Family Curves and Formulas with Paul F. Aubin

Tame unruly parametric curves with the Revit Family Editor, and start controlling circles, arcs, arches, splines, and even complex curves like cyma moldings.

3h 51m Intermediate Views: 53,893

[See Related Courses](#)



COURSE

Revit: Architectural Families with Eric Wing

Improve your Revit workflow with Revit families. Learn how to model reusable features such as chair rails and baseboards, doors, cabinets, and shelving with Revit architectural families.

3h 32m Appropriate for all Views: 60,677

[See Related Courses](#)



COURSE

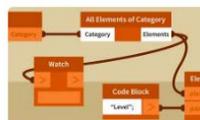
Revit: Tips, Tricks, and Troubleshooting with Paul F. Aubin

Get a new tip, trick, or troubleshooting technique for Revit 2017 every Tuesday. This weekly series offers workflow enhancements, customizations, and shortcuts for both Revit beginners and seasoned users alike.

- Place multiple elements with Dynamo (8m 4s)
- Using Dynamo to rename sheets (8m 3s)
- Using Dynamo to rename views (7m 2s)

11h 3m Appropriate for all Views: 155,999

[See Related Courses](#)



COURSE

Dynamo: Revit Workflow with Ian Siegel

Use Dynamo to apply basic visual programming concepts to architectural design in Revit. Learn how to automate everyday tasks such as numbering rooms and calculating occupant loads.

- Highlight Revit elements with Dynamo (4m 14s)
- Calculate occupant loads with Dynamo (5m 12s)
- Concatenate lists of strings with Dynamo (4m 26s)

+ Show More

1h 29m Appropriate for all Views: 23,493

[See Related Courses](#)



COURSE

Dynamo Essential Training with Ian Siegel

Learn how to use Autodesk Dynamo with Revit. Generate algorithms to analyze data, read and edit data from outside sources, create geometry in Dynamo itself, or edit the geometry in Revit files.

- What is Dynamo? (5m 35s)
- Placing Revit families with Dynamo (7m 36s)
- Placing adaptive components with Dynamo (3m 29s)

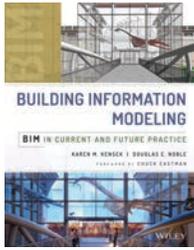
+ Show More

3h 3m Appropriate for all Views: 93,157

[See Related Courses](#)

Optional Teaching Videos: [revitcourse.com](http://www.revitcourse.com). USC has a partnership program with [revitcourse.com](http://www.revitcourse.com).

Optional Chapters about Research in BIM



Building Information Modeling: BIM in Current and Future Practice (Wiley
<http://www.wiley.com/WileyCDA/WileyTitle/productCd-111876630X.html>)

Karen M. Kensek, LEED AP BD+C, Assoc. AIA

Douglas E. Noble, PhD, FAIA

Readings from the Wiley book are optional. They are intended to give you a much broader insight into research topics in BIM.

Foreword by Chuck Eastman

Introduction

Chapter 1: Smart Buildings/Smart(er) Designers: BIM and the Creative Design Process
Glenn Goldman and Andrzej Zarzycki, New Jersey Institute of Technology

Chapter 12: Analytical BIM: BIM Fragments, Domain Gaps, and Other Impediments
Karen M. Kensek, University of Southern California

Chapter 13: One BIM to Rule Them All: Future Reality or Myth?
Brian R. Johnson, University of Washington

Chapter 14: Component-Based BIM: A Comprehensive, Detailed, Single-Model Strategy
Anton C. Harfmann, University of Cincinnati

Chapter 16: BIM, Materials, and Fabrication
Christopher Beorkrem, UNC Charlotte School of Architecture

BIM Analytics (I recommend reading ONE of these six chapters)

Chapter 5: Parametric BIM SIM: Integrating Parametric Modeling, BIM, and Simulation for Architectural Design
Wei Yan, PhD, Texas A&M University

Chapter 6: Models and Measurement: Changing Design Value with Simulation, Analysis, and Outcomes
Phillip G. Bernstein and Matt Jezyk, Autodesk

Chapter 7: Energy Modeling in Conceptual Design
Timothy Hemsath, University of Nebraska—Lincoln

Chapter 8: Performance Art: Analytics and the New Theatre of Design Practice
Daniel Davis and Nathan Miller, CASE

Chapter 10: Urban Energy Information Modeling: High Fidelity Aggregated Building Simulation for District Energy Systems
Nina Baird, Shalini Ramesh, and Khee Poh Lam, Carnegie Mellon University
Henry Johnstone, GLHN Architects & Engineers, Inc.

Chapter 11: BIM and the Predesign Process: Modeling the Unknown
Michael Donn, Centre for Building Performance Research, Victoria University of Wellington

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 turning in printouts and uploading files on Blackboard.

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.

Grading Breakdown

	Percentage of Grade	Assignments	Number of points
Homeworks	75%	Homework 1 – Introduction to BIM	20 – time consuming
		Homework 2 – Understanding Families	20 – detailed
		Homework 3 – 2D / 3D Coordination	20 – difficult
		Homework 4 – Schedules and Details	10
		Homework 5 – Construction Sequencing and Clash Detection	10
		Homework 6 – Rendering and VR	10
		Homework 7 – Conceptual Modeler and Adaptive Components	10
		Homework 8 – Introduction to Dynamo (solar)	10
		Homework 9 – Dynamo (geometry)	20 – time consuming
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 and as print-outs. They are due **before the beginning** of class. There are **no make-ups** on assignments, quizzes, or participation responses.

Course Schedule: A Weekly Breakdown: *readings are due at the beginning of the week*

	Lecture	Homework	Required Readings & References
Week 1 Aug. 26	Introduction to Arch 507 Introduction to BIM and Revit “dumpy house” Title block, Site Perspective, section box, “explode”		Routledge – <i>Introduction</i>
Week 2 Sept. 2	Labor Day Holiday		
Week 3 Sept. 9	Introduction to Families Instances and types System, loadable, in-place Explain visitor centers <i>see homework 2</i>	HWK 1 due	Routledge – <i>Chapter 1</i> hwk1 GSG_Revit_Architecture_2015.pdf Marcello Jan. 18Sgambelluri Revit hardscape handout.pdf
Week 4 Sept. 16	Creating Families Loadable Parametric Components Massing What is LOD? <i>see homework 2</i>		Routledge – <i>Chapter 2</i>
Week 5 Sept. 23	Understanding Families Parametric Components Massing / conceptual mass Scaling a drawing Copy/Paste to Level Linked files demo	HWK 2 due	Routledge – <i>Chapter 3</i>
Week 6 Sept. 30	Introduction to Revit Structure		Routledge – <i>Chapter 4</i>
Week 7 Oct. 7	BIM as a Database Schedules Annotation and Detailing Rhino to Revit techniques? <i>see homework 4</i>	HWK 3 due	Routledge – <i>Chapter 5</i>
Week 8 Oct. 14	Construction phasing and animation Clash detection Navisworks	HWK 4 due	Routledge – <i>Chapter 6</i>
Week 9 Oct. 21	Rendering Animation Virtual Reality <i>see homework 6</i>	HWK 5 due	Routledge – <i>Chapter 7</i> Lynda.com (optional) (login from Blackboard on the left side of the screen); search on "Revit rendering" 3. Materials – about an hour 5. Lighting – about 20 minutes 6. Rendering – about an hour 7. Cloud Rendering – about 15 minutes 8. Walkthroughs – about 30 minutes

Week 10 Oct. 28	Conceptual Modeler Parametric Pattern Based Curtain Walls Parametric Adaptive Components	HWK 6 due	Routledge – <i>Chapter 8</i>
Week 11 Nov. 4	Visual Scripting – attractors	HWK 7 due	Routledge – <i>Chapter 9</i> Marcello Sgambelluri mass family handout.pdf http://therevitkid.blogspot.com/2013/07/revit-tutorial-massing-and-adaptive.html
Week 12 Nov. 11	<i>BIM in the Profession</i>	HWK 8 due	Routledge – <i>Conclusion</i> Dynamo Visual Programming for Design Overview.pdf 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 13 Nov. 18	Visual Scripting – DesignScript and Lists Other sample scripts Description of final project – examples <i>Dynamo Applications in AEC; discuss previous semesters' examples</i>		Dynamo_language_guide_version_1.pdf https://www.youtube.com/watch?v=h0Sk1w7xU4Q
Week 14 Nov. 25	<i>BIM in the Profession</i>	HWK 9 due	Marcello Sgambelluri handout
Week 15 Dec. 2	Rhino to Revit Conclusion <i>Best of BIM and Future BIM</i>		
FINAL PRESENTATIONS, Monday, December 16, 11 am – 1 pm			

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

In Spring 2019, the students estimated that this course cost them about \$20 - \$120 for printing assignments and buying the textbook.