

# USC School of Architecture

## PRELIMINARY

(in-progress, last updated 12/2/2020)

### Architecture 507: Theories of Computer Technology

**Spring Semester, Units: 3**

**Fridays:** 9 am – 11:50 am ONLINE (see Blackboard links)

**Instructor:** Karen Kensek

**Office:** Watt 309 – but will be doing office hours and additional scheduled hours through Zoom

**Office Hours:** send email for appointment; happy to talk with you!

**Contact Info:** [kensek@usc.edu](mailto:kensek@usc.edu)

**Class Assistant:** to be announced

**Office Hours:** to be announced; additional hours available by email

**Contact Info:** to be announced

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*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). 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

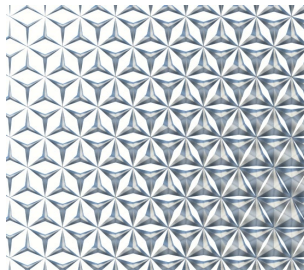
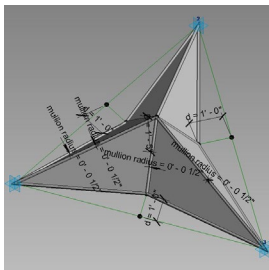
**Recommended Preparation:** basic understanding of 2D CAD and 3D digital modeling. Although this course is offered in the School of Architecture, the techniques taught are equally applicable to others with an interest in the applications of building information modeling. Building science majors, structural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

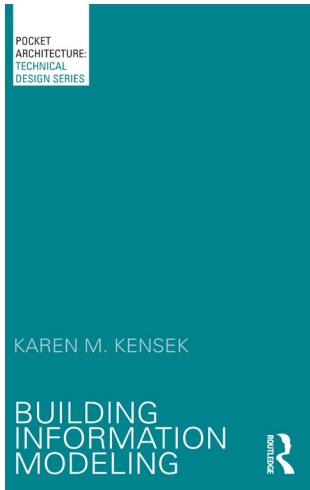
Download **Autodesk Revit 2021** from <http://students.autodesk.com>. You will also be using Dynamo, Navisworks, and Enscape. Dynamo is part of Revit; Navisworks can be downloaded from Autodesk; and you can get a free educational version of Enscape (it works with both Rhino and Revit). Contact Dipak if you have problems ([dshirke@usc.edu](mailto: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. <https://itservices.usc.edu/vdi/>



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. Books may be 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

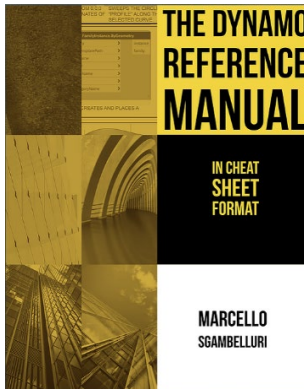
Chapter 3: Data Exchange and Interoperability

Chapter 4: BIM Implementation

Chapter 5: Beyond Basic BIM

Application: Project Case Studies

Conclusion



### Required – buy before April 2, 2020

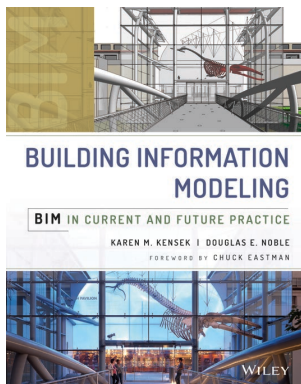
#### The Dynamo Reference Manual

Marcello Scambelluri

<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 (NBIMS v1\_p1.pdf)  
*AEbytes -Got Macros.pdf* (on Blackboard)

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

#### LinkedIn Learning, formerly Lynda.com

Accessible 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](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](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 Fridays.**

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            |
|----------------------|---------------------|--|-----------------------------|
| <b>Homeworks</b>     | 75%                 | Homework 1 – Introduction to BIM                         | 20 – <b>time consuming</b>  |
|                      |                     | Homework 2 – Understanding Families                      | 10                          |
|                      |                     | Homework 3 – 2D / 3D Coordination                        | 20 – <b>difficult</b>       |
|                      |                     | 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  | 20 – <b>detailed</b>        |
|                      |                     | Homework 8 – Introduction to Dynamo (solar)              | 10                          |
|                      |                     | Homework 9 – Dynamo (geometry)                           | 10                          |
| <b>Final Project</b> | 20%                 | Final Project  | 100 – <b>mind expanding</b> |
| <b>Participation</b> | 5%                  | Pop-quizzes  | varies                      |
|                      |                     | Questions on readings                                    | varies                      |
|                      |                     | Other  | varies                      |

## Assignment Submission Policy

Assignments will usually be turned in both on Blackboard as print-outs and application specific file formats. They are due **before the beginning** of class, 9 am. There are **no make-ups** on assignments, quizzes, or participation responses.

**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.  |
| <b>Week 1</b><br>Jan. 15  | Introduction to Arch 507<br>Introduction to BIM and Revit<br>“dumpy house”<br>Site, contour labeling<br>Perspective, section box, “explode”<br>Introduce building choice |                  | hwk1 GSG_Revit_Architecture_2015.pdf  |
| <b>Week 2</b><br>Jan. 22  | Discuss building choice<br><br>Introduction to Families<br>Instances and types<br>System, loadable, in-place<br>Title block  |                  | Routledge – <i>Introduction</i><br>Marcello Jan. 18Sgambelluri Revit<br>hardscape handout.pdf   |
| <b>Week 3</b><br>Jan. 29  | Creating Families<br>Loadable Parametric Components<br>Massing / conceptual mass<br>What is LOD?   | <b>HWK 1 due</b> | Routledge – <i>Chapter 1</i>  |
| <b>Week 4</b><br>Feb. 5   | Understanding Families<br>Parametric Components<br>Symbolic lines<br><br>Massing / conceptual mass<br>Scaling a drawing<br>Curved beam, tilted wall (both ways)          | <b>HWK 2 due</b> | Routledge – <i>Chapter 2</i>  |
| <b>Week 5</b><br>Feb. 12  | Introduction to Revit Structure<br>Introduction to Revit Mechanical  |                  | Routledge – <i>Chapter 3</i>  |
| <b>Week 6</b><br>Feb. 19  | BIM as a Database<br>Schedules<br>Annotation and Detailing   | <b>HWK 3 due</b> | Routledge – <i>Chapter 4</i><br><br><b>Last day of class for Arch 517</b>   |
| <b>Week 7</b><br>Feb. 26  | Construction phasing<br>Clash detection<br>Navisworks  | <b>HWK 4 due</b> | Routledge – <i>Chapter 5</i>  |
| <b>Week 8</b><br>Mar. 5   | Rendering<br>Animation<br>Virtual Reality<br>Game Engines  | <b>HWK 5 due</b> | Routledge – <i>Chapter 6</i>  |
| <b>Week 9</b><br>Mar. 12  | <b>WELLNESS DAY</b>  |                  | Routledge – <i>Chapter 7</i>  |
| <b>Week 10</b><br>Mar. 19 | Conceptual Modeler<br>Adaptive Components<br>Pattern based<br>Non-pattern based  | <b>HWK 6 due</b> | Routledge – <i>Chapter 8</i><br>MS mass family handout.pdf<br><br><a href="http://therevitkid.blogspot.com/2013/07/revit-tutorial-massing-and-adaptive.html">http://therevitkid.blogspot.com/2013/07/revit-tutorial-massing-and-adaptive.html</a> |

|   |   |  |   |
|---|---|--|---|
| <b>Week 11</b><br>Mar. 26   | Adaptive Components Parameters<br>dist, offset, rotate, material, visibility<br><br>Introduction to visual scripting<br>Introduction to Dynamo<br>Dynamo applications<br>Packages |  | Routledge – <i>Chapter 9</i>  |
| <b>Week 12</b><br>Apr. 2  | Visual Scripting – attractors   | <b>HWK 7 due</b><br><b>FP1 due</b>                         | <b>The Dynamo Reference Manual</b> , Marcello Sgambelluri (purchase this)<br><br><a href="https://www.simplycomplex.org/dynamo-reference-manual">https://www.simplycomplex.org/dynamo-reference-manual</a>  |
| <b>Week 13</b><br>Apr. 9  | Visual Scripting<br>DesignScript and Examples<br><br>Description of final project – examples  | <b>HWK 8 due</b>   | Dynamo Visual Programming for Design Overview.pdf<br><br>Dynamo_language_guide_version_1.pdf<br><br><a href="https://www.youtube.com/watch?v=h0Sk1w7xU4Q">https://www.youtube.com/watch?v=h0Sk1w7xU4Q</a><br><br>Dynamo Primer - <a href="http://dynamoprimer.com/">http://dynamoprimer.com/</a><br>Dynamo - <a href="http://dynamobim.org/">http://dynamobim.org/</a><br>Dynamo - <a href="http://dynamobim.com/learn/">http://dynamobim.com/learn/</a><br>Colin McCrone's - <a href="http://dynamobim.org/wp-content/uploads/forum-assets/colin-mccroneautodesk-com/07/10/Dynamo_language_guide_version_1.pdf">http://dynamobim.org/wp-content/uploads/forum-assets/colin-mccroneautodesk-com/07/10/Dynamo_language_guide_version_1.pdf</a> |
| <b>Week 14</b><br>Apr. 16   | <b>BIM in the Profession</b>  | <b>HWK 9 due</b><br><b>FP2 due</b><br><br><b>Start FP3</b> | <a href="https://www.rhino3d.com/inside">https://www.rhino3d.com/inside</a><br><br>Rhino to Revit Points Export Handout.pdf<br>RhinoToRevit_MethodList_Gayathree.pdf  |
| <b>Week 15</b><br>Apr. 23   | <b>BIM in the Profession</b><br><br><b>Conclusion</b>   | <b>Work on final project!</b>                              | Routledge – <i>Conclusion</i>   |
| <b>Week 16</b><br>Apr. 30   | <b>WELLNESS DAY</b>   |  |   |
| <b>FINAL PRESENTATIONS</b><br><b>FP3 – Friday, May 7<sup>th</sup>, 8 am – 10 am</b> |   |  |   |

## 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](mailto: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](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). (George Yang)*