USC School
of Architecture

Architecture 507: Theories of Computer Technology
(in-progress, last updated 1/6/15)
Spring Semester, Units: 3
Friday: 9 am – noon in WPH B36

Instructor: Karen Kensek
Office: Watt 307
Office Hours: send email for appointment
Contact Info: kensek@usc.edu (preferred); 213-740-2081 (office)

Teaching Assistant: Geoffrey Becker
Office: MBS studio – third floor, Watt Hall, south-east corner
Office Hours: to be arranged
Contact Info: gbecker@usc.edu

Teaching Assistant: Yi Deng
For Dynamo part of the class only
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IT Help: Enrique Barajas, School of Architecture
Contact Info: ebarajas@usc.edu; 213-740-3602

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 on Fridayss from 9 am – noon. 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). BIM is a critical topic in the architecture profession. Learn what it is, how to apply it, innovative uses, and how it relates to sustainable design issues and the AEC industry in general. This course also relies heavily on the knowledge already in the profession: guest speakers will be used to enrich the class content with up-to-date information. It is important that you attend class on-time! In addition to many hands-on computer sessions by the instructor, there will also be guest lecturers from both the profession and the software industry. They have spent considerable time and effort to come talk with the class. Listen, be attentive, and ask appropriate questions. They are valuable resources.

This course is applicable to upper division undergraduate students and graduate students who have a strong background in traditional CAD and three-dimensional modeling. The course applies to the MBS graduate certificate if you are a graduate student. The primary software used will be Revit Architecture and Dynamo. Other programs such as Green Building Studio, Vasari, and Navisworks may also be used.
Because of the rapid advancements expected in the technological underpinnings of the course, every effort is made to provide instruction that adjusts to current conditions and is generic to computer hardware and software platforms. Although 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. It is assumed that students have a basic understanding of 2D CAD and 3D digital modeling. Please contact the instructor if you have questions.

Prerequisite(s): upper division standing or graduate student
Co-Requisite (s): none
**Concurrent Enrollment:** none
Recommended Preparation: ability to create a 3D virtual building

Course Notes

Please note that you are required to attend all the lectures and labs and show up on time.

Technological Proficiency and Hardware/Software Required

Download Autodesk Revit from http://students.autodesk.com . You will also be using Dynamo. More instructions will be provided on how to access that later in the semester. Contact Enrique if you have problems (ebarajas@usc.edu). Autodesk Revit 2015 is available on computers in the University labs or in the School of Architecture. These programs only run under Windows and are free for student use.

http://dynamobim.org/
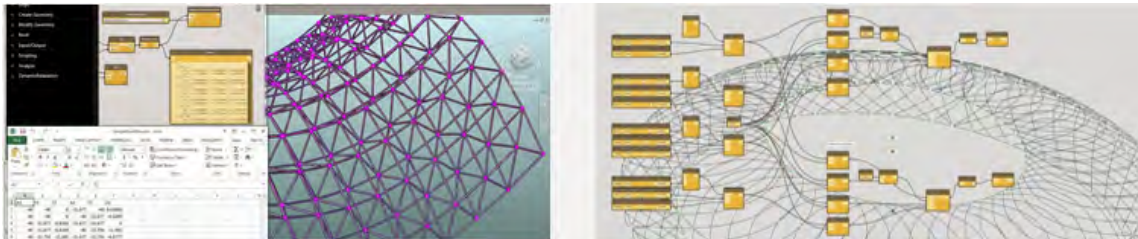
Required Readings and Supplementary Materials
Specific due dates for the readings are listed on the syllabus. You are required to have read the material **before** class. There may be in-class quizzes on the readings. There will be other readings posted on Blackboard or put on reserve in the AFA library as necessary.

There are two required textbooks for this course. Please order them on-line immediately from the publishers or any other place (like amazon.com). The **Routledge** book is critical. You will be reading most of this entire book. For the **Wiley** book, you will be reading selected chapters. If you cannot afford the Wiley book by yourself, get together with a friend and buy one to share.

Required
> *AECbytes -Got Macros.pdf* (on Blackboard)

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
OPTIONAL
> 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
Read the subsection on *Computational design* - pages 172 – 183 only
> BIM analytics, Cloud computing, **Computational design**, Increased sophistication of owners, Summary

Application: Project Case Studies (read ONE of the four case studies)
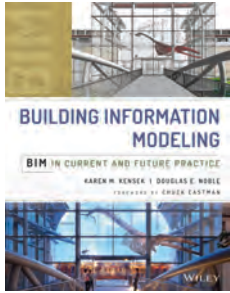> designLAB architects: Small BIM Tames Big Brutalism
> ZGF: BIM in Transition: Making the Leap at a Large Firm
> CASE: Building Information Coordinators
> Mortenson Construction: Outstanding Project Success Through Collaboration

Conclusion

Required

WILEY
Building Information Modeling: BIM in Current and Future Practice (Wiley 2014)
http://www.wiley.com/WileyCDA/WileyTitle/productCd-111876630X.html
Karen M. Kensek, LEED AP BD+C, Assoc. AIA
Douglas E. Noble, PhD, FAIA

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 (read 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

Optional readings on Blackboard

Mimic a Master Builder: A Tribute to Felix Candela, Alfredo Medina, pp. 10-15 (thin shell concrete forms) thin shell concrete forms AW201205lr.pdf

aiab095712 - AIA BIM contract documents.pdf

National Building Information Modeling Standard (NBIMSv1_p1.pdf)

Reference Documents

PDF and Zip files for Software References on Blackboard

Please download all the files in the Content section on Blackboard.

Revit Architecture 2010-11.zip
Marcello Sgambelluri mass family handout.pdf
Marcello Sgambelluri Revit hardscape handout.pdf
adaptive components - misc.zip
Revit 2010 conceptual modeler.pdf
Navis - students.zip
thin shell concrete forms AW201205lr.pdf
NBIMSv1_p1.pdf
aiab095712 - AIA BIM contract documents.pdf
dumpy house.zip
Troy Peters - Revit scripts.zip
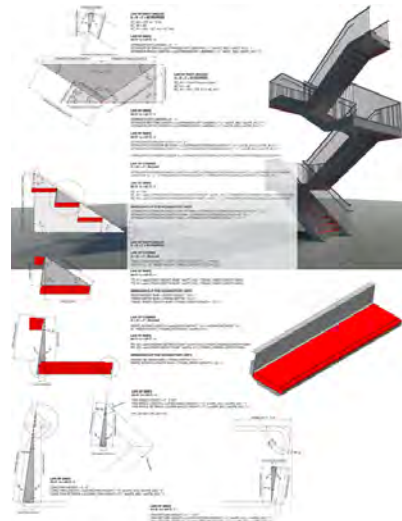the syllabus, all the homework assignments, and the final project

These references have LOTS of information for Revit. I find that the Table of Contents and Search are especially useful for finding what I am looking for.

revit_architecture-2011-user-guide-en.pdf
Revit 2010 FamiliesGuideArchitectureImpENU.pdf
http://wikihelp.autodesk.com/Revit/enu/2013

Marcello Sgambelluri, Revit parametric elephant

http://buildz.blogspot.com/2010/04/elephant-in-room.html

Fuzzy Math session at AU, parametric stair

http://jasongrant.squarespace.com/

On-Line Reference Documents

Interesting blogs that also link to other interesting blogs
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/
Tim Meador – Hummingbird - http://ghhummingbird.wordpress.com/author/meadort/
Dynamo - http://dynamobim.org/

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

Lynda (accessible from Blackboard)
http://www.lynda.com/Revit-Architecture-2011-tutorials/essential-training/62086-2.html

Autodesk
http://sustainabilityworkshop.autodesk.com/
http://sustainabilityworkshop.autodesk.com/design-strategies/net-zero-energy-buildings
http://sustainabilityworkshop.autodesk.com/software-tutorials
Glenn Katz - http://www.bimtopia.com/
http://bimcurriculum.autodesk.com/
http://wikihelp.autodesk.com/Revit/enu/2013
http://autodeskvasari.com/forum
http://students.autodesk.com/
http://resources.autodesk.com/Architecture/Revit_Architecture/Webcasts
http://seek.autodesk.com
http://wikihelp.autodesk.com/Revit/enu/2013/Help/00005-More_Inf0/0352-Beginner352
http://wikihelp.autodesk.com/Revit/enu/Community/Examples
http://wikihelp.autodesk.com/User:drafts/2011_Revit_Architecture_-_Video_Tutorials_1_of_3_-
     _Getting_Started_(ENU)
http://wikihelp.autodesk.com/Revit/enu/2012/Help/Revit_MEP_Beginner's_Guide

More references for Autodesk products including Revit are available at
http://www.revitcity.com/index.php
http://autodesk-revit.blogspot.com/
http://www.augi.com
http://designreform.net/tag/revit-familes/

Navisworks for Architects Screencast
http://resources.autodesk.com/Architecture/Navisworks/How_Tos
Watch this screencast and see valuable tips on how Autodesk Navisworks helps architects and designers experience enhanced control, collaboration, and information aggregation on even the most complex projects.

Other references are listed with specific assignments

Description and Assessment of Assignments

Homework assignments come out on Fridays and are usually one or two weeks in length. If an assignment is two weeks in length, it is because 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). 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. Grades will be posted on Blackboard. There is also a final project and questions on the readings in this course.

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.

> 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.

You will need at least three USB flash devices or a combination of these: Flash drive, portable hard drive, hard drive. One is for your assignment, one as a backup, and one for turning in assignments if required although usually Blackboard will be used for this. Label everything with your name and e-mail address.

Accounts
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 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 .

Grading Breakdown

	Percentage of Grade	Assignments	Number of points
Homeworks	70%	Homework 1	20
		Homework 2	10
		Homework 3	20
		Homework 4	10
		Homework 5	10
		Homework 6	10
		Homework 7	10
		Homework 8	10
Final Project	20%	Part 1	20
		Part 2	20
		Part 3	40
Participation	10%	Pop-quizzes	varies
		Questions on readings	varies
		Other	varies

Assignment Submission Policy
Assignments will be turned in both on Blackboard and as print-outs. The are due **before the beginning** of class. There are **no make-ups** on assignments, quizzes, or participation responses.

Course Schedule: A Weekly Breakdown

	Lecture	Homework	Required Readings & References
Week 1 January 16	Introduction to BIM		Routledge - *Application* – **one** of the case studies Marcello Sgambelluri Revit hardscape handout.pdf Revit Architecture 2010-11.zip hwk1 GSG_Revit_Architecture_2010.pdf
Week 2 January 23	Understanding Families		Routledge – *Introduction* and *Chapter* 1
Week 3 January 30	Creating Parametric Components	**HWK 1 due**	Routledge – *Chapter* 2
Week 4 February 6	Advanced Parametric Components	**HWK 2 due**	
Week 5 February 13	Conceptual Masses		Routledge – *Chapter* 3
Week 6 February 20	BIM as a Database, Interoperability	**HWK 3 due**	
Week 7 February 27	Rendering and Animation	**HWK 4 due**	Routledge – *Chapter* 5 **(read the subsection on** *Computational design***)** and *Conclusion*
Week 8 March 6	Conceptual Modeler and Parametric Pattern Based Curtain Walls	**HWK 5 due**	Wiley – *Forward* and *Chapter* 12 Revit Architecture 2010 conceptual modeler.pdf Marcello Sgambelluri mass family handout.pdf
Week 9 March 13	Introduction to Parametric Adaptive Components	**HWK 6 due**	Wiley – *Chapter* 13 and *Chapter* 14
Week 10, March 20, **Spring Break**			
Week 11 March 27	Introduction to Visual Scripting	**HWK 7 due**	Wiley – *BIM Analytics* (read **one** of the following chapters: 5, 6, 7, 8, 10, 11)
Week 12 April 3	Visual Scripting - attractors	**HWK 8 due**	http://bimcurriculum.autodesk.com/unit/unit-8-computational-design (especially 8.3.1 about attractors) http://autodesk.typepad.com/bpa/2013/08/more-fun-with-dynamo-for-bpa-automatic-shading-design.html
Week 13 April 10	Visual Scripting – solar control	**FP, part 1 due**	Wiley – *Chapter* 16 See final project handout
Week 14 April 17	BIM Customization		Wiley – *Chapter* 1 *AECbytes -Got Macros.pdf*
Week 15 April 24	BIM in the Profession	**FP, part 2 due**	**Optional:** Routledge – *Chapter* 4
Week 16 May 1	Course Synthesis		**Optional:** aiab095712 - AIA BIM contract documents.pdf National Building Information Modeling Standard (NBIMSv1_p1.pdf)
FINAL, May 8, 8 – 10 am, **Final Project, part 3 due**			

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 Section 11, *Behavior Violating University Standards*https://scampus.usc.edu/1100-behavior-violating-university-standards-and-appropriate-sanctions/. 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/.

Discrimination, sexual assault, and harassment are not tolerated by the university. You are encouraged to report any incidents to the *Office of Equity and Diversity* http://equity.usc.edu/ or to the *Department of Public Safety* http://capsnet.usc.edu/department/department-public-safety/online-forms/contact-us. This is important for the safety whole USC community. Another member of the university community – such as a friend, classmate, advisor, or faculty member – can help initiate the report, or can initiate the report on behalf of another person. *The Center for Women and Men* http://www.usc.edu/student-affairs/cwm/ provides 24/7 confidential support, and the sexual assault resource center webpage sarc@usc.edu describes reporting options and other resources.

Support Systems

A number of USC's schools provide support for students who need help with scholarly writing. Check with your advisor or program staff to find out more. Students whose primary language is not English should check with the *American Language Institute* http://dornsife.usc.edu/ali, which sponsors courses and workshops specifically for international graduate students. *The Office of Disability Services and Programs* http://sait.usc.edu/academicsupport/centerprograms/dsp/home_index.htmlprovides certification for students with disabilities and helps arrange the relevant accommodations. If an officially declared emergency makes travel to campus infeasible, *USC Emergency Information http://emergency.usc.edu/*will provide safety and other updates, including ways in which instruction will be continued by means of blackboard, teleconferencing, and other technology.

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 .