ARC 327R/386M Energy Modeling & the Design Process
University of Texas at Austin
School of Architecture
Fall 2018

Syllabus

Lecture: M 7:00-10:00 pm Sut 2.110
Unique #: 00759 , 00989
Course Website: http://energymodeldesignprocess.wordpress.com/

Contact:
Instructor: Dason Whitsett
Office: t.b.d.
Office hours: Monday 5:00-6:00
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Description:

This course explores how energy simulation can support the design of comfortable low-carbon, high-performance buildings. Students will learn to set comfort and energy use goals and use simulation to parametrically evaluate the impacts of various design strategies on the targeted performance. EnergyPlus and OpenStudio are the primary software tools used, but students will leave the course with a solid foundation in the broad principles that apply to any simulation tool. In addition, the course looks at how simulation tools have been used historically and what possibilities exist for the future. Readings are diverse, spanning from technical topics to phenomenology.

For the major project of the semester, students design a remodel of an existing building to Passive House standards in a multi-stage parametric analysis process. Hybrid strategies- those which leverage passive means and user engagement in combination with active systems- will be the focus of these investigations. Energy performance of the final design will be compared to benchmarks and the Architecture 2030 targets.

On the final project, students reverse this process- conceiving of a thermal experience and apply knowledge of building performance principles to the design of a building to create that experience with minimal energy expenditure.

Learning Objectives:

1. Develop familiarity with principles and tools of parametric energy simulation.

2. Critically evaluate the role and reliability of simulation in the design process.

3. Begin to use quantitative simulation data to evaluate qualitative design goals

Prerequisites:
Previous energy simulation experience is not necessary, but basic knowledge of building energy performance is. Prerequisites would be satisfied by any of the following: Environmental Controls II, Solar Geometry and Energy Flow in Buildings, or consent of the instructor. Engineering students generally have appropriate background experience.

Format:
This will be a seminar-style class with a considerable portion of time devoted to class discussion and presentation by students. Because of the nature of the course, there is a significant opportunity for learning from the findings of other students. A high degree of class participation will be expected of students.

Texts & Tools:
Required Books
Heschong, Lisa. 1979. *Thermal Delight in Architecture*. Cambridge, Mass: MIT Press.

Pallasmaa, Juhani. 2012. *The Eyes of the Skin: Architecture and the Senses*. Chichester: Wiley-Academy.

Additional readings will be posted on Box and assigned from the software documentation materials. Readings will be assigned on the course website, so check in there regularly for updates.

Required Software
All of the following software is available for free download at the links provided. You should download and install the software *in the order* it is listed below. All in Mac or PC version according to preference except as noted otherwise.

Install in this Order

1. SketchUp 2017. Either Sketchup Make or Sketchup Pro will work.
http://www.sketchup.com/download/all

2. OpenStudio v2.60- Create a username and password to log in.
https://www.openstudio.net

Recommended Software
Text Editor for PC: Notepad ++ https://notepad-plus-plus.org/

with the EnergyPlus syntax highlighting tool available at:
http://energyplus.helpserve.com/Knowledgebase/List/Index/44/utilities

Text Editor for Mac: Text Wrangler
https://itunes.apple.com/us/app/textwrangler/id404010395?mt=12

Box desktop application- UT cloud storage solution.

Optional Software

Euclid 0.9.3-
http://bigladdersoftware.com/projects/euclid/

EnergyPlus 8.7- Create a username and password to log in.
https://energyplus.net/downloads

If newer versions of software are released during the course of the semester, do not upgrade unless we agree as a class to do so. Be careful not to follow the prompts that the programs will give you. Once you have multiple versions, it becomes more complicated to ensure you are using the correct one, and you generally can't save back to earlier versions.

Computer System Requirements
You *may* need access to a Windows PC for portions of this course- the computers in the computer lab will work for this need if you are a Mac user, but it is more convenient to have your own. All of the software we will be using is available for Mac, and I will be running OpenStudio mainly on my Mac. Howerver, the Mac OS version of EnergyPlus lacks a tool that we may use in the latter part of the semester. Using a Mac in Bootcamp mode or with an emulator such as Parallels generally works well. Some students have found emulators to be finicky, so I recommend Bootcamp. Parallels and Windows are available to students at reduced cost from the Campus Computer Store. Support for operating system issues is available from the IT desk in the FAC.

Web Resources:
The course website at http://energymodeldesignprocess.wordpress.com/ will be an important interface point. It will detail assignments, provide important links, tips, reminders, etc. Students should click on the "follow" at the bottom of the left bar to be sure to receive important updates. This is how the instructor will notify the class of new information.

The course will also make extensive use of Box as a repository for files for download and for students to upload assignments to. The instructor will create a shared folder for distributing materials to the class and a shared folder with each individual student for handing in assignments digitally. You need to have your box account associated with your EID for this to work properly.

Assignments:
Introductory Exercises

Students will complete several introductory simulation assignments to get familiar with the fundamentals of simulation software.

Case Study
Groups of students will be asked to develop a case study critically evaluating the use of simulation in a built project. Each group will present their findings to the class.

Simulation Project 1: Parametric Building Performance Optimization
Students will select an existing building to perform a series of simulation analyses upon. Each student will simulate the baseline energy performance of the structure, parametrically consider various energy conserving measures (ECMs), to compare the simulated energy performance of the structure to measured data where available and to achieve a level of performance meeting the Passive House standard.

Simulation Project 2: Simulation as a Design Tool
Having developed basic skills at applying simulation, students will establish a set of thermal, energy, light and other performance criteria for a space or built element and use simulation in combination with their knowledge of passive design principles to propose a design that fulfills those criteria as closely as possible.

Final Paper
This short paper will be the student's opportunity to demonstrate the ability to translate from quantitative data to the qualitative experience. Each student will write a narrative in the style of Italo Calvino's *Invisible Cities* describing what it is like to experience the space designed in Project 2. An appendix will provide quantitative backup for description in the narrative.

Writing and Communication Skills
Developing the ability to effectively communicate your ideas is essential to success in any field today. As our world becomes more mobile and digitally connected, more and more information is transmitted via graphics and the written word. The quality of your communication will affect your grades.

If you need help with writing, please avail yourself of the services available at the UT Learning Center in Jester Center. For more information on their services see: http://registrar.utexas.edu/catalogs/gi09-10/ch05/

Presentations:
Students will present their work to the class on several occasions during the semester. Presentations serve two main functions in the course. First, there is significant opportunity for learning from the findings and experience of other students. Second, it is essential to develop the skill to communicate what you have found to others. The best analysis in the world is useless if you cannot convey the findings effectively to others involved in the project. Collaboration is the future of (sustainable) design, which means that effective communication skills are more essential than ever.

Attendance:
Attendance is mandatory and will bear upon the class participation grade. The course will be fast-paced and catching up once behind will be difficult. Please notify the instructor in advance of necessary absences or if you are sick. Students with three or more unexcused absences will be dropped from the course without notice.

A student who is absent from a class for the observance of a religious holy day may complete the work issued within a reasonable time after the absence if proper notice has been given. The deadline for notification of such an absence is fourteen days prior to the class absence or the first class day for religious holy days that fall within the first two weeks of the semester.

Late Work:
All work is due on the day assigned. Grades will be reduced one half-letter grade for each day an assignment is late. Get your work done on time! It makes everyone's life much better and you will learn more. Catching up is difficult once behind.

Grading Scale:

A	Exceptional work
A-	Work goes well beyond minimum of assignment in effort and insight
B+	Work demonstrates particularly solid reasoning and good effort
B	Good work
B-	Assignment completed with minor problems
C	Assignment completed, but with problems
D	Assignment incomplete and/or has significant problems
F	Unacceptable work

No incompletes will be given without full documentation of extenuating circumstances as covered by University policy.

Grade Weighting:

Class participation	15
Introductory Exercises	10
Case Study	15
Project 1	25
Project 2	25
Final Paper	10
Total	100%

Course Outline- Energy Modeling & the Design Process- Fall 2017

Week			Abbrev	Class	Meet In:	Assignment Due	Gen Reading Due	OS Training	Training Link
1	9/3	1.1		Labor Day- No Class					
2	9/10	1.1	g.01	Class Introduction					
		1.2	a.01	Software Introduction, [Ex A Skills]		Software Installed		Follow link: Installatiion Instructions and Workflow Overview.	http://nrel.github.io/OpenStudio-user-documentation/getting_started/getting_started/#installation-instructions
3	9/17	2.1	g.02	Simulation Software Background		Exercise A	Wk 2 readings		
		2.2	a.02	OS Intro- Concepts: Space, Story, Zone		Case Study topic selected		Follow link: Introductory Tutorial: "Selecting Template", "Skp Plugin- Buiding Envelope", "Skp Plugin- Space Types and Thermal Zones"	"
		2.3	a.03	Scripts, Building Form & Envelope, [Ex B1 Skills]				Follow link: Remaining videos on page.	"
4	9/24	3.1					Wk 3 readings	On Box: _OpenStudio Interface Quickstart.pdf through "SketchUp — User Scripts".	
		3.2	a.04	Measures, HVAC Intro, [Ex B2 Skills]		Exercise B1		On Box: _OpenStudio Interface Quickstart.pdf through "BCL Account Page bcl.nrel.gov".	
		3.3	a.05	Parametric Analysis, [Ex B3 Skills]		Exercise B2		On Box: _PAT-Quick_Start_Guide.pdf through "View Locally Run Results"	Constructions — Materials
5	10/1	4.1	th.01	Framing Experience & Sustainability			Wk 4 readings		
		4.2	a.06	Buiding Geometry, Definitions, [Ex C Skills]		Exercise C		Follow link and Practice Sketchup if you are not already familiar with the interface.	http://nrel.github.io/OpenStudio-user-documentation/reference/sketchup_plugin_interface/
		4.3	p.01	<u>Case Study Presentations</u>		Case Study			
6	10/8	5.1	th.02	Performative Design- Perspectives			Wk 5 readings		
		5.2	g.04	t.b.d.		Exercise B3		Follow link: "Envelope" and "Constructions" sections on left menu.	http://nrel.github.io/OpenStudio-user-documentation/tutorials/creating_your_model/
		5.3	b.01	Energy Benchmarking, PH, Envelope, Geometry Creation				On Box: _OpenStudio Interface Quickstart.pdf through "Constructions- Materials".	
7	10/15	6.1	w.01	*Project I Meetings*		P1 Proposal	Wk 6 readings	On Box: _OpenStudio Interface Quickstart.pdf through "Thermal Zones".	
		6.2	b.02	Envelope- Fenestration, Shading, Window Shades				Follow Link: all	http://nrel.github.io/OpenStudio-user-documentation/tutorials/tutorial_shadingcontrols/
		6.3	w.02	*Working Session- Project I. 9:30-noon*				Follow Link: :"OpenStudio Application", "Site", "Downloading Components…", "Using Facility Tab", "Spaces", and "Thermal Zones" sections on left menu.	http://nrel.github.io/OpenStudio-user-documentation/tutorials/creating_your_model/
8	10/22	7.1	g.05	Guest Presentation			Wk 7 readings		
		7.2	w.03	*Working Session- Project I. 9:30-noon*		P1a Code Baseline			
		7.3	b.03	Schedules and Loads		P1b Envelope Modifications		Follow Link: : "Schedules" and "Internal Loads" sections on left menu.	"
9	10/29	8.1	th.03	Performative Design- Possibilities			Wk 8 readings		
		8.2	b.04	Lighting and Daylighting		P1b Envelope Modifications		On Box: _OpenStudio Interface Quickstart.pdf through "Constructions- Materials".	
		8.3	b.05	Daylighting		P1c Schedules & Internal Loads		Follow Link: all	http://nrel.github.io/OpenStudio-user-documentation/tutorials/creating_your_model/
10	11/5	10.1	w.04	*Working Session- Project I. time t.b.d.*			Wk 9 readings		
		10.2	b.06	Ventilation/Infiltration		P1d Daylighting			
		10.3	b.07	HVAC				On Box: _OpenStudio Interface Quickstart.pdf through "HVAC — Edit Variable Refrigerant Flow (VRF)".	
11	11/12	11.1	w.05	*Working Session- Project I. time t.b.d.*		P1e Ventilation	Wk 10 readings		

		11.2	b.08	HVAC			
		11.3	c.01	Generators & Renewables	P1f HVAC		
12	11/19	12.1	th.04	Performative Design- The Eye		Wk 11 readings	
		12.2	p.02	<u>Project 1 Presentations</u>			
		12.3	p.03	<u>Project 1 Presentations</u>	P1 Report		
13	11/26	13.1	th.05	Performative Design- The Body		Wk 12 readings	
		13.2	c.02	Advanced Topics- Algorithms and PCM			
		13.3	c.03	Advanced Topics			
14	12/3	15.1	th.06	Performative Design- Reality Check (Waltz & POE reports)		Wk 13 readings	Site/Source Energy, Reports
		15.2	w.07	*Working Session- Project 2. time t.b.d.*			Energy Generation, Water
		15.3	th.07	Uncertainty, Role of Simulation, Right Tools			Guest Lecture- TBA
15	12/10	16.1	p.04	<u>Project 2 Presentations</u>	Project 2		
		16.2	p.05	<u>Project 2 Presentations</u>			
		16.3	g.07	Wrap-up	Final Paper		

The University Honor Code:
The core values of The University of Texas at Austin are learning, discovery, freedom, leadership, individual opportunity and responsibility. Each member of the University is expected to uphold these values through integrity, honesty, trust, fairness, and respect toward peers and community.

Academic Dishonesty
Academic dishonesty or scholastic dishonesty includes, but is not limited to, cheating, plagiarism, collusion, falsifying academic records, misrepresenting facts, and any act designed to give unfair academic advantage to the student (such as, but not limited to, submission of essentially the same written assignment for two classes without the prior permission of the instructor), or the attempt to commit such an act.

Plagiarism includes, but is not limited to, the appropriation of, buying, receiving as a gift, or obtaining by any means material that is attributable in whole or in part to another source, including words, ideas, illustrations, structure, computer code, and other expression or media, and presenting that material as one's own academic work being offered for credit.

For more information on the University's policies on academic dishonesty, please see: http://registrar.utexas.edu/catalogs/gi09-10/app/gi09.appc03.html

Students in Need of Special Accommodations:
At the beginning of the semester, students with disabilities who need special accommodations should notify the instructor by presenting a letter prepared by the Services for Students with Disabilities Office. To ensure that the most appropriate accommodations can be provided, students should contact the SSD Office at 471-6259 or 471-4641 TTY.

Counseling and Mental Health Services
Taking care of your general well-being is an important step in being a successful student. If stress, test anxiety, racing thoughts, feeling unmotivated or anything else is getting in your way, there are options available for support.

For ***immediate*** support:
- Visit/Call the Counseling and Mental Health Center (CMHC): M-F 8-5p | SSB, 5th floor | 512-471-3515 |cmhc.utexas.edu
- CMHC Crisis Line: 24/7 | 512.471.2255 | cmhc.utexas.edu/24hourcounseling.html

CARE Counselor in the School of Architexture is: Abby Simpson, LCSW
- M-F 8-5p | BMC 3.390 | 512-471-7642 (Please *leave a message* if she is unavailable)

Other Services at CMHC:
- Brief assessments and referral services
- Mental health & wellness articles - cmhc.utexas.edu/commonconcerns.html
- MindBody Lab - cmhc.utexas.edu/mindbodylab.html
- Classes, workshops, & groups - cmhc.utexas.edu/groups.html
- Tips on self-care - cmhc.utexas.edu/selfcare.html

Other Helpful Offices at UT
- Student Emergency Services (SES) - deanofstudents.utexas.edu/emergency
- Services for Students with Disabilities (SSD) – diversity.utexas.edu/disability
- Office of the Student Ombuds - ombuds.utexas.edu/student