University of Southern California - School of Architecture

Arch 215 - Design for the Thermal Environment

Semester: **Fall 2017**
Time: **Tuesday & Thusday 9:30AM - 10:50AM**
Location: **Harris Hall - 101**
Instructor: Tim Kohut (email: kohut@usc.edu)
TA: Kyeongsuk Lee (kyeongsl@usc.edu), Zhan Yang (zhanyang@usc.edu)

Office Hours: Tues. & Thurs 8:30AM-9:00AM, 11:00AM to 11:30AM or by appointment

Course Description

Fueled by population growth, within the next twenty years - according to Architecture 2030 - the global built environment will be redesigned, added to, or remade, adding an area equal to 3.5 times the existing buildings of the United States (900 billion square feet). In the process, energy patterns will be locked in for our cities, and as a result for our planet, for the following 50 years. If Climate Change is to be manageable and not catastrophic, future development must be defined by an awareness and a commitment to high performance, deep energy efficiency, and even carbon neutral design.

During the past century, the architectural profession has moved, by and large, away from a centuries old awareness of the environment, a deeper understanding of local climates, and a knowledge of how to maintain balance between building and environment. As a result, deeper dependencies on mechanized heating and cooling, especially when buildings were designed with ingrained inefficiencies, became the norm and the solution to any problem. Energy use in buildings skyrocketed as a result, fueling the need for more power plants to supply energy for inefficient buildings and cities. For generations, this energy has been provided, by and large, by fossil fuel fired power plants, leading to increased CO2 emissions. Recently, there has been a professional awakening around the role architects play in contributing to the problem of climate change. In the October, 2003 edition of Metropolis, Ed Mazria called out the profession pointing out that, “Architects Pollute”. In the immediate aftermath, the American Institute of Architects (AIA) brought focus to energy efficiency and sustainability - both of which are now core doctrines for the AIA.

Architects see problems and solve problems. This is critically important when it comes to energy dependence and climate change. We are are living through a time when the profession is in transition. Designing without understanding the impacts for energy, water and resource consumption is no longer possible. State and National Energy Codes now place limits on the amount of energy that can be used by buildings. This is a time of great challenge for architects (and future architects). It is also a time of great opportunity.

This course will discuss Climate Change and the critical role architects play in the discussion in the context of understanding and designing for the thermal environment of buildings. Through the semester, students will discuss and review basic concepts of sustainability, gaining an understanding of climate appropropriate design, passive heating and cooling, and renewable energy systems. At the same time, through weekly readings and assignments, students will use tools to help them understand, measure and design better buildings. They will be exposed to and will learn the international language of sustainability.

During the semester, students will explore concepts and test ideas, building a single building (design and climate assigned by the instructor) to test passive energy features, evaluate daylighting, and ultimately to design a Zero Net Energy Building.

Required Textbook:
Carbon-Neutral Architectural Design (Pablo LaRoche) -
Available at the Bookstore, E-Book Available from:
https://www.crcpress.com/Carbon-Neutral-Architectural-Design-Second-Edition/Roche/p/book/9781498714297

Recommended Textbooks:
Mechanical and Electrical Systems for Buildings (Walter Grondzik) -
EBook Available from:
http://www.wiley.com/WileyCDA/WileyTitle/productCd-1118615905.html

Catalog Description

A one semester course focused on climate awareness and the impact that architects and architecture have on the planet. The course will cover human comfort, climate analysis, passive and active systems, heating and cooling, energy analysis, and water reuse..

This survey, with a special emphasis on climate awareness, energy efficiency, and sustainable design, provides an understanding of the basic principles and appropriate application required for high performance building systems. Students will learn, incrementally, what it takes to design a highly energy efficient, carbon neutral building. Discussions and assignments will focus on on climate analysis, climate appropriate design strategies; passive heating, cooling, ventilation cooling; mechanized electrical, mechanical, and plumbing of buildings; and renewable energy and water systems.

Learning Outcomes

Upon completion of this course, it is expected that students will be able to:

1. Perform architecturally focused Climate Analysis, including an evaluation of passive design strategies. Evaluate the impact and potential of solar radiation to both help and hinder high performance buildings. Understand how energy moves through the building envelope and how architectural features can manipulate and control this flow of energy.
2. Understand what design strategies are most appropriate for a specific climate and site. Understand how building envelope, solar shading, and passive energy energy features can minimize the dependence on mechanized energy systems (heating, cooling, lighting, and heating of hot water).
3. Analyze energy use in buildings to gauge the impact of design alternatives, design approaches, measuring the impact of each individually or in combination to first reduce building energy use, then move towards Zero Net Energy (ZNE), and finally arrive at Carbon Neutrality.
4. Develop and articulate a vocabulary founded in sustainability and focused on high performance energy efficiency and carbon neutral architecture. Create an awareness to building energy codes and high performance, sustainable building programs (California Energy Code, Cal-Green, LEED, and Living Building Challenge).

Weekly Course Schedule

1. 8/22/17 - Why Sustainability? Intro to Climate Change and Carbon Neutral Architectural Design
   8/24/17 - How we approach Sustainability - The Tools we will use and where to find them

2. 8/29/17 - Climate Analysis - Vernacular Architecture, Intro to Climate Consultant
   8/31/17 - Homework assignment review

3. 9/5/17 - Sun Motion - Intro to Solar Shading
   9/7/17 - Homework assignment review

4. 9/12/17 - Sun Motion - Part II - Designing Solar Shading
   9/14/17 - Homework assignment review

5. 9/19/17 - Heat Flow Through the Building Envelope (Part I) - Conduction
   9/21/17 - Homework assignment review

6. 9/26/17 - Heat Loss and Heat Gains (Convection & Radiation and how they impact opaque surfaces)
   9/28/17 - Homework assignment review

7. 10/3/17 - High Performance Glass and Optimizing Window Design
   10/5/17 - Homework assignment review

8. 10/10/17 - Natural Ventilation in Buildings (Passive Cooling Part I) - Human Thermal Comfort - ASHRAE 55
   10/12/17 - Homework assignment review

9. 10/17/17 - Passive Heating in Buildings - (Final Assignment Intro) - Sizing of HVAC Systems
   10/19/17 - Homework assignment review

10. 10/24/17 - Mechanical Heating & Mechanical Cooling - Sizing of HVAC Systems Part II
    10/26/17 - Homework assignment review

11. 10/31/17 - Daylighting in buildings
    11/2/17 - Homework assignment review

12. 11/7/17 - Renewable Energy Systems, Carbon Neutral Architecture
    11/9/17 - Homework assignment review

13. 11/14/17 - Water Reuse in Buildings , Energy Codes, LEED, Living Building Challenge
    11/16/17 - Homework assignment review

14. 11/21/17 - Special Topic - Guest Lecture
    11/23/17 - Thanksgiving - No Class

15. 11/28/17 - Residential Building Diagnostics
    11/30/17 - Commercial Building Diagnostics

16. 12/5/17 - Study Day
    12/7/17 - Final Exam - Final Assignment Due

Final Grade Calculation

60% Weekly Assignments
15% Weekly Lecture and Reading Quizzes
25% Final Project

Calculation Of Grade
Letter grades are converted to numeric values using the following values:

Letter	%	Definition
A	93-100	Student learning and accomplishment far exceeds published objectives for the course/test/assignment and student work is distinguished consistently by is high level of competency and/or innovation.
A-	90-92.99	
B+	87-89.99	Student learning and accomplishment goes beyond what is expected in the published objectives for the course/test/assignment and student work is frequently characterized by its special depth of understanding, development, and/or innovative experimentation.
B	83-86.99	
B-	80-82.99	Students learning and accomplishment meets all published objectives for the course/test/assignment and the student work demonstrates the expected level of understanding, and application of concepts introduced.
C+	76-79.99	
C	72-75.99	
C-	68-71.99	Student learning and accomplishment based on the published objectives for the course/test/assignment were met with minimum passing achievement.
D+	64-67.99	
D	60-63.99	
F	< 60	Student learning and accomplishment based on the published objectives for the course/test/assignment were not sufficiently addressed nor met.

Disabilities
Over the years we have had many students in the course with various disabilities and have had excellent experiences thus far. Any Student requesting academic accommodations based on a disability is required to register with Disability Services and Programs (DSP) each semester. A letter of verification for approved accommodations can be obtained from DSP. Please be sure the letter is delivered to Prof. Kohut as early in the semester as early as possible. DSP is located in GFS 120 (Grace Ford Salvatori Hall, 3601 Watt Way. The phone number for DSP is (213) 740-0776. Email is ability@usc.edu.

Critical Dates and Religious Observances:
The university 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.

Disruptive Behavior
Behavior that persistently or grossly interferes with classroom activities is considered disruptive behavior and may be subject to disciplinary action. Such behavior inhibits other students' ability to learn and an instructor's ability toteach. A student responsible for disruptive behavior may be required to leave class pending discussion and resolution of the problem and may be reported to the Office of Student Judicial Affairs for disciplinary action.

Statement on Academic Integrity
USC seeks to maintain an optimal learning environment. General principles of academic honesty include the concept of respect for the intellectual property of others, the expectation that individual work will be submitted unless otherwise allowed by an instructor, and the obligations both to protect one's own academic work from misuse by others as well as to avoid using another's work as one's own. Violations of academic honesty (i.e. copying another student's work and submitting it as your own) will result in a grade of "0" for the assignment or quiz and may have other disciplinary consequences. Students who share their work with others will also receive a grade of "0". Quizzes and tests must be taken in class, even if the quiz or test is given on line. Students who submit a quiz or test given online (through Blackboard or other means) and who are not in the classroom at the time the quiz or test is administered are violating the principles of academic honesty. The test or quiz being taken will be graded as "0". There may be other disciplinary consequences. All students are expected to understand and abide by these principles. *SCampus*, the Student Guidebook, (www.usc.edu/scampus or http://scampus.usc.edu) contains the University Student Conduct Code (see University Governance, Section 11.00), while the recommended sanctions are located in Appendix A.

Professional Degree:

The USC School of Architecture's five year BARCH degree is an accredited professional architectural degree program. 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/2004_Conditions.aspx.

Attendance

Attending classes is a basic responsibility of every USC student who is enrolled in courses at the School of Architecture. Regular and punctual class attendance is considered an essential part of satisfying the NAAB accreditation requirements therefore attendance will be taken at every class session. Students who are not in class at the time a quiz is given will not be given an opportunity to make up the test (without exception) and will be given a grade of "0" for the quiz. Students who take a test or quiz and do not remain for the duration of the lecture will have their quiz or test disqualified (and graded as "0"). Students who arrive late for class will not be given any extension of time to take a quiz or test; the quiz end time will be the same for all students. If arriving late, a student must be respectful of a class in session and do everything possible to minimize the disruption caused by a late arrival. It is always the student's responsibility to seek means to make up work missed due to absences.

2010 Imperative Statement:

The Architecture Faculty has voted to accept the 2010 Imperative-- to improvement of ecological literacy among the students and faculty and to achieve a carbon-neutral design school campus by 2010. To that end, this class will address issues of carbon neutrality and ***supports*** the following goal for all designs produced in the USC School of Architecture:

> **"The design should engage the environment in a way that dramatically reduces or eliminates the need for fossil fuel."**

This does not mean that no other issues are to be addressed. Precisely to the contrary, all design issues are fair game, but in the background, all will be considered within the generalized goal of reducing or eliminating the need for fossil fuel.