AS3201
Advanced Building Systems
SCI-Arc Semester: Spring 2012

Instructors:
Ilaria Mazzoleni, Instructor (imsciarc@yahoo.com)
Jeffrey Landreth, Instructor (jeffrey.landreth@gmail.com)

Course Meetings:
Day: Thursdays
Time: 6-9pm
Classroom: Room 225

Course Description:

Climate change impacts and depletion of natural resources are destroying the delicate balance of natural systems that make life on earth possible. Buildings contribute significantly to these problems and therefore require a more integrated approach with natural systems. The appropriation and reinvention of uses for these resources constitute our responsibility and challenge.

A deeper understanding of human needs and our natural systems is required to inform sustainable design and facilitate the integration of systems. In this class we will explore the concepts of sustainability, efficiency and performative architecture, as they relate to building systems.

Sustainability: In general terms it means the capacity to endure. In terms of the built environment, it is a popular interdisciplinary term for describing the responsible design, construction and operation of buildings that minimize impact on the environment.

Efficiency: The one word that describes the underlying principles of the industrial revolution and an extraordinary impact on our standard of living and the environment. We will explore the concept of efficiency and its role in environmental design and sustainability.

Performative Architecture: A creative performative approach to building system design integrates contemporary environmental challenges with complex geometries emerging from our design studios. In this course we consider programmatic and space requirements, in conjunction with appropriate and responsive envelope/facade design, efficient active and passive building systems, and considerations for operation of the building over its life.

The seminar focuses on the understanding of intelligent design techniques used to optimize building performance throughout its life, in an integrated and holistic manner. The course content includes active and passive building systems as they apply to the overall site, building envelope and façade, building environmental control systems and conveying systems.

Course Organization:

The course will be co-taught by Mazzoleni and Landreth providing both the architectural and engineering perspectives of building systems design and integration. Core concepts will be developed through the themes of sustainability, efficiency and performative architecture.

The introductory part of the course is intended to create a dialogue between all, identifying and discussing key terms and definitions as they relate to Sustainability, Efficiency and Performative Architecture (focused on integrated and optimized building systems). The general course structure will include the following major design and building system themes:

- Sustainable Design Principles and Human Behavior
- Climate and Site Analysis and Design
- Building Materials and Assemblies
- Building Envelope and Passive Systems
- Ordering Systems Skills
- Environmental Building Systems (Active and Generative)

Weekly readings and lectures will provide the basis for knowledge development and will be further reinforced through weekly assignments focused on both qualitative and quantitative analysis of the major building systems. Exams (midterm and final) will be used to test understanding and ability in addition to 1 individual and 3 group assignments.

Group assignments will focus on the implication of building form and surfaces on specific building performances. Students will use systems and strategies related to materials, envelopes/facades, passive systems and active systems; allowing for a deepening and practical understanding of all major core topics. Other topics will include an overview of relevant building codes and standards (ASHRAE, Title-24), LEED ® certification assessment, resource use, and relevant case studies. Quantitative and qualitative performance-based (Performative Architecture) analysis will offer a comprehensive approach to the understanding of these core topics.

Site visits and case studies will be used to help communicate and reinforce core concepts and strategies and will be introduced during the lectures and further explored by teams for each assignment. These will be determined upon the availability of locations and announced during the semester. All students are expected to attend.

Course Objectives:

A hierarchical approach will be used in the analysis of the major course objectives, which include all students' performance criteria, such as:

- Course Objective 1: To develop an advanced vocabulary around design principles for passive and active building systems.
- Course Objective 2: Site, programmatic and space zoning design criteria
- Course Objective 3: Develop an understanding of optimized strategies and techniques for building envelope systems, including energy performance, materials use/selection and weatherization.
- Course Objective 4: To explore technologies and strategies for passive and active building environmental control systems and their integration with various envelope options.
- Course Objective 5: Review and explore generative systems: renewable resources and their potential in building energy generation; selection and design principles
- Course Objective 6: Develop an understanding of integrated building systems thinking, application and analysis.

Projects/Assignments Overview:

Weekly Lectures: Will cover the major course topics listed above. Guest speakers with specific knowledge on selected topics will help provide technical depth to lectures and class discussions. Attendance and class participation is mandatory. For details see logistics and grading procedures below.

Exams: Two exams (equally weighted) will be used to test knowledge and comprehension. Exam material will cover, but not limited to, weekly lectures, weekly handouts/readers, and mandatory reading in bibliography. Exams will be individual and taken during class (closed books). Refer to Logistics and Grading Procedures for a breakdown of the grading and see the Schedule for tentative exam dates.

Assignment in 3 parts (Materials, Passive Systems and Active Systems): Team of 2 students. The purpose of the assignment is to apply and experiment with core concepts and strategies learned through lectures, handouts, and readers. This will be performed primarily through qualitative and quantitative analysis. Assignments will require site investigations, critical review and development/optimization of performance. The assignment will be developed and reviewed weekly. Although assignments are developed in a team, grades will be given individually.

Course Schedule

Week	Date	Lecture	Assignment
Wk 1	**01/12**	Class Intro and Core Concepts Sustainability and Human Behavior/Comfort	Introduction: Assignment 0
Wk 2	**01/19**	Materials 1: Intro to the Material World	**Due/Present: Assignment 0** Intro to Assignments (M,P,A)
Wk 3	**01/26**	Materials 2: Cradle to Cradle, Assembly/Disassembly, and LCA	Review: Materials
Wk 4	**02/03**	Materials 3: Facades and Advanced Building Materials	Review: Materials
Wk 5	**02/09**	Passive 1: Facades, Daylighting and Other Passive Systems	**Due/Presentation: Materials** Introduction: Passive Systems/Facades
Wk 6	**02/16**	Passive 2: Complex Envelope/ Façade Systems (Guest Lecturer)	Review: Passive Systems/Facades
Wk 7	**02/23**	**Field Trip:** LACMA	Review: Passive Systems/Facades
	02/27	STUDIO Mid-term	
Wk 8	**03/01**	EXAM 1 Review of Sustainability Computing	Review: Passive Systems/Facades
Wk 9	**03/08**	Active Systems 1: Space/Zone Systems and Building Distribution	**Due/Presentation: Passive Systems** Introduction Active Systems
Wk 10	**03/15**	Active Systems 2: Equipment and Plant Rooms	Review: Active Systems
Wk 11	**03/22**	Active Systems 3: Energy Supply and Generative Systems	Review: Active Systems
Wk 12	**03/29**	Whole Building Integration and Optimization	**Due/Presentation: Passive Systems**
Wk 13	**04/05**	Water Systems: Intro to Building Water Use and Systems	**ASSIGNMENT BOOK DUE >** to print for end of the year show (04/20) Study for Final Exam
Wk 14	**04/12**	**Exam 2:** Active System and Water	Instructor Reviews and Submit and Upload Files for Archiving
	04/16 **04/20**	**STUDIO Final** **End of the year show**	

NOTE: Subject to change depending upon the progress of the class

Readings / Reference Material

Mandatory Reading:

- McDonough, William and Michael Braungart. Cradle to Cradle: Remaking the Way We Make Things. North Point Press, 2002.
- Kolarevic, B. and Malkawi A., Performative Architecture: Beyond Instrumentality. Spon Press, 2005.
- Stein, Ben et. al. Mechanical and Electrical Equipment for Buildings. 10th Edition. J Wiley & Sons Inc., 2006.
- Daniels, Klaus. Advance Building Systems: A Technical Guide for Architects and Engineers. Basel: Birkhaeuser, 2003.
- Schittich Christian, In Detail: Building Skins, Birkhaeuser
- Addington M., Schodek D. L., Smart Materials and Technologies in Architecture, Elsevier, 2005

Code References:

- International Building Codes. International Code Council, 2007.
- California Green Building Standards Code (CalGreen). California Code of Regulations Title 24, Part 11. California Building Standards Commission. 2010.
- California Energy Efficiency Standards. California Code of Regulations Title 24, Part 6. California Energy Commission, 2008.
- ASHRAE Standard 90.1 – 2007. Energy Standard for Buildings Except Low-Rise Residential Buildings. American Society of Heating, Refrigeration and Air Conditioning Engineers.
- ASHRAE Standard 62.1 – 2004. Ventilation for Acceptable Indoor Air Quality. American Society of Heating, Refrigeration and Air Conditioning Engineers.
- ASHRAE Standard 55 – 2004. Thermal Environmental Conditions for Human Occupancy. American Society of Heating, Refrigeration and Air Conditioning Engineers.

Additional readings:

- MacKay David J.C. Sustainable Energy: Without the Hot Air. Cambridge: UIT, 2009.
- Brown G.Z., DeKay Mark, Sun, Wind, Light: Architectural Design Strategies. John Wiley & Sons, 2001.
- Kieran Stephen & Timberlake James, Refabricating Architecture, New York: McGraw-Hill, 2004

Additional text and readers will be given during class and readings will be posted on the server periodically.