ARCH-599
Title: Sustainable Design for Healthy Indoor Environments
Units: 3
Semester: Fall
Grading Type: Letter-Graded
Course Type: Regular class
Location: Watt Hall
Day and Time: Tuesday 9:00AM - 11:50AM

Instructor: Joon-Ho Choi
Office Location: WATT Hall #318
Office Hours: Thursday 12:00PM – 1:00 AM
Contact Info: joonhoch@usc.edu, 213-740-4576

Course Description
This course will expose seniors and/or graduate students to a systematic evaluation process for performing and diagnosing indoor environmental quality relative to thermal, lighting, air quality, acoustic, and spatial conditions in buildings. Emphasis will be on fundamental approaches for developing integrated environmental design methods that are primary requirements for students in the fields of architecture, environmental design, and building science. This knowledge is basic to understanding the principles underlying human-architecture interaction.

The course will focus on the building design process required to assure indoor environmental quality (IEQ) and the needs of building occupants to promote their environmental health, work productivity, psychological comfort, aesthetic quality, and satisfaction. Technical applications will involve user surveys, environmental data collection, and in-depth analysis, as well as suggested steps and processes for solving environmental problems. Course content is designed to help students develop a framework for addressing architectural design and research problems and for identifying practical solutions to the design planning process that will assure a successful building project.

Learning Objectives
After completing this course, a student should understand the following concepts and ideas:

- POE and building indoor environmental quality (IEQ)
  - Origin of POE and technical definitions
  - POE and building indoor environmental quality
  - Impacts of IEQ on human health, productivity, and environmental satisfaction
  - Benefits of conducting a POE study

- Evaluation methods
  - Documenting Architectural and environmental variables for building indoor environments
  - Environmental measurements
  - Building attribute surveys
  - Environmental satisfaction surveys (User questionnaire)
  - Data collection and archival projects

- Analysis methods and techniques

- Quantitative studies
- Problem identification and solution findings
- Examination of correlations between environment and human factors

Textbook

- The Healthy Indoor Environment : How to assess occupants' wellbeing in buildings (Philomena M. Bluyssen, Routledge, 2013)
- A Guide to Human factors and Ergonomics (Martin Helander, CRC Press, 2005)

Required Readings and Supplementary Materials

- Indoor Environmental Quality (Thad Godish, CRC Press, 2000)
- Greening Existing Buildings (Jerry Yurdelson, Mcgraw-Hills, 2009)
- Sick Building: Definition, Diagnosis and Mitigation (Thad Godish, CRC Press, 1994)
- Design for an Empathic World: Reconnecting People, Nature, and Self (Sim Van der Ryn, Island Press, 2013)
- Design for Aging Post-Occupancy Evaluation (AIA, Wiley, 2007)
- Evidence-based Design for Interior Designers (Linda Nussbaumer, Fairchild Books, 2009)
- The Sustainable Sites Handbook: A Complete Guide to the Principles, Strategies, and Best Practices for Sustainable Landscapes (Meg Calkins, Wiley, 2012)
- Problem Seeking,: An Architectural Programming Primer (HOK Inc., Wiley, 2012)
- ASHRAE Performance Measurement Protocols (PMP)
- ASHRAE 55 Standards: Thermal Comfort - 2010
- ASHRAE 62.1 Standards: Ventilation for Acceptable Indoor Air Quality - 2007
- ASHRAE High Performance Building Handbook
- Illuminating Engineering Society (IES) Handbook
- DataMining: Practical Machine Learning Tools and Techniques (3rd Edition) – 2011
- Introduction to Business Statistics [Student Edition]

Prerequisite(s)

N/A

Co-Requisite/Concurrent Enrollment

N/A

Recommended Preparation

Any building thermal, lighting, air quality, and/or acoustic systems, architectural design and process, and statistical analysis experiences and/or preparations are recommended.

Course Notes

Lecture notes, a syllabus, handouts, reading assignments, and any other course materials will be posted on Blackboard. Practice with control hardware for homework or assignments will be incorporated in the course.

Teaching Method: This class will be conducted as a seminar and will mix lecture presentations by the instructor with student presentations, class demonstrations, slide presentation, project reviews, and guest speakers, as well as system construction with the application of acquired knowledge to a real built environment. An environmental chamber in Watt Hall will be used as a test bed and students will be required to complete their course projects and assignments using the facility in order to concurrently learn and put

the acquired skills and knowledge into practice. Required texts and several reference books will be recommended to supplement course work. Since the course is primarily for graduate level students, course participants can choose any data type or source relative to their research interests or projects they are conducting.

Technological Proficiency and Hardware/Software Required
This course is based on a traditional classroom setting. In addition, students may need some hardware practices, soldering, electric circuit fabrication, etc.

Description and Assessment of Assignments
Provide enough information about an assignment so a student or reviewer can tell what kind of work is to be done and how it should be completed, i.e. how the learning outcome will be assessed. Include any assessment and grading rubrics that will be used.

Grading Breakdown

Assignments	Points	% of Grade
Mid-term project	200	20%
Final project	300	30%
Assignment and quizzes	400	40%
Class participation	100	10%
TOTAL	1000	100%

Assignment Submission Policy
Deliverables are defined as any work required from the student that was assigned for acquisition or preparation outside of the regular classroom, e.g. web-based reference documents, homework, take-home quizzes, and projects. All deliverables are mandatory and due at the beginning of class on the required due date. Failure to submit a deliverable on-time and reasonably well attempted shall result in a deduction of 50% of the assigned point value, with an additional 10% deducted for each full-day late until such work is delivered into the instructor's possession, properly completed. Any deliverable not properly submitted within one calendar week of a required due date may result in a failing grade to the student in this course. Any student who may be absent from class on the due date may submit their work beforehand directly to the instructor, or, on the due date via another student. Exceptions to this policy shall be considered with adequate justification.

Additional Policies
Quality: All deliverables shall be graded for quality and content, 60% and 40% respectively. Chaotic, illegible, disorganized deliverables shall negatively impact the course grade.
Attendance: On-time attendance is expected in this course as is required in professional practice. Late arrival and repeated absences shall negatively impact the course grade.

Additional Notes
Student Assignments

This is a project-oriented class. Therefore, students will be required to finish each assignment for the class on time. Students will be given an individual assignment, a group project, or both. The assignments will be geared to developing data acquisition construction skills for building indoor environmental condition measurements, enhancing students' skills for data analysis, and developing an environmental diagnostic tool that will be applicable to a real building design project.
Students will be given seven assignments and two projects during the course that will help them gain a deeper understanding of the quantitative approaches being taught. In addition, students will have reading assignments based on articles handed out in class or available on the web.

The assignments will include:

1) Practicing environmental data measurement skills.
2) Investigating significant features of collected data.
3) Developing a diagnostic tool by employing existing (advanced) problem-solution finding skills.

Statement for Students with Disabilities
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 me (or to TA) as early in the semester as possible. DSP is located in STU 301 and is open 8:30 a.m.–5:00 p.m., Monday through Friday. Website and contact information for DSP:
http://sait.usc.edu/academicsupport/centerprograms/dsp/home_index.html, (213) 740-0776 (Phone), (213) 740-6948 (TDD only), (213) 740-8216 (FAX) ability@usc.edu.

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. 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.

Students will be referred to the Office of Student Judicial Affairs and Community Standards for further review, should there be any suspicion of academic dishonesty. The Review process can be found at: http://www.usc.edu/student-affairs/SJACS/. Information on intellectual property at USC is available at:
http://usc.edu/academe/acsen/issues/ipr/index.html.

Emergency Preparedness/Course Continuity in a Crisis
In case of a declared emergency if travel to campus is not feasible, USC executive leadership will announce an electronic way for instructors to teach students in their residence halls or homes using a combination of Blackboard, teleconferencing, and other technologies.

ARCH 599 SCHEDULE OF CLASSES

Week	Description	Project / Assignment*
1	Introduction to Post Occupancy Evaluations *Reading:* The Healthy Indoor Environment o *Chapter 1:Human Model (p.3-16)*	Assignment #1
2	Building Indoor Environmental Quality *Reading: Handouts*	**Project (I)**
3	Human Health and Work Productivity in the Built Environment *Reading:* The Healthy Indoor Environment o *Chapter: Bodily Process (p. 17-42)*	Assignment #2
4	*Cost – Benefit Analysis for Building Environmental Quality Differences* *Reading:* A Guide to Human factors and Ergonomics *Chapter: Cost-Benefit Analysis of Improvements in the Human Factors Design (p. 17 – 27)*	
5	Architectural Design and Environmental Variables for Building IEQ *Reading:* A Guide to Human factors and Ergonomics o *Chapter: Vision and Illuminance Design (p. 41- 65), Physical Workload and Heat Stress (p. 225-236), Noise and Vibration (p. 237-255)*	Assignment #3
6	Data Collection 1: Environmental measurements *Reading:* The Healthy Indoor Environment o *Chapter: Bodily Process (p. 58-76)*	
7	Data Collection 2: Building Attribute Survey and User Satisfaction Questionnaire *Reading:* The Healthy Indoor Environment o *Chapter: Data Collection and Technique (p. 251-256), Appendix A (p. 375-389)*	Assignment #4
8	Mid-term *Exam / Presentation (Project I due)*	
9	Data Coding and Types *Reading: Handouts*	Assignment #5
10	Data Analysis 1 *Reading:* The Healthy Indoor Environment	**Project (II)**

Week	Description	Project / Assignment*
	○ *Chapter: Data Analysis (p. 198-205)*	
11	Data Analysis 2 *Reading: Handouts*	Assignment #6
12	Technical Methods for Problem Detection *Reading:* The Healthy Indoor Environment ○ *Chapter: Scenarios (p. 319-358).*	
13	Solution Findings for Environmental and Occupants' Physiological Factors *Reading:* The Healthy Indoor Environment ○ *Chapter: Scenarios (p. 319-358).*	Assignment #7
14	Thanks Giving Break	
15	Case study and Practice with on-site measurement data *Reading: Handouts*	
16	Final project presentations / Exam *(Project II due)*	

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Course number: Arch 599
Number of Units: 3
Fall, Spring, Summer: FALL
Letter grade or P/NP: Grade

25 word catalogue description: Introduction to the building design process for indoor environmental quality and the requirements of building occupants to ensure their environmental health, productivity, comfort and satisfaction, and environmental sustainability.

Reason for adding/offering this course: This course is to provide an introduction to comprehensive understanding skills about building indoor environmental quality (IEQ) and its impacts that affect occupant health and environmental sustainability. Also presented will be fundamental approaches to the development of integrative design methods for enhancing human physiological and environmental benefits in a building environment. These design and technical approaches are necessary for students in the fields of architecture (landscaping) and building science, as well as being of being of benefit to students in the areas of building/construction and relevant engineering disciplines. This course is expected to remain as one of primary courses in the Division of Building Science after the experimental stage.