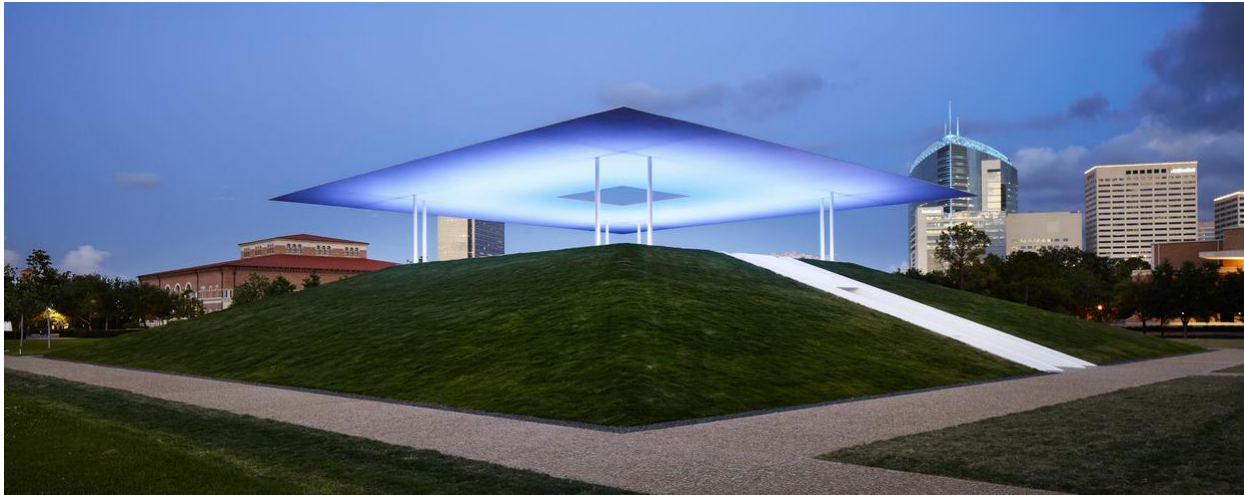


# ARCH 575b Systems: Luminous and Auditory Phenomena in Architecture

Spring 2019 Course Syllabus  
University of Southern California | School of Architecture

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Tuesdays 6:00pm – 8:50pm | 3 units



James Turrell Art Installation at Rice University, Houston © Casey Dunn

## Course Description

This course is the second in the building systems series and covers topics of lighting and acoustics. The fundamental scientific principles governing light and sound in the built environment will be examined in the context of human physiological, psychological and biological needs. It exposes students to technologies, materials and strategies for control of light and sound in buildings as well as the basic analyses needed to inform design decision-making and examine project performance. The course will continue the themes of resource efficiency and end-user comfort through the examination of emerging metrics for daylight sufficiency, visual and acoustic comfort.

## Learning Objectives

- Understanding of the fundamental scientific principles governing the luminous and auditory environments.
- Awareness and ability to implement design strategies and appropriate technologies to utilize daylight effectively.
- Ability to conduct basic analyses using hand calculations in a design context.

## National Architectural Accrediting Board

Student Performance Criterion addressed are in bold.

- A.1 Communication Skills
- A.2 Design Thinking Skills
- A.3 Visual Communication Skills
- A.4 Technical Documentation
- A.5 Investigative Skills
- A.6 Fundamental Design Skills
- A.7 Use of Precedents
- A.8 Ordering Systems Skills
- A.9 Historical Traditions and Global Culture
- A.10 Cultural Diversity
- A.11 Applied Research
- B.1 Pre Design
- B.2 Accessibility**
- B.3 Sustainability**
- B.4 Site Design
- B.5 Life Safety**
- B.6 Comprehensive design
- B.8 Environmental Systems**
- B.9 Structural Systems
- B.10 Building Envelope Systems
- B.11 Building Service Systems**
- B.12 Building Materials and Assemblies
- C.1 Collaboration
- C.2 Human Behavior**
- C.3 Client Role in Architecture
- C.4 Project Management
- C.5 Practice Management
- C.6 Leadership
- C.7 Legal Responsibility**
- C.8 Ethics and Professional Judgment
- C.9 Community and Social Responsibility

## Course Calendar

Week	Date	Topics	Assign.
1	1.08	Intro to course logistics and Sound & Light Matter group project; <b>Acoustic Lecture – Fundamentals:</b> Basic physical principles and human perception of sound. Sound propagation and measurement. Acoustic terms, physical principles, acoustic metrics.	A
2	1.15	<b>Acoustic Lecture – Sound isolation:</b> transmission loss, STC rating, building systems noise control. Example problems and construction types for effective sound isolation.	B
3	1.22	<b>Acoustic Lecture – Sound absorption:</b> sound absorbing treatments, reverberation, noise reduction; Strategies for sound absorption.	C
4	1.29	<b>Acoustic Lecture – Room acoustics:</b> sound paths, ray diagrams, echo control, surface treatments. Speech intelligibility and reverberation time.	D
5	2.05	<b>Acoustic Lecture – Acoustic design in practice:</b> technologies, immersive audio and multi-sensory environments. Case studies of the auditory environment.	E
6	2.12	<b>Acoustic Lecture – Performance spaces and audio systems:</b> Acoustic design for assembly spaces; amplified sound design and implementation of sound masking; biofilic systems.  Review for the midterm exam.	F
7	2.19	<b>Midterm Exam</b>	n/a
8	2.26	<b>Lighting Lecture – Fundamentals:</b> physics of light, color and human visual perception; Light and human psychological and biological needs for visual information; lighting terms, physical principles, photometric units. Optical properties of materials, implications in simulation and design.	n/a
9	3.05	<b>Lighting Lecture – Electrical Lighting:</b> objectives and design implications. Energy efficient lighting systems, controls, and design approaches	G
<b>Spring Recess March 10 - 17</b>			

Week	Date	Topics	Assign.
10	3.19	<b>Lighting Lecture – Daylighting:</b> Light from the sun and sky; introduction to climate-based day lighting. Case studies in effective day lighting.	H
11	3.26	<b>Lighting Lecture – Façades:</b> High-performance glazing and complex fenestration systems for day lighting. Dynamic facade shading and light-redirecting systems.	I
12	4.02	<b>Lighting Lecture – Lighting design in practice:</b> case studies in effective daylighting and electrical lighting; introduction to High Dynamic Range imaging for photometric analysis	J
13	4.09	<b>Systems Lecture – Electrical:</b> fundamental principles, applications and needs. Buildings and the grid: demand response and net-metering.	K
14	4.16	<b>Systems Lecture – Water:</b> Building / landscape water demand and end-use efficiency. Storm water control and rainwater harvesting / storage. Green roof systems. Net-zero water: sustainable onsite water concepts and systems. Greywater and blackwater systems.	L
		<b>Review – Pin-ups and Final Exam</b>	
15	4.23	<b>Presentation of Final Projects</b>	n/a
16	TBD	<b>Final Exam</b>	n/a

Note: Group Assignments and individual homework will be assigned at each class session and should be completed by the next class session or otherwise noted.

## Assignments and Final Project

Assignments will consist of lighting and acoustic calculations, case study research of sound and light environments, and subjective evaluation of lighting and acoustic comfort paired with hand-held physical measurements. The final project will be based on the multi-week assignments and will be presented in groups at the end of the semester.

Groups for the final project will be assigned during the first class session. Each group will select a space at the School of Architecture to transform and re-design an environment to accommodate the proposed activity and occupants.

The final project and associated assignments will be provided in a separate class handout.

## General Information

Midterm and Final: There will be both a written midterm and final for this course.

Extra Credit: There is no extra credit awarded for this course.

Late Work: No late work will be accepted with the exception of extreme circumstances (documented medical or personal emergency). Consequently, if you choose to miss a class, it is your responsibility to determine what assignments you have missed and turn them in before they are due.

Work Requirements: This course requires consistent engagement throughout the term and timely completion of assignments. This class is designed to require 2 hours of focused out-of-class work for each hour of in class instruction. Because the class meets for 3 hours each week, you are expected to contribute 6 hours of out-of-class time each week to assignments.

## Class Attendance

Attendance at all class sessions, including lectures, reviews, and field trips, is required. Not being in class within the first 10 minutes is considered tardy; three tardies constitutes an absence. Failure to be present for the entire class session, unless approved by your instructor, may count as an absence.

Personal illness, family emergency, pre-approved academic reason, or religious observance may be excusable; notify your instructor of such situations as soon as possible and before the affected class session.

Unexcused absences from more than three classes will result in the lowering of your final grade one full letter grade. False representation of your attendance is a violation of the University's ethics policy.

Acceptance of late work may only be considered for excused absences, at the discretion of your instructor.

## Readings and Resources

### Text Books

- Perception and Light as Formgivers for Architecture. Lam. (Free download). <http://www.wmclam.com/index.php/publications>
- Architectural Acoustics. M. David Egan. J. Ross, 2007. ISBN-13: 978-1932159783.
- Architectural Lighting, M. David Egan, Victor Olgyay. ISBN-13: 978-0070205871
- Mechanical and Electrical Equipment for Buildings. Wiley, 2015. ISBN-13: 978-1118615904
- The IES Lighting Handbook, 10th Edition. (Student edition, PDF). ISBN-13: 978-0879950071.

## Reference

These texts will be useful for you to refer to during the semester for additional detail on specific topics.

- The Science of Sound, 3rd Edition. Thomas D. Rossing. Addison-Wesley, 2011. ISBN-13:978-0805385656.
- Planning and Installing Sustainable Onsite Wastewater Systems. S..M. Parten. McGraw-Hill, 2009. ISBN-13: 978-0071624633.

Software (free download)

1. Photosphere (for viewing HDR images)  
Works on Mac only. Available from Greg Ward's website: <http://www.anywhere.com/>
2. DIVA plugin for Rhino Day lighting analysis plugin for Rhino (apply for student license)  
<http://diva4rhino.com/>
3. COMFEN (get latest non-beta version)  
Works on PC only  
<http://windows.lbl.gov/software/comfen/comfen.html>

## iOS / Android Apps (free or low cost)

- SPL meter app for mobile device  
(Decibel 10th, iOS only) <https://itunes.apple.com/us/app/decibel-10th/id448155923?mt=8>  
(deciBel, Android only) <https://play.google.com/store/apps/details?id=bz.bsb.decibel&hl=en>
- Decibel Meter Pro (by Performance Audio), \$0.99
- Light Meter (lux measurement tool by Vlad Polyanskiy), \$1.99
- LightMeter (by Whitegoods)  
(Or comparable pocket light meter for mobile device)  
<https://itunes.apple.com/us/app/lightmeter-by-whitegoods/id501638921?mt=8>  
<https://www.sparkfun.com/categories/273>

## Evaluation and Grading

The grading for the course will be based on the following percentages:

Participation and attendance (pop quiz)	10%
Assignments	20%
Midterm exam	25%
Final Exam	25%
Final project	20%

As part of your process this semester, you will demonstrate your ability to integrate the following NAAB Student Performance Criteria. To pass the course, your work must demonstrate at least a minimum level of competence in each of these aforementioned areas.

You can read more about each criterion at: <https://www.naab.org/accreditation/>

## 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, contains the Student Conduct Code in Section 11.00, while the recommended sanctions are located in Appendix A: <http://web-app.usc.edu/scampus/university-governance/>. 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/>.

Unsatisfactory performance warnings will be issued when work does not meet minimum requirements. University guidelines relative to plagiarism pertain to original design work; you are expected to do all your own design and presentation work. Receiving substantial assistance, or appropriating another's design work, will be treated as plagiarism.

## 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. Any student concerned about missing class for a recognized religious holiday should bring this matter up with your instructor in the first week of classes. A list of recognized religious holy days may be found at: <http://orl.usc.edu/religiouslife/holydays/>.

## Disability Accommodations

The University of Southern California is committed to full compliance with the Rehabilitation Act (Section 504) and the Americans with Disabilities Act (ADA). As part of the implementation of this law, the University will continue to provide reasonable accommodation of academically qualified students with disabilities so those students can participate fully in the University's educational programs and activities. Although USC is not required by law to change the "fundamental nature of essential curricular components of its programs in order to accommodate the needs of disabled students," the University

will provide reasonable academic accommodations. The specific responsibility of the University administration and all faculty serving in a teaching capacity is to ensure the University's compliance with this policy.

The general definition of a student with a disability is any person who has "a physical or mental impairment which substantially limits one or more of such person's major life activities," and any person who has "a history of, or is regarded as having, such an impairment." Reasonable academic and physical accommodations include but are not limited to: extended time on examinations; substitution of similar or related work for a non-fundamental program requirement; time extensions on papers and projects; special testing procedures; advance notice regarding book lists for visually impaired and some learning disabled students; use of academic aides in the classroom such as note takers and sign language interpreters; early advisement and assistance with registration; accessibility for students who use wheelchairs and those with mobility impairments; and need for special classroom furniture or special equipment in the classroom.

#### Obtaining Accommodations:

- **General:** 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 your studio instructor 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. The phone number for DSP is (213) 740-0776.
- **Physical Accommodations:** DSP will work with classroom scheduling, the course instructors and their departments, and the students to arrange for reasonable accommodations.
- **Academic Accommodations:** Students seeking academic accommodations due to a physical or learning disability should make the request to the course instructor prior to or during the first week of class attendance, as well as registering with DSP as early in the semester as possible. Course instructors will require that a student present verification of documentation when academic accommodations are being requested.

## Writing Center

For assistance with academic writing, students may wish to take advantage of the Writing Center maintained by USC. Evaluation of paper clarity, organization, syntax and grammar is available by appointment, free of charge. If you'd like to improve your writing and your ability to communicate your ideas, consider using this valuable resource. See their website at: <http://dornsife.usc.edu/writingcenter/> for more information.

## Sustainability Initiative

The School of Architecture has adopted the 2010 Initiative for Sustainability, which includes the following language: *"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.

This intention impacts our design process in a number of ways, including:

- orientation of buildings and site development to minimize negative environmental force impacts and take advantage of positive ones
- building modestly: providing the minimum space necessary to handle required programmatic needs
- maximum practical use of day-lighting; careful use of orientation and provision of control/shading mechanisms to handle associated heat loads
- maximum practical use of passive solar techniques for heating and cooling
- maximum practical use of natural ventilation techniques; selection of hybrid systems for ventilation, heating and cooling which permit this

No school can lay a claim to sustainability sensitivity that does not institute and vigorously pursue a recycling program. This recycling program is in force at all times. We pledge to provide adequate, well-marked recycling containers for each section and to provide a posted, printed recycling protocol so you know what goes where.

### **Accreditation Statement**

The USC School of Architecture's five-year Bachelor of Architecture program and the Master of Architecture program 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, <https://www.naab.org/accreditation/>.