Columbia University - School of Architecture, Planning and Preservation.

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ARCHA4626 Acoustics

Design Course Syllabus

This course covers the fundamentals of acoustics and its application to design in the built environment. The format is interactive; lectures have images, video, listening, sound creation, sound visualization and sound measurement. There are two specific assignments, one practical (Boom Box) and one theoretical/practical (Sound Space). There are two field trips, one to experience interesting acoustic environments in New York City, and one to the Arup SoundLab.

We will investigate the relationship between sound and architectural space, encouraging students to think about how different types of buildings sound as well as understanding the impact that sound, noise, and vibration, have on design in the built environment. We will explore the fundamentals of sound and noise: propagation, isolation, control, and mitigation. How to use sound as a positive contributor in architectural design – including room acoustics design theory, the effect of shape, form, geometry and material selection on acoustics. Students will take all the combined knowledge to create the final assignment.

Lecture 1 - Introduction to Acoustics

a. General introduction to the course.

b. Sound, noise, and vibration – what's the difference?

c. Speed of sound, frequency, wavelength.

d. The fundamental relationship between architecture, shape, form, volume and materials.

e. What does an acoustic consultant do?

f. Discussion with the students on interest areas for addition into the course schedule.

Lecture 2 - Fundamentals of Acoustics (1): Sound Isolation and Noise Control

a. Fundamentals of sound propagation.

b. Sound Propagation, Representation & Measurement.

c. Sound Transmission mechanisms

d. Sound isolation - properties of materials.

e. Noise and vibration theory and criteria.

f. Noise and vibration control from building systems and its implication on architectural design.

Lecture 3 - Fundamentals of Acoustics (2): Room Acoustics and Electroacoustics

a. Fundaments of sound in enclosed spaces.

b. Surface material and geometry sound absorbing, reflecting and diffusing properties.

c. Relationship to human perception – sound reflection sequence, sound in 3d, reverberation.

d. Good and bad examples of acoustics in the built environment.

e. Electoracoustics and audio systems design – Funamentals.

Lecture 4 – Assignment 1 – Boom Box

At the end of lecture 3, students are provided with details of a sound signal and the object that will produce it. They are provided with a specification to create an enclosure no bigger than 2' x 2' x 2' to isolate the sound as effectively as possible with minimum weight. They have 1 week to produce the enclosure and in lecture 4 they will measure and test the performance of each other's boxes.

Lecture 5 – Field Trip 1

A walking tour of spaces with interesting acoustics in NYC.

Lecture 6 – Design for the Performing Arts

Part 1 - History of performing arts space design, from 40,000 BC to 1945

Part 2 – Post war design or arts spaces and the impact on perception of acoustics in all aspects of architecture design.

Lecture 7 – The Role of Acoustics in the Future of Architecture Design

This last lecture will examine the integration of multimedia components of all aspects of the built environment and the changes this is having on a range of aspects of design of the built environment. It will also address emerging trends in ideas related to "soundscaping" and aural architecture, both the subject of current debate in the architecture and acoustics design community

Lecture 8 – Student Choice

Based on other projects or building types being studied at Columbia, through discussion from lecture 1, this lecture will be entirely designed around the types of buildings the students wish to focus on.

Lecture 9 – Arup SoundLab Trip

Arup SoundLab demonstration that allows students to listen in a lab to sounds of building from real measurements and computer models

Lecture 10 – Assignment 2 - Sound Space

The aim of this exercise to develop an understanding of how sound can be used to shape a design. Develop a design concept for a room, space or object that is primarily driven by the principles of sound. The acoustical goal of the design should be clearly stated at the outset, and all the features of the design should have an acoustic purpose or function that lead clearly to this goal.