

## **COLUMBIA UNIVERSITY**

GRADUATE SCHOOL OF ARCHITECTURE, PLANNING AND PRESERVATION

**Fall 2017**

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**A4628 - Acoustics**

This course examines 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. Several classes have a simple exercise which are posted to a Tumblr account for discussion in the specified class.

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.

Exercises will follow certain classes taking the form of students finding examples of specific acoustics attributes and uploading photos, sounds, videos etc. to Tumblr.

### **Class 1: Introduction to Acoustics**

General introduction to the course

A brief history of human relationship between sound and architecture

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

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

Acoustics and the design process.

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

*Exercise 1 introduced*

### **Class 2: Fundamentals of Acoustics (1): Sound Isolation and Noise Control**

*Exercise 1 due*

Speed of sound, frequency, and wavelength.

Fundamentals of sound propagation

Sound Propagation, Representation & Measurement

Sound Transmission mechanisms

Sound isolation - properties of materials

Noise and vibration theory and criteria

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

*Exercise 2 introduced*

### **Class 3: Fundamentals of Acoustics (2): Room Acoustics and Electro-acoustics**

*Exercise 2 due*

Fundamentals of sound in enclosed spaces

Surface material and geometry sound absorbing, reflecting and diffusing properties

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

Good and bad examples of acoustics in the built environment

Electro-acoustic and audio systems design – Fundamentals

*Assignment 1 introduced*

### **Class 4: Anti Boom Box Presentations**

*Assignment 1 due and class participation in presentation*

At the end of Class 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 class 4 they will measure and test the performance of each design. The highest overall sound isolation for lowest weight wins.

### **Class 5: Field Trip**

A walking tour of spaces with interesting acoustics in NYC.

*Exercise 3 introduced*

***Assignment 2 introduced***

### **Class 6: Performing Arts 1 + 2**

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.

*Exercise 4 introduced*

### **Class 7: Assignment 2 – Soundspace “Midterm” Presentations**

Student presentations of sound space projects. 3-5 minute presentation of progress with critique.

### **Class 8: Future of Acoustics**

*Exercise 4 due*

This last class will examine the integration of multimedia/audio to the built environment and the impact on design of the built environment. It will also address emerging trends in ideas related to “soundscaping” (how urban, landscape and architectural design are shaped to create a defined sound character) and aural architecture, the influence of multi-media on acoustic design, all the subject of current debate in the architecture and acoustics design community. Application to Sound Art will also be discussed.

### **Class 9: Field Trip 2: Arup SoundLab**

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

### **Class 10: Desk crits for Assignment 2**

### **Class 11: Soundspace Final Presentations**

Assignment 2 Final Presentations

The aim of assignment 2 is 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.