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I, Marco Downs, hereby submit this original work as part of the requirements for the degree of: Master in Architecture. It is entitled: MainStage: Building Active Listening Space on UC Campus.

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I have reviewed the Thesis/Dissertation in its final electronic format and certify that it is an accurate copy of the document reviewed and approved by the committee.

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MainStage: Building Active Listening Space on UC Campus

A thesis submitted to the
Graduate School
of the University of Cincinnati
in partial fulfillment of the
requirements for the degree of

Master of Architecture

In the School of Architecture and Interior Design
of the College of Design, Architecture, Art, and Planning

by

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B.Des. Arch. University of Florida

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Committee: Vincent Sansalone, Chair
Jerry Larson
Listening is a basic and vital way people connect to each other and the spaces they inhabit. Dramatic and musical performances bring listening to the surface of perception, bringing performer and listener together in the space of performance. The complete separation of performance spaces from their context creates an artificial and potentially counterproductive separation between “music” and “everyday sound.” While indoor performance spaces are useful and convenient spaces for public performance, concert halls cannot replace or reproduce the experience of outdoor listening, and they do not need to do so. While there are many spaces for the presentation of theater, music, dance, and other modes of performance on the University of Cincinnati’s campus, most of them are enclosed, conditioned, and shut off from the outside world.

When made fully accessible and spatially inviting, spaces designed for gathering and performance can become special listening places at all times, whether a performance is happening or not. For this project, the ancient Greek theater will be used as a formal and conceptual precedent; its principles will be applied to a new physical and cultural context. The design of an open-air performance space on UC’s West Campus will serve as a way to explore the relationships between architecture, ambient sound, performance, and place while also addressing issues of site-specificity and public identity. The new performance space is proposed as an asset to the College-Conservatory of Music and the larger community. This thesis addresses relationships between sound, action, and place. ‘MainStage’ is proposed as a complement to and extension of ‘MainStreet,’ an already extant and vibrant pedestrian corridor on UC Campus. The goal of MainStage is to provide a place for formal and informal gathering, performance and listening, hopefully serving to stimulate UC’s community and culture in the process.
Introduction

Sound
  aural experience
  noise and music
  acoustics and listening

Action
  listening
  performing
  gathering

Place
  site/situation
  program/precedent
  process/design
Outdoor performance spaces can be vibrant spaces for listening, vital nodes of activity, and strong catalysts to the formation of a sense of place.

The character of listening spaces expresses and reinforces values associated with sound; being able to transform the aural character of a space allows for a fluid and flexible relationship between audience and performer, as well as the relationship between ‘music’ and ‘noise’

Using responsive architecture, context, and public space as tools, this project seeks to foster an open-minded and experimental relationship between the ambient sound and activity of the site and the sound and activity of the stage.

The main premise of this thesis is threefold:
1. Sound can charge place with emotion and a sense of presence.
2. Music is intentional(ized) sound.
3. Space for listening includes intentional and non-intentional sound.
By balancing and attempting to unify these basic concepts, I am working towards an architectural position that addresses neglected and dormant issues, both on UC campus and in current architectural discourse.

This document is divided into three main parts: sound, action, and place.

Each of these sections address a set of sub-concepts:

In “Sound” I discuss aural experience, acoustics, concepts of music and noise, and music/sound art precedents.

In “Action” I discuss the action of performing, the action of making architecture for performance, and the idea of acting on and within architecture.

In “Place” I discuss the site, program, precedents, and design process.
Sound affects how we experience architecture. Often this influence is subtle, even unnoticeable, but we are always immersed in an ocean of sound. Architects, artists, philosophers, musicians, and scientists have all studied the role sound plays in the experience of space. I will discuss some of their ideas, especially those that have a large-scale focus and

In this section, I will discuss the division of sound into two categories: music and noise. Although this division is arbitrary and elastic, their relationship must be addressed in the design of an outdoor performance space. I believe this building type is unique in providing an opportunity to productively explore the coexistence and interactions of intentional and unintentional sound.

Ultimately, this project is not about delving into the specifics of acoustics or the intricacies of music or the politics of noise. It is a way of framing all of these issues in a space and program that can benefit from the overlaps and tensions inherent in all of these forces.
R. Murray Schafer has coined the term ‘soundscape’ in an attempt to group all sounds in a given place as a holistic system. Schafer 1977. Soundsapes have also been described as ‘acoustic ecologies,’ in which the relationships between the system’s many sounds and sound sources are complex and intricately interconnected. Schafer and the World Soundscape project have provided a number of influential and provocative ways of thinking about sound, some of which have influenced my thinking and methods in dealing with sound. Before explaining how this project confronts the soundscape as a whole, I will first talk about the two major conceptual categories in sound: music and noise.

Music is important and integral to every culture, Turino 2008. There are many uses for and contexts associated with music: from intensely private to casually public, from secular to religious, from pleasurable recreational music to the work songs of slaves. Even those who reject musical performance as against their belief system seem to make excuses, allowances, or substitutions of other activities that allow them to present and listen to sound in a musical way. For example, some Islamic scholars say that music is prohibited by the Qur’an. Some restrict certain musical instruments, while others restrict every type of musical performance except for singing. Even if music
MUSIC IN ISLAM

Contents

Introduction
Music is Haraam
The Effects

Introduction

In recent years, certain developments have taken place which has brought the subject of music as an extremely significant issue. Music has spread to such an extent that it is afflictimg every muslim in this modern era. Today, individuals are being confronted by a situation where one is forced to listen to music whether by choice or without. Music is played in nearly all department stores and super markets. Even whilst walking in the streets, we find cars blaring with music. No matter which direction we go, we are blasted with music. The increasing popularity of music, which is prevalent in our society poses a tremendous danger for muslims.

Music is Haraam

References within the context of the Holy Qur’an along with the Hadith of the Prophet ﷺ confirm that music is haram. Interpreters of the Qur’an have defined the term ‘lahwat hadith’ which is mentioned in the Qur’an as:

1) Singing and listening to songs.
2) Purchasing of male and female singers.
3) Purchase of instruments of fun and amusement.

When Sayyiduna Abdullah Ibn Mas’ood ﷺ, a very close companion of our Prophet ﷺ, was asked about the meaning of the term 'lahwat hadith', he replied

“I swear by Him besides whom there is no other God, that it refers to ghinaa (singing).”

This statement, he repeated three times. This view is unanimously supported by the four Khalifas, the eminent Sahabaah, Tabi’een, the four Imams and other reliable Islamic scholars and authorities.

One hadith from the Bukhari Shareef, the most authentic Book of Hadith, further confirms unlawfulness of music and singing:

“There will be people of my Ummah who will seek to make lawful; fornication, wine-drinking and the use of mu’aazzif (musical instruments).”

Detailed analysis of the arabic word ‘mu’aazzif’ shows that it refers to musical instruments, the sounds of those musical instruments and singing with the accompaniment of instruments.

Closer analysis of the wordings of the Hadith establishes the prohibition of music. Firstly, the words “seek to make lawful” shows that music is not permissible, as logically one can only seek to make lawful that which is not allowed. Secondly, if music was not prohibited, then it would not have been brought within the same context as fornication and wine-drinking.

MUSIC - IT’S EFFECTS

Muslims are aware of nothing that has been prohibited by Allah except that which is harmful to the welfare of a Muslim individual and the society as a whole. The divine attribute behind the prohibition of music can be comprehended by looking into the diverse influence music can have.

Experiments carried out by doctors and professors have confirmed that the music of today is such that it does not only affect the brain, but each and every organ of one’s body. There is a close relationship between music and bodily movements. We find that people listening to music automatically start tapping their fingers and feet, as if the music is permeating in their blood.
were completely prohibited. Muslims still experience the recitation of the Qur'an and call to prayer, both activities which deal with the shaping of sound with the voice in a different way than everyday speech, fulfilling a deep need for melody and rhythm. This example points to a definition of music in its most basic form: an intentional separation and presentation of certain privileged sounds from any others that may be happening in the space. This process of separation is done both cognitively and physically. Cognitively, we seem to use the same method to separate music from other sounds as we use to separate speech from other sounds. In fact, this very broad definition of music can also be used for speech: sounds performed for others that must be sifted out from other sounds in order to understood. Although distinctions can be made between speech and song, these distinctions are not absolute and are largely irrelevant in the design of a flexible outdoor performance space.

Rhythm, especially musical rhythm, is intrinsically tied to our heartbeats. While the sound of our heartbeat normally passes without notice (except when we suspect that something is wrong), hearing develops before sight in the fetus, and there is a period of time in the womb when the sound of our mother’s heart, rushing blood, and voice are major features of experience. [http://health.discovery.com/centers/pregnancy/americanbaby/senses.html]

“With respect to music, the emergence of sound art in the 1980s was characterized by a problematic attitude toward Western art music - in particular, the avant-garde and experimental work claiming a relationship to sound per se. The idea of the musicalization of sound arose as a means to identify and supersede techniques in which sounds and noises were made significant by making them musical.”
The word Rhythm comes from a Greek word related to the word for “flow.” Oxford English Dictionary, Online Edition. This has an interesting connection to the psychologist Mihaly Csoszntmihalyi’s conception of flow, Turino 2008. In his book Music as Social Life, Thomas Turino describes “flow” as a state of mind in which one becomes focused, clear-minded, and completely immersed in the activity at hand. As Turino and others have discussed, music often produces flow, and changes the perception of time in many listeners and performers. This warped sense of time is just one of the ways music creates altered states. In Csoszntmihalyi’s words, music can guide us into “optimal experience.”

Like music, Noise is a contentious and slippery term for a conceptual region of the soundscape. Generally speaking, noise is unwanted sound. Of course, different people have different value judgements with regards to sound; these differences in the definition of noise have spurred conflict, legislation, and tension between different groups. R. Murray Schafer has categorized soundscapes as being “hi fidelity” or “low fidelity,” the distinction being that low fidelity soundscapes have certain overriding noises that disturb and drown out other sounds, as opposed to high fidelity environments in which a constellation of different sounds can be distinctly heard. Schafer gives examples, calling out natural settings

1 Make a joyful noise unto the LORD, all ye lands.  
2 Serve the LORD with gladness: come before his presence with singing.  
From Psalm 100, King James Bible.

Sound is intrinsically and unigorably relational: it emanates, propagates, communicates, vibrates, and agitates; it leaves a body and enters others; it binds and unbinds, harmonizes and traumatizes; it sends the body moving, the mind dreaming, the air oscillating. It seemingly eludes definition, while having profound effect.
Brandon Labelle, Background Noise
such as forests (with their choruses of animal and insect noises) as high fidelity environments, while a busy city street (with its loud drone of passing cars) might be a low fidelity environment.

In his writings on sound art, Brandon Labelle has explored the concept of ‘background noise’ as a positive force: a ground against which figures can show themselves and from which sound(s) can grow. In his book entitled *Background Noise*, Labelle seeks to “lend more thorough consideration onto instances of sound art at its most social, most spatial, and within its most public moments, where it is brought self-consciously into play with the intention of performing...” *Labelle 2007.*

LaBelle’s discussion of sound artists and their work is wide-ranging and explorational, starting with John Cage and associated artists, juxtaposing those artists with musique concrète composers, jumping to Japan and the percussion/performance ensemble Group Ongaku, and culminating in a discussion of contemporary sound artists such as Bill Fontana, Max Neuhaus, and Maryanne Amacher. One thing many of these artists have in common is their interest in reframing, presenting, and revealing sounds usually considered ‘background noise’ - the sounds of bridges, electrical vibrations, etc.

Noise, as a concept, has a long and
complicated history. From being ignored, to being swept under the rug of perception, to being shut out and fought against, to being presented as music, to being presented as art, noise is a flexible concept that thrives in opposition to privileged sounds such as music and speech. In his book *Noise Water Meat*, Douglas Kahn compares noise to dirt, and I find this to be an apt comparison. With all of the connotations of richness, life, decay, and filth, dirt and noise have a similar reputation and a similar potential for the fertilization of sterile environments.

Depending on the tolerance and expectations of listeners, noise can be a poisonous distraction or a comforting/exciting presence; to present sound in an outdoor setting is to encounter noise and deal with it, taking its positive and negative aspects as part of a dynamic experience. Although noise is an important part of the aural design of outdoor performance spaces, there are other important acoustical issues that come to bear on the topic.

The study of acoustics has four major areas of inquiry: reflection of sound off of surfaces, absorption of sound into materials, refraction of sound through openings, and the transference of sound through materials (including air). As the ancient Greeks knew, sound is a wave that moves in an outwardly
radiating sphere unless interrupted by materials capable of reflecting or absorbing the wave. More precisely, sound is a pressure wave that moves in sequences of expansion and contraction, bumping particles into one another to cause the expansion of the overall wave front. I believe this understanding of sound as interacting waves of particles is vital to the development of useful acoustical intuition.

One of the first surviving treatises on architectural acoustics comes from Vitruvius. In book five of *De Architectura*, he gives guidelines on the siting and design of outdoor theaters, a tradition inherited from the Greeks. In his discussion of sound and public space, Vitruvius addresses air quality, seating capacity, music theory, and other issues, attempting to unify these fields into a comprehensive theory on the design of the amphitheater. Virtuvius urged architects to select a suitable site and follow proportional and geometric principles that followed an understanding of music and speech. He called the two modes of music “proportional” and “actual.” The “proportional” mode is a conflation of harmonic proportion and spatial proportion, with the accompanying assertion that a proportion that is satisfying in sound (for example, two plucked strings of different length) will be satisfying in spatial layout. Palladio, Alberti, and other

When these matters are arranged with great care and skill, particular attention must be bestowed on the choice of a place where the voice falls smoothly, and reaches the ear distinctly without an echo. Some places are naturally unfavourable to the diffusion of the voice.

Vitruvius, *Ten Books on Architecture*, Book V

Where Gothic architecture had effected a harmonic rationalization of music, Renaissance music, inversely, initiated a gradual increase in sonic tension between new sounds people were learning to hear, and the architecture of the church. This strain... would eventually lead to a divergence between classical music and the sacred architecture that so influenced its roots. Music, in effect, outpaced its architectural context and required a new kind of space to be adequately heard.

architects used systems based on musical proportion, claiming a link to the larger cosmos and a fulfillment of a direct connection between music and architecture. Sheridan 2003. The “actual” mode of acoustics addresses architecture as it can be heard. It relays specific advice, derived from experience and experimentation, on how sound behaves under certain physical conditions.” Sheridan 2003. It is the complex and ephemeral nature of sound that pushes acoustical design toward strategies that are empirical and ad hoc.

Ted Sheridan argues that the history of concert hall design is “the story of [a] struggle to create an architecture that has a condensed acoustic envelope within a large, expansive space.” As music and theater moved indoors (starting in the middle ages), the design of large volumetric spaces accompanied the development of large scale musical compositions. Spatial practices and musical practices pushed and pulled each other until a balance was reached and a tradition was established. To this day, concert halls are built with specific musical compositions in mind, and are tuned precisely to fulfill expectations of how this music should sound.

Modern acoustics started in the early 20th century with Wallace Clement Sabine’s rigorous experiments on relationships between speech intelligibility, room reverberation
of the measured data, some adjustments may have to be made to account for different air cavity depths or mounting methods.

Occasionally it is necessary to estimate the absorption of materials beyond the range of measured data. Most often this occurs in the 63 Hz octave band, but sometimes occurs at lower frequencies. Data generally are not measured in this frequency range because of the size of reverberant chamber necessary to meet the diffuse field requirements. In these cases it is particularly important to consider the contributions to the absorption of the structural elements behind any porous panels.

**Layering Absorptive Materials**

It is the rule rather than the exception that acoustical materials are layered in real applications. For example a 25 mm (1 in) thick cloth-wrapped fiberglass material might be applied over a 16 mm (5/8 in) thick gypsum board wall. A detailed mathematical analysis of the impedance of the composite material is beyond the scope of a typical architectural project, and when one seeks the absorption coefficient from tables such as those in Table 7.1, one finds data on the panel, tested in an A-mounting condition, and data on the gypsum board wall, but no data on the combination.

If the panel data were used without consideration of the backing, the listed value at 125 Hz would suggest that there would be a decrease in absorption from the application of the panel relative to the drywall alone. This is due to the lower absorption coefficient that comes from the test mounting method (on concrete), rather than from the panel itself.

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**Table 7.1 Absorption Coefficients of Common Materials**

<table>
<thead>
<tr>
<th>Material</th>
<th>Mount</th>
<th>125</th>
<th>250</th>
<th>500</th>
<th>1k</th>
<th>2k</th>
<th>4k</th>
</tr>
</thead>
<tbody>
<tr>
<td>Walls</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Glass, 1/4&quot;., heavy plate</td>
<td></td>
<td>0.18</td>
<td>0.06</td>
<td>0.04</td>
<td>0.05</td>
<td>0.02</td>
<td>0.02</td>
</tr>
<tr>
<td>Glass, 3/32&quot;, ordinary window</td>
<td></td>
<td>0.55</td>
<td>0.25</td>
<td>0.18</td>
<td>0.12</td>
<td>0.07</td>
<td>0.04</td>
</tr>
<tr>
<td>Gypsum board, 1/2&quot;, on 2 x 4 studs</td>
<td></td>
<td>0.29</td>
<td>0.10</td>
<td>0.05</td>
<td>0.04</td>
<td>0.07</td>
<td>0.09</td>
</tr>
<tr>
<td>Plaster, 7/8&quot;, gypsum or lime, on brick</td>
<td></td>
<td>0.013</td>
<td>0.015</td>
<td>0.02</td>
<td>0.03</td>
<td>0.04</td>
<td>0.05</td>
</tr>
<tr>
<td>Plaster, on concrete block</td>
<td></td>
<td>0.12</td>
<td>0.09</td>
<td>0.07</td>
<td>0.05</td>
<td>0.05</td>
<td>0.04</td>
</tr>
<tr>
<td>Plaster, 7/8&quot;, on lath</td>
<td></td>
<td>0.14</td>
<td>0.10</td>
<td>0.06</td>
<td>0.04</td>
<td>0.04</td>
<td>0.05</td>
</tr>
<tr>
<td>Plaster, 7/8&quot;, lath on studs</td>
<td></td>
<td>0.30</td>
<td>0.15</td>
<td>0.10</td>
<td>0.05</td>
<td>0.04</td>
<td>0.05</td>
</tr>
<tr>
<td>Plywood, 1/4&quot;, 3&quot; air space, 1&quot; batt,</td>
<td></td>
<td>0.60</td>
<td>0.30</td>
<td>0.10</td>
<td>0.09</td>
<td>0.09</td>
<td>0.09</td>
</tr>
<tr>
<td>Soundblox, type B, painted</td>
<td></td>
<td>0.74</td>
<td>0.37</td>
<td>0.45</td>
<td>0.35</td>
<td>0.36</td>
<td>0.34</td>
</tr>
<tr>
<td>Wood panel, 3/8&quot;, 3-4&quot; air space</td>
<td></td>
<td>0.30</td>
<td>0.25</td>
<td>0.20</td>
<td>0.17</td>
<td>0.15</td>
<td>0.10</td>
</tr>
<tr>
<td>Concrete block, unpainted</td>
<td></td>
<td>0.36</td>
<td>0.44</td>
<td>0.51</td>
<td>0.29</td>
<td>0.39</td>
<td>0.25</td>
</tr>
<tr>
<td>Concrete block, painted</td>
<td></td>
<td>0.10</td>
<td>0.05</td>
<td>0.06</td>
<td>0.07</td>
<td>0.09</td>
<td>0.08</td>
</tr>
<tr>
<td>Concrete poured, unpainted</td>
<td></td>
<td>0.01</td>
<td>0.01</td>
<td>0.02</td>
<td>0.02</td>
<td>0.02</td>
<td>0.03</td>
</tr>
<tr>
<td>Brick, unglazed, unpainted</td>
<td></td>
<td>0.03</td>
<td>0.03</td>
<td>0.04</td>
<td>0.04</td>
<td>0.05</td>
<td>0.07</td>
</tr>
<tr>
<td>Wood paneling, 1/4&quot;</td>
<td></td>
<td>0.42</td>
<td>0.21</td>
<td>0.10</td>
<td>0.08</td>
<td>0.06</td>
<td>0.06</td>
</tr>
<tr>
<td>with airspace behind</td>
<td></td>
<td>0.19</td>
<td>0.14</td>
<td>0.09</td>
<td>0.06</td>
<td>0.06</td>
<td>0.05</td>
</tr>
<tr>
<td>Wood, 1&quot;, paneling with airspace behind</td>
<td></td>
<td>0.19</td>
<td>0.14</td>
<td>0.09</td>
<td>0.06</td>
<td>0.06</td>
<td>0.05</td>
</tr>
<tr>
<td>Shredded-wood fiberboard, 2&quot;, on concrete</td>
<td>A</td>
<td>0.15</td>
<td>0.26</td>
<td>0.62</td>
<td>0.94</td>
<td>0.64</td>
<td>0.92</td>
</tr>
<tr>
<td>Carpet, heavy, on 5/8-in perforated mineral fiberboard</td>
<td></td>
<td>0.37</td>
<td>0.41</td>
<td>0.63</td>
<td>0.85</td>
<td>0.96</td>
<td>0.92</td>
</tr>
<tr>
<td>Brick, unglazed, painted</td>
<td></td>
<td>0.01</td>
<td>0.01</td>
<td>0.02</td>
<td>0.02</td>
<td>0.02</td>
<td>0.03</td>
</tr>
<tr>
<td>Light velour, 10 oz per sq yd, hung straight, in contact with wall</td>
<td>A</td>
<td>0.03</td>
<td>0.04</td>
<td>0.11</td>
<td>0.17</td>
<td>0.24</td>
<td>0.35</td>
</tr>
<tr>
<td>Medium velour, 14 oz per sq yd, draped to half area</td>
<td></td>
<td>0.07</td>
<td>0.31</td>
<td>0.49</td>
<td>0.75</td>
<td>0.70</td>
<td>0.60</td>
</tr>
<tr>
<td>Heavy velour, 18 oz per sq yd, draped to half area</td>
<td></td>
<td>0.14</td>
<td>0.35</td>
<td>0.55</td>
<td>0.72</td>
<td>0.70</td>
<td>0.65</td>
</tr>
</tbody>
</table>

*From Marshall Long, Architectural Acoustics*
BASIC PHYSICS

THE MULTITUDE OF NATURE OF ACOUSTICS

The science of sound is closely related to the study of physics, chemistry, and mathematics. It is the study of the behavior and properties of sound waves, including their generation, transmission, and perception. Sound waves are mechanical waves that travel through a medium, such as air, water, or solids, and are characterized by their frequency, amplitude, and wavelength.

THE ACOUSTIC ENVIRONMENT

The acoustic environment is the space in which sound waves travel. It is influenced by factors such as temperature, humidity, and air pressure, which can affect the speed and direction of sound waves. The acoustic environment also includes the presence of objects, such as buildings and obstacles, which can reflect, absorb, or scatter sound waves.

THE PHYSICAL PROPERTIES OF SOUND WAVES

Sound waves are longitudinal waves, meaning that the particles of the medium vibrate parallel to the direction of the wave. The speed of sound is determined by the properties of the medium through which it travels, including its density and compressibility.

PROPAGATION OF SOUND WAVES

Sound waves are propagated through compression and rarefaction, resulting in changes in the pressure of the medium. These changes are transmitted to adjacent particles, which then transmit the wave to other particles, creating a chain reaction that propagates the sound wave through the medium.

The speed of sound in air at room temperature and standard atmospheric pressure is approximately 343 meters per second. Sound waves are also influenced by temperature, with sound waves propagating faster in hotter air and slower in colder air.

APPROXIMATING THE EFFECTS OF MECHANICAL WAVES

The effects of mechanical waves, such as sound waves, can be approximated using mathematical models and equations. These models can help predict the behavior of waves in different environments and under different conditions.

The study of sound waves and their effects is important in many fields, including acoustics, engineering, and medicine. Understanding the properties and behavior of sound waves is crucial for designing and optimizing systems that involve the transmission of sound, such as speakers, microphones, and other audio equipment.
SOUND PRESSURE LEVEL

To compress these large numbers into an easier-to-use format, sound pressure levels (SPLs) are expressed using the logarithmic decibel (dB) scale.

CHARACTERS IN SOUND PRESSURE LEVELS.

Because of their logarithmic nature, decibel values cannot be simply added. To predict changes in sound pressure level when additional sound sources are added, the following rules of thumb can be used:

1. If the difference between two sound levels is:
   - 0 - 1 dB add 1/2 dB to the higher level
   - 1 - 3 dB add 1 dB to the higher level
   - 3 - 6 dB add 2 dB to the higher level
   - 6 - 9 dB add 3 dB to the higher level
   - 9 dB or more add 4 dB to the higher level

HUMAN SENSITIVITY TO CHANGES IN SOUND LEVEL.

Because the difference between two sound levels is:

1. 1 dB the change is barely perceptible
2. 3 dB the difference in loudness is barely perceptible
3. 6 dB the difference in loudness is noticeable
4. 9 dB the difference in loudness is obvious
5. 12 dB the difference in loudness is obvious
6. 15 dB the sound appears twice as loud
7. 18 dB the sound appears four times as loud

INVERSE SQUARE LAW.

The spherical divergence of sound in space decreases the intensity of sound with distance. The inverse square law can be used to estimate the change in sound pressure level (SPL) due to distance.

The formula for calculating the change in SPL due to distance is:

\[ \text{SPL}_{\text{new}} = \text{SPL}_{\text{old}} - 6.02 \times \log_{10}(\text{distance}) \]

SOURCE POWER LEVELS AND SOUND PRESSURE LEVELS

<table>
<thead>
<tr>
<th>FREQUENCY (Hz)</th>
<th>SOUND PRESSURE LEVEL (dBA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 Hz</td>
<td>0 dB</td>
</tr>
<tr>
<td>1 kHz</td>
<td>20 dB</td>
</tr>
<tr>
<td>10 kHz</td>
<td>60 dB</td>
</tr>
<tr>
<td>100 kHz</td>
<td>120 dB</td>
</tr>
</tbody>
</table>

RESIDENTIAL NOISE

- Automobiles: 60 - 70 dBA
- Vacuum cleaner: 60 - 70 dBA
- Garbage disposal: 65 - 75 dBA
- Washing machine: 60 - 70 dBA
- Air-conditioning unit: 60 - 70 dBA
- Running: 70 - 80 dBA
- Street noise: 75 - 85 dBA
- Traffic noise: 80 - 90 dBA

From Gruneisen, Soundspace
PSYCHO-ACoustics

HUMAN HEARING

The two main aspects of human hearing are the physiology of the auditory system, and the processing of sound information in the brain. The resulting perception of sound is not easily measurable, and does not always relate to physical events in a linear fashion.

PERCEPTION

Psycho-acoustics is concerned with the perception of sound. It is not an isolated discipline, but is closely interrelated with psychology, physiology, medicine, physics, music, engineering, architecture and other fields. The relative and subjective nature of perception and the complexity of the involved processes are the subjects of much ongoing research.

Human hearing and perception is a complex and highly evolved system. It can detect a wide range of sounds and identify them by pitch, timbre, loudness, and location.

PRESSURE RANGE

At the threshold of hearing, the lowest perceivable sound pressure level, movements of the ear canal can be as small as one tenth the size of a hydrogen atom. But the ear can also respond to sound pressures a million times greater, with an energy content of a trillion (10^12) times more.

SELECTIVITY

The auditory system has the ability to select and recognize different sounds by their frequency and timbre, or to pick them out of an array of other sounds.

THE PHYSIOLOGY OF HEARING

THE AUDITORY MECHANISM

The ear is divided into three parts: the outer ear, the middle ear, and the inner ear. Each fulfills a distinctive function, from gathering sound to forwarding information to the central nervous system.

THE OUTER EAR

The pinna, or external ear, receives and directs sound into the ear canal. Its characteristic shape acts as a comb filter whose frequency response helps with the localization of sound sources, especially at higher frequencies.

THE MIDDLE EAR

The eardrum, three small bones (the hammer, anvil, and stirrup) in the middle ear, further reinforces the sound energy striking the eardrum. Acting as mechanical levers, they transfer the vibrations to the inner ear.

THE INNER EAR

The fluid-filled and oval-shaped cavities of the inner ear are the transducer that turns the mechanical energy from the middle ear into electrical signals for the auditory cortex in the brain. Sound energy in the oval window, responds to frequency-dependent vibrations, resulting in the perception of pitch.

HEARING LOSS

Upper frequency hearing usually diminishes with age. Long-term, or repeated, exposure to intense sound levels, occupational or recreational, can cause permanent damage at all ages.

Health regulations govern both the loudness level and time of exposure per day. Music industry and medical groups are concerned with the protection of musicians, audio professionals and audiences.

PERCEPTION VERSUS PHYSICS

While measurements of the physical aspects of sound are reproducible and allow accurate predictions of its varieties, human perceptual responses are not predictable.

TERMINOLOGY

Subjective attributes of sound are frequently used to describe sound, especially in music.

PHYSICS

Objective (measurable)

Perception

Sound pressure level (SPL)

Locomotor (e.g., sound"

Spectrum"

Tone, or pure tone, quality"

PITCH

Pitch is the subjective perception of frequency, the characteristic of a sound that makes it sound higher or lower, or that determines its relative position on a scale.

For pure tones, pitch is determined mainly by frequency, but also by sound level. The pitch of complex sounds also depends on the timbre of the sound and its duration.

Absolute pitch is the ability to recognize the pitch of a tone without the use of a reference tone. Less than 0.1 percent of the population have this ability. Most people have a degree of relative pitch recognition, the ability to tell whether a tone is higher or lower than another.

Loudness

The relationship between sound pressure level and loudness perception is not linear. Equal loudness contours show the average perception of loudness of a large number of test subjects.

Sounds at the same perceived loudness level have the same"
Industries machinery, as well as cooling, ventilation, and electrical equipment can be significant sources of noise in otherwise quiet areas.

**Sound Propagation**

Sound is attenuated with increasing distance from a point source, and to a lesser degree from a linear source, such as a freeway. Factors like topography, planting, atmospheric and wind conditions greatly influence propagation.

**Noise Surveys**

Measurements of noise can consist of short-term and long-term surveys. When combined, can present a picture of existing or expected noise levels. Basic noise level measurements can be interpreted through spectrum analyzers for frequency-specific data.

**Zoning Lamps**

By surrounding areas out of the residential area, a non-residential area, a highway to prevent noise. Special provisions must be taken.

**Noise Mitigation Measures**

Location and relative proximity to potential sound sources is a key factor in determining expected noise levels.

**Terrain Shapes**

Natural or man-made topographic shapes are very effective in shielding or propagating sound.

**Outlining Barriers**

Fencing or structures buildings can deflect, absorb or reflect sound, especially higher frequencies. Diffraction around barriers occurs for lower frequencies, making them less effective at greater distances.

**Vegetation**

Surface vegetation can help attenuate propagated sound. However, this shading effect of trees and shrubs is often underestimated. A thin visual barrier of greenery has a negligible effect on a sound barrier.

**Building Placement**

The separation and overall shape of buildings can block or propagate undesired noise and affect sound levels.

**Building Features**

Barriers, balconies, overhangs, strucures, recesses and surface treatments in building designs can be used to improve acoustical protection from outdoor noise. Shadow zones out of the acoustical line of sight from nearby sources can prevent openings. Diffraction around barriers and unsmooth reflections from hard surfaces need to be considered.

The correct detailing and construction of building elements into windows, doors and mechanical systems are further steps in blocking unwanted noise.

---

**Room Acoustics**

Acoustic design is not limited to obvious applications such as concert halls; it is relevant to many other, more mundane spaces. The prediction and planning of sonic performance is the concern of room acoustics. Like architecture itself, it falls somewhere between the scientific and the intuitive.

Contrary to free-field conditions, the boundaries of a room greatly affect sound in indoor spaces. Most of the sound energy reaching a listener inside a room has already been reflected by surfaces and objects.

Sound, with its different frequencies and wavelengths, requires various analytical approaches, depending on its properties. Higher frequencies can be predicted by using on-acoustic theories, while lower frequencies are affected by room acoustics and normal modes.

**General Room Properties**

The volume of a room influences its acoustic properties. The sound of large spaces is effectively understood to be different from smaller rooms.

Small rooms have a tendency towards more pronounced modal resonances related to their specific proportions.

In large rooms, reverberation is more pronounced and echoes are more likely to occur. Long waves have room to develop, and low frequencies respond better.

**Proportions**

Room proportions strongly affect acoustic performance, especially in smaller rooms.

Equal or whole multiples of room dimensions in different directions result in SPL's and acoustic properties in a room that are enhanced to favor upper and disturbing bass sounds.

Desirable room proportions, resulting in favorable even distribution of room modes, have been identified by various acousticians (表A-1).
GEOMETRY

Room shapes determine the reflection patterns for high frequencies and the build-up of standing waves for lower frequencies. Irregularly shaped spaces can permit better design control, but are also more complex to predict. [06–07]

ROOM MODES
Standing waves, or room modes, are due to the build-up of low-frequency sound waves that radiate directly to a specific spatial dimension.

The first (fundamental) axial mode between two surfaces occurs when one half of the wavelength corresponds to the room dimension. Harmonic modes occur at multiples of the fundamental frequency. [08]

Additionally, modes arising from a rectangular mode between four surfaces, and oblique modes involving six or more surfaces fall into these dimensions. [09]

Consideration, single dominant room modes are undesirable. They can be minimized by choosing irregular room proportions and by adding frequency absorbers. Airing walls and ceilings can improve the distribution of standing waves, but does not eliminate them.

ROOM BOUNDARIES

REFLECTIONS
Flat surfaces, with dimensions sufficiently larger than the wavelength of a sound wave, can reflect a sound wave to another surface. Where the angle of reflection equals the angle of incidence. [09]

Reflection patterns depend on the surface shape.

Corresponding diffuse wave fronts, creating a wide distribution pattern of the sound energy, can often be used to acoustically advantage.

Concrete surfaces focus wave fronts to one point, creating unique reflection patterns. All points of any geometric form should not be near the locations of any receiver.

Corner reflections can be problematic because they reflect sound back in the direction of the incoming wave front. [09]

ECHOS
Echoes occur in rooms with parallel hard surfaces, or hard concave shapes.

REFLECTION FREE ZONES
Under certain circumstances, such as in the control room of a recording studio, areas completely free of first-order reflections must be created.

DIFFUSION
Diffusion occurs when sound waves are reflected from surfaces that the sound energy is redistributed in all directions. To diffuse sound waves, reflecting surfaces should generally have irregularities at approximately the scale of half the wavelength of the sound. [09]

To achieve diffusion over a broad band of sound frequencies, all wavelengths must be scattered. Self-similar patterns at different scales, such as fractal geometry, can be layered onto a surface for this purpose. Decorative surfaces and architectural details in historic buildings perform the same function.

Dissimilar surfaces reflect sound as a combination of specular and diffuse reflections. [09]

DIEFFUSE SOUNDS
When energy from a sound source reaches the listener’s ears, it is reflected off surrounding surfaces, and the variation of sound coming from all directions at equal levels is heard.

DIFFRACTION
Sound waves encountering an obstacle change their direction of travel to bend around it. Similarly, when sound waves pass through an opening in a surface, they spread out, a phenomenon known as diffraction.

The degree of diffraction depends on the size of the obstacle or opening in relation to the wavelength of the sound. Larger wavelengths have much more easily; lower frequencies can therefore be heard even when the source is not visible. [09]

DIFFUSION
A change in the direction of travel of waves occurs when the speed of propagation changes. This can happen either abruptly, at a change of medium in a solid, or gradually, when sound waves travel through air of different temperatures. A similar effect can be experienced by vehicles passing by. [09–10]

SOUND ABSORPTION
Absorption is the transformation of sound into another form of energy, for example into heat. The level of sound absorption in a space will have a great effect on the reverberation time and loudness. Sound absorption is highly frequency dependent.

SOUND ABSORPTION COEFFICIENT
The sound absorption coefficient (\(\alpha\)) is the indicator of a material’s absorption capacity. It describes the fraction of the incident sound energy a material absorbs at a given frequency.

One square foot of perfect (100%) sound absorption equals 1 table.

Materials with a high absorption coefficient, such as cotton, felt, and войлак, are known to be absorptive materials. Materials with a low absorption coefficient, such as stone, metal, and glass, are known to reflect sound energies. [10–11]

CHARTS or graphs show the sound absorption coefficients for various materials across the spectrum, or vice versa available. Manufacturers provide values for specific building products. [10–11]

NOISE REDUCTION COEFFICIENT
The NRC is a simple average of a material’s absorption coefficients at the middle frequencies, standardized to be used for rough estimates.

TOTAL ROOM ABSORPTION
The sum of all room surfaces multiplied by their respective absorption coefficients adds up to the total room absorption:

\[ A = \sum_{i=1}^{n} A_i \]

where:

- \( A \) = total room absorption (in sq ft)
- \( A_i \) = area of the room (in sq ft)

The sound absorption coefficient at a given frequency is:

\[ \alpha = \frac{A}{\pi d^2} \]

ABSORPTION BY AIR
In large spaces, sound absorption by air becomes a significant factor for higher frequencies, resulting in a reduction of sound energy above 1 kHz. [10–11]

ABSORPTION BY PEOPLE
In spaces with an audience, sound absorption by the occupants in the area factor. Differences between concert halls and theaters may be significant. [10–11]
SOUND ABSORPTION METHODS

There are two types of sound absorbers: hard and soft. The greatest effect occurs when the entire spectrum is achieved with a combination of different absorbers.

POROUS ABSORBERS
Porous materials, the most commonly used absorbers, include carpet, drapes, "acoustic" ceiling tiles, glass fiber, mineral wool, cotton or felt batting, and lining, among other measures and open-cell foam.

These materials are generally applied to high frequencies well. Absorption occurs through friction in the internal spaces within the material. Main factors affecting the absorption are the thickness, as well as the insulation of the material and, to a lesser degree, the density of the material. [1-17]

Health concerns about loose fibers in fiberglass have been raised, and more variable insulators are available. Newer materials like cellulose, foamed and singed aluminum also offer alternative choices for sound absorption.

Composites: solid, fluffy, lightweight foams offer almost no insulation value, and have little effect for soundproofing.

BASE TRAPS
So-called "base traps" usually consist of porous materials thick enough to absorb low frequencies. In general, the greater the depth, or distance from a wall, the better it is. A quarter of the wavelength to be absorbed. For example, at 20 Hz, it requires a depth of 2.65 m (8'). This is often not a practical solution.

DISPERSIVE ABSORBERS
Most effective in the low frequency range at their own resonant frequency. Measuring panels can be tailored to specific frequencies and wavelengths.

While they can be installed in an existing room, drywall or partition, sometimes with advanced effects, they can be used purely to supplement sound absorbers, balancing the overall absorption range.

Dispersion absorbers absorb vibration in response to sound, thereby absorbing the energy. Factors affecting the frequency range are the panel density and the depth of the absorption behind. A broader bandwidth can be absorbed by adding porous material inside the airspace, thereby asymmetrically shaping the cavity or by the depth of the airspace. [1-17]

VOLUME RESONATORS
Sometimes called Helmholtz resonators, volume resonators are useful for narrow-band low frequency absorption. They can be tuned to a specific frequency.

Factors determining the resonant frequency are the size of the opening, the depth of the neck and the volume of trapped air behind the neck.

The basic concept of a single as-filled cavity with Helmholtz resonators can be expanded by combining an array of resonators. Large surface areas covered with wood slats and slits, or perforated panels can achieve the same effect. Damping the air space, or varying the depth, result in broader-band absorption. [21-22] Aquatic concrete blocks with cavities and slit patterns are examples of volume resonators available on the market.

From Gruneisen, Soundspace
ACOUSTIC DESIGN

The relatively low speed of sound is one of the reasons for acoustical problems in rooms. We can easily perceive differences in the arrival time of direct and reflected sounds. Echoes and reverberations are serious defects in many rooms. Other concerns are noise reduction, speech intelligibility and background noise levels.

NOISE CRITERIA

Noise criteria curves are used to determine the level of desired or acceptable background noise in a room, either to evaluate an existing situation, or to specify a design value. [12]

NC curves compensate for the lower sensitivity of the ear at lower frequencies. [23]

REVERBERATION

Addressing the build up and decay of sound over time, reverberation has been one of the most important aspects of room acoustics. While other research has been added constantly since the early days, reverberation still remains important. [11]

Reverberation times used to be too long to make speech perception without difficulty or impossible. If reverberation is too short, rooms sound "dead", and sound propagation is limited.

REVERBERATION TIME

Reverberation time is the duration it takes for the sound in a room to decay by 60 dB (also RT-60), or for a very loud sound to become effectively inaudible. [24]

Sabine's formula is used to predict reverberation time:

\[ T = \frac{0.167 \times V}{S} \]  
[Where:]
- \( T \) = reverberation time (time required for a sound to decay 60 dB after the sound source has stopped in seconds)  
- \( V \) = room volume in cubic meters (m³) or cubic feet (ft³)  
- \( S \) = total room absorption in sables (1 sable = 2.5 m²)

or:

\[ T = \frac{0.147 \times V}{S} + S_{\text{abs}} \]  
[Where:]
- \( T \) = reverberation time (time required for a sound to decay 60 dB after the sound source has stopped in seconds)  
- \( V \) = room volume in cubic meters (m³) or cubic feet (ft³)  
- \( S_{\text{abs}} \) = total room absorption in sables (1 sable = 2.5 m²)

This formula is accurate for most general acoustical calculations in relatively diffuse conditions, and with "typical" proportions, or about 500 Kg. For special requirements, more precise methods are available.

Reverberation is directly related to room volume; a greater room volume results in proportionally more reverberation.

Reverberation is inversely proportional to the amount of sound absorbing material in a room. More absorbing material results in less reverberation.

Reverberation time is frequency-dependent and needs to be checked for each octave band. Three-dimensional illustrations called "scientific graphics" show reverberation decay as a function of frequency and time. [23]

Different room uses require different reverberation times. [26]

NOISE REDUCTION

Sound levels in a room build up due to reflections from its enclosing surfaces. The size of the room and the amount of absorption in it determine the build-up of sound levels.

Noise reduction due to addition or removal of absorbing material can be predicted. Some absorptions vary with frequency.
ACTIVE ACOUSTICS
Electronic sound masking systems are sometimes used in office environments to provide an artificial background noise level and to improve speech privacy where ambient noise levels are too low.

Active noise reduction through electronics is a developing field. Through the recording and simultaneous playback with opposite phase of the ambient noise, the sound energy is cancelled. Currently feasible only for simple problems like fan noise in air conditioning ducts, development of active noise reduction is under way for larger applications.

Amplification and the enhancement of musical acoustics with electronic means is one of the new ground areas in the field of classical music. Reverberation level and other factors can be manipulated through electronic processors, even microphones and loudspeakers. These methods are useful in multipurpose rooms, to adjust them to precise demands. Although good results can be achieved, the basic principle remains controversial for many.

ACOUSTIC SIMULATION METHODS
As the developments in computer-aided acoustics continue to be a neutral environment, this allows the presentation to an audience and the prediction of existing and future conditions.

ROOM ACOUSTICS SIMULATIONS
The prediction of room-acoustic performance is an important tool for the design of spaces for sound. Much work has been done since Wallace Sabine's development of calculation methods for reverberation times over a century ago. Increasing computing power and ongoing research allow virtual acoustics to be modelled and analysed. Despite impressive advances, the precision and completeness of prediction of sonic performance remains elusive, and is as much an art as a science.

DRAWINGS
Single room acoustic analysis can be performed with two-dimensional drawings. Ray-tracing of sound paths is possible for high-frequency sounds, but complex for lower frequencies. Limited results can be achieved for isolated aspects of room acoustics. [28]

CALCULATIONS
Mathematical calculations and numerical analysis of data are the basis for establishing critical air volumes, low frequency response and room modes, as well as all other acoustical parameters.

Reverberation time calculations are a common tool for basic acoustic information.

PHYSICAL ARCHITECTURAL MODELS
Architectural models for acoustic testing were the closest approximation of real situations before the development of advanced computer modeling. They are still employed for large-scale projects and to verify the computer data.

Arrive models, filled with gas to account for the change in scale, can be used to perform three-dimensional tests. The frequencies of the test sounds are adjusted to the scale of the model. Microphones, with high sensitivity, are placed to simulate the audience, and are equipped with microphones to test each seat individually with frequency-scaled sound sources placed on the stage. [29]

COMPUTER MODELS
Modeling programs of varying complexity are available for acoustical predictions. [30]

Analytical programs for basic information on rectangular rooms are available at a relatively low cost. [31]

Proprietary programs for complex spaces have been developed for in-depth studies. More recent work shows other possibilities.

From Gruneisen, Soundspace

[figure: Acoustic model, Disney Concert Hall, Los Angeles, USA]

[figure: Acoustic data for rectangular spaces (room size, dpw)]

[figure: Complex modeling and acoustical (soft acoustic)]
time, and materiality of wall surfaces (specifically, sound absorption properties); he found an inverse relationship between the amount of absorptive material in the room and the reverberation time of the room. An engineer and mathematician, Sabine devised formulas and relationships that still guide the material selection and proportion of spaces, especially purpose-built, specialized halls for the performance of music and theater.

Sabine’s principles and those developed in the tradition of acoustical science and design are very useful and applicable in the design of outdoor spaces, but care must be taken to take the values and expectations of the authors into account, and to recognize that these expectations may be different than my own.

Direct sound contributes the most to the aural character of outdoor performance spaces. Since open volumes ‘leak’ a great deal of sound energy, direct sound is best thought of as a precious and fleeting resource. Stepped seating is used to get people closer to the sound source. Hard reflective surfaces can direct sound towards the listener. They can also create effects such as echo, sound focusing, and resonance depending on their texture, arrangement, geometry, and spatial relationship between sound source and sound receiver.

Our echoes roll from soul to soul,  
And grow for ever and for ever.  
Blow, bugle, blow, set the wild echoes flying,  
And answer, echoes, answer, dying, dying, dying.  
Alfred Tennyson, from The Princess
In some circles, the experience of outdoor listening has been maligned and neglected, especially by those who characterize music as a fragile and gentle entity that must be shielded from other sound sources. I am not refuting that traditional way of framing music—it is perfectly valid. I am arguing that hearing others is an important way we form our identities and enjoy public space. This outward listening action is not at odds with the notion of focusing inward on performance. Rather, spaces can be both designed as both mouth and ear, becoming a crucible for sound, a mouthpiece for sound, and a collector or net for sounds. This type of flexible space requires a careful consideration of action at multiple scales, which I will discuss in the next section.
In this section I will discuss three scales or modes of action that come into play in the project.

First is the project’s ostensible reason for being: the performance and reception of auditory events, including but not limited to music and theater.

Second is the act of changing acoustical properties of the architecture by direct physical action on architectural elements.

Third is the simple act of gathering, which provides a counterpoint to the formalized act of performance and brings attention to the spatial and contextual issues of place. •

If you can walk, you can dance.
If you can talk, you can sing. 
Zimbabwean proverb
For me, the most interesting and relevant interpretations of musical experience are those which posit musical experience as an active process that manifests in composers, performers, and listeners: potentially everyone can have a meaningful musical experience.

When people become engaged with a musical piece, listening can be a very active experience. We might follow along silently, tap our feet, sing along, dance, clap hands, play air guitar, yell; these are all natural and sometimes irresistible responses to the music we hear. These responses are related to the actions of performing, as we project, produce, and react to sound through the internal and external movements of our bodies.

Three major aspects of performance: timing, voice, and presence. These are obviously tightly related, and can be conflated, fused, and confused. Performers interact with the environment to create aural and visual effects that transform the experience of these elements. By ‘timing’ I mean not only the sequence and rhythm of sound but the effect of the experience of time on the part of listeners and performers. By ‘voice’ I mean literal audible voices and the more subtle establishment of identity through performance. Presence can manifest itself visually, audibly, and

The musical experience is dependent upon open-mindedness.
The musical experience is dependent on the adoption of a less hierarchical and more democratic relationship among composers, performers, and listeners.
The musical experience is dependent upon the encounter of musical difficulties.
John Cage, paraphrased by Reiner and Wright in On The Nature of Musical Experience

The musical experience is available only to those people (composers, listeners) who are armed with the full resources of their aural senses, psychological faculties, and intellect, and are capable of a kind of higher ‘speculation.’
The musical experience is made possible through two key elements of music - sound and time. Of the two, time is the more immediate.
The musical experience is dependent upon the counterpoint between real time and musical time.
The musical experience is dependent on the composer’s use of unity and variety.
Igor Stravinsky, paraphrased by Reiner and Wright in On The Nature of Musical Experience
Thomas Turino describes musical performance as having two major axes: it can range from performative to participatory, and from composed to improvised. This mapping of performance situations gives us a way of understanding how social expectations and performance situations affect the form and character of music and vice versa. For example, the repetition and rigid structure of much participatory music makes it possible for participants (musicians, dancers, or both) to join in and drop out at any time and improvise within the limits of the composition: a rigid, modular musical form allows for a more open social forum.

Turino is also interested in recorded vs. live music, and how this distinction changes the social dynamics of the musical presentation. Although pre-recorded, ‘static’ music, what Turino describes as “studio audio art,” is incredibly popular and ubiquitous, there is still a need for live, immersive performance. For Turino this liveness is most fully embodied in participatory music making, but can be meaningfully explored in other kinds of experience, including presentational music and theater.

It is almost as though a non-listening speech tends to favor “simple” mechanisms that divide and extinguish, whereas listening requires a laborious attitude more consistent with problems of integration and living. And the gathering that allows these qualities to unfold is not so much concentrated on a single point to the exclusion of others: it is a silent acceptance that tends to unite through the attitude of integrating and letting live. John Cage, quoted by Brandon LaBelle in Background Noise

...most Shona village musicians do not rehearse at all before a ceremony, although they play together over time both informally and in community events. Participatory performance usually do not have fixed programs or set lists; any number of pieces might be introduced in any order during the performance as participants desire or the event requires. Moreover, the dynamics and shape any piece takes will depend on the individual contributions of participants during performance, and these cannot be planned or predicted in advance.

Thomas Turino, Music as Social Life

No longer do we necessarily approach theatre primarily as the physical enactment of a written text with our historical concern anchored in the interplay between that text and its physical realization. We are now at least equally likely to look at the theatre experience in a more global way, as a sociocultural event...

Marvin Carlson, Places of Performance: The Semiotics of Theatre Architecture
<table>
<thead>
<tr>
<th>Participatory</th>
<th>Presentational</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Goal</strong></td>
<td><strong>Goal</strong></td>
</tr>
<tr>
<td>Maximum sonic, kinesic participation of all present</td>
<td>Preparation of music for maximum interest for others</td>
</tr>
<tr>
<td><strong>Conception</strong></td>
<td><strong>Conception</strong></td>
</tr>
<tr>
<td>Music making as social intercourse and activity among face-to-face participants; emphasis on the doing among all present</td>
<td>Music as an activity and object created/presented by one group (musicians) for another group (audience) in face-to-face situations; emphasis on the doing (artists) and listening (audience)</td>
</tr>
<tr>
<td><strong>Roles/Audience Distinction</strong></td>
<td><strong>Roles/Audience Distinction</strong></td>
</tr>
<tr>
<td>Little or no artist-audience distinction, only participants and potential participants; few or no physical barriers or markers distinguishing participants although activities (singing, dancing, playing instruments) can vary among participants</td>
<td>Clear artist-audience distinctions; artists and audience mediated by physical markers such as stages, lights, mics, video cameras and screens (e.g., in stadium concerts) within face-to-face situation</td>
</tr>
<tr>
<td><strong>Time and Attention</strong></td>
<td><strong>Time and Attention</strong></td>
</tr>
<tr>
<td>Focus is inward among participants, is on the act of doing, and is in the moment; sound-motion exists only in the moment</td>
<td>Focus for musicians is on themselves, the audience, and the sound; for the audience is on the musicians and the sound, attention is in the moment, sound-motion exists only in the moment</td>
</tr>
<tr>
<td><strong>Continua</strong></td>
<td><strong>Continua</strong></td>
</tr>
<tr>
<td>Less physical/semiotic separation among actors</td>
<td>More physical/semiotic separation among actors (artists + audience)</td>
</tr>
<tr>
<td>Less planning/control of musical sound</td>
<td>Greater planning and control of sound</td>
</tr>
<tr>
<td>More attention to music as social activity</td>
<td>Less attention to music as social activity</td>
</tr>
<tr>
<td>Less attention to music as art object</td>
<td>More attention to music as art object</td>
</tr>
<tr>
<td>Quality of social interaction is central to the conception of ‘music’ and ‘good music’</td>
<td>Quality of sound is central to the conception of ‘music’ and ‘good music’</td>
</tr>
<tr>
<td>Sound-motion in the moment, immediate feedback as to how one is doing; sound is ephemeral</td>
<td>Indefinite time delay between music making and listening; feedback delayed; sound is semi-permanent</td>
</tr>
<tr>
<td>Social focus inward among participants</td>
<td>Social focus outward for musicians/ producers toward an audience and for the audience toward sound alone</td>
</tr>
</tbody>
</table>

*From Turino, *Music as Social Life*
The word ‘theater’ literally means a “place where one observes.” Carlson 1989. Theater is a separation and dramatization of actions apart from other actions (as music is a separation of sounds apart from other sounds). The spatial situation that theater creates often relies on sound accompanied with vision - the voice and presence of the actor(s) being the focus of attention and the site of meaning. The very term ‘actor’ speaks to this special framing of the performer on stage: everyone constantly performs actions, but the focus is on the actor and how we encounter him or her: “It is not... separate spaces for player and observer which make theatre, but their simultaneous presence and confrontation: “As against the Actor, we take on the collective character of the Audience.” Carlson 1989. In the encounter of the Actor (with a capital ‘A’) with the observers, theatrical space is created.

Theatrical performance spaces underwent an interiorization and isolation similar to the concert hall type, becoming discrete objects in the city that house and symbolize theatrical performance and the larger culture that performance is part of. The acoustical separation of the theater from the ‘outside’ (and from unwanted sounds, sights, smells, weather conditions, etc.) can be interpreted as an attempt

LISTEN TO YOUR EARS. Open the door of the building in which you live, step out and listen. Hildegard Westerkamp, “Say Something about Music...” in Site of Sound (LaBelle and Roden, eds.)
to create a privatized, hierarchical controllable ‘world’ within the space of the theater. While the theater as a discrete, enclosed building has been a popular and oft-utilized form, the appropriation of ‘everyday’ space for performance has developed parallel to, and sometimes in confrontation with, the development of the formal, institutional theater space. Marvin Carlson cites various examples where theater companies have played in spaces that were not designed as theaters - factories, restaurants, churches, city plazas, etc. Carlson 1989. This tradition has been continued and is especially strong in New York City, where plays and dances are performed in the subway, parks, parking lots, and even shallow ponds.

**Group Ongaku** is an example of a performance group that sought to act and make music in nontraditional settings, in nontraditional ways, in order to “expand musical experience” Labelle 2007. Brandon LaBelle’s way of describing their work is especially evocative of the kind of freedom and aggression that was partially inflamed by the formalization and perceived staleness of music and theater.

This project is an attempt to occupy a position between the specialized performance hall (in which the architect works from a set of guidelines to spatially support a set type of performance) and the appropriational performance (in which

All the world’s a stage,
And all the men and women merely players;
They have their exits and their entrances;
And one man in his time plays many parts.
His acts being seven ages...
William Shakespeare, *As You Like it* (from a monologue spoken by Jaques)

“What I like about outdoor work is that it’s a collaboration with the public,” said Tom Pearson, who created “Lacuna” in the reflecting pool at Lincoln Center (they drained it first) for this year’s Lincoln Center Out of Doors. “Everything in the environment becomes part of your work, and at the same time, people see how art interrupts or illuminates their everyday space.”
the initial democratization of Japan and instead supported a return to pre-war politics. Installing leaders of the war into high-ranking positions and casting Japan as a docile ally, the United States helped dissolve the greater social and political move toward democracy. This sudden reversal was cloaked in nostalgia for a past and its traditional practices. This nostalgia, in turn, made its way into the contemporary art scene in Tokyo, influencing the academies and juried exhibitions, a situation that generated such groups as Gutai and forced them into a peripheral position, stigmatizing their work as "irrational" and "Western." Gutai was partially a resistance to this reversal toward an imagined past, embracing instead the democratic spirit so many Japanese were hoping for. Its work bespeaks a desire for a freedom never had before, and its performative excess with materiality can be viewed as an expression against the very fabric of society, as if by breaking the surface of paper, or challenging mud, some other reality would present itself.

**Body Against Space**

Ongaku's work of the early 1960s can be understood as stemming from this general cultural backdrop. Gutai's influential flair for radical performance, for cultural antagonism, emblazoned by the growing tensions and fervor surrounding the ratification of United States-Japan policy in 1960, delivers up physical action prominently within the musical framework. For its work insists upon corporeal action, a theater of physical choreography as well to objects and space. Here, Ongaku's "sound objects" are not found in the inner mechanics of tape machines and scientific auditory research but in the physical relation between subject and object. Freedom from representational devices, from the mechanics of meaning, was found in unconscious waves taking shape in sonic movement.

Within architectural discourse, the body is cast as both user and intruder, fulfilling and sabotaging, according to Bernard Tschumi, spatial order:

> First there is the violence that all individuals inflict on spaces by their very presence, by their intrusion into the controlled order of architecture. Entering a building may be a delicate act, but it violates the balance of a precisely ordered geometry. ... Bodies carve all sorts of new and unexpected spaces, through fluid or erratic motions. Architecture, then, is only an organism engaged in constant intercourse with users, whose bodies rush against the carefully established rules of architectural thought. No wonder the human body has always been suspect in architecture: it has always set limits to the most extreme architectural ambitions.⁴

Such disruption of the architectural order by the individual body has built within it the power, as Jane Rendell describes, to "(un)do" architecture, for such (un)doing articulates "spatial and temporal rhetorics of use" and ultimately function as "strategies of resistance." Through their persistent nagging of the architectural order, rhetorics of use remind architecture of its own power to shape and define experience. Architecture, as an external force bound to the Law through a legal framework of urban planning, building codes, and city politics imposes, however gently or dramatically, a force the individual must negotiate. Thus, one never truly escapes architecture, for to move through the built environment is to encounter an endless confrontation—of corporeal drive against spatial form, of impulse against spaces of expression. To design then is literally to create tensions of movement.

To move from use to resistance, as Rendell does, further reveals the everyday as a site of contestation and negotiation, where one is traumatized by the spatial. However, such trauma sets in motion a conversation, however unstable or quiet, through which one becomes conscious of both architectural power and the power of one's own body: one recognizes the larger architectural order to which one is both held and made responsible. This intersection could be understood as the formation of the individual in general, for in this recognition one is separated from an exterior body (social) and bound to it as symbolic system (representation). That is, architecture defines one's place within it by promising free movement while keeping one housed within its limits.

Against such trauma, spatiality itself offers potential escape routes, where use becomes resistance, where the order of the individual intersects with the order of Law, revealing fissures, cracks, and openings. Rather than overturn architectural order, such intersections remodel on a microlevel the patterns of its articulation, where one may live according to personalized navigations, modeling forms of freedom along the way. Following Rendell, one resists through an undoing that promises other forms, and thus other experiences.

Such resistance is realized in varying methods, from everyday actions, such as turning the kitchen into a library, to cultural practices, such as musical performance. The performativity of Ongaku can be understood in relation to such spatial resistance, as a kind of anthropological amplification of Cage's *Living Room Music* (scored for found objects) by announcing itself against given forms and their assigned functions: improvisatory action turns chairs into percussion instruments, lamps into amplified hum-machines, pots and other cookery into vessels for the production of collective expression. Such small instances, while innocuous and humorous on one level, form the basis for a potent vocabulary: to move through a house, restituting domestic action onto acts of sonic improvisation refrains architecture and forms of design, as well as its inherent power to inform and determine experience.

Resisting locational pressures, and realigning spatial coordinates, Ongaku finds its political backdrop and sounding board in relation to the student movements in Japan in the early 1960s. As Tone reflects:

> When we were about to organize the group, Ongaku, the timing of that coincided with the climax of the anti-Japan-US security treaty movement, Zen-Gakuren or All Japan Student League, which mobilized tens of thousands of people to surround
the architect’s work is done before the performance is conceived and the space can play a supportive or antagonistic role to the performance. The goal of my architectural action is to create an arena that allows for and even provokes numerous, interesting spatial relationships between actor(s) and audience(s), creating a topography of performance listening, and watching.

Adaptable architecture can be broadly split into two categories - dynamic-kinetic and dynamic-static. Literally dynamic, moving architecture promises an infinite or near-infinite range of possibilities within in a (usually modular) set of elements. Dynamic-static architecture can create a ‘feeling’ of movement within a non-moving form. It can also set up multiple possibilities and accomodations for those elements that are endowed with movement such as people, water, and sound.

Anti-precedents: Kinetically adaptable acoustics arises from numerous conflicting issues that cannot be accomodated with a static form. Adaptable acoustical systems are usually employed in enclosed concert halls to change reverberation time or the perceived acoustical ‘size’ of the space. These changes accomodate different types of music that traditionally demand a certain aural character.
IRCAM, designed by Renzo Piano Building Workshop in association with the Centre Georges Pompidou, is an experimental music space, acting as a place for both performance and rehearsal. The walls of the main rehearsal space are composed of a repetitive series of rotating panels. Rotating the panels changes the materiality of the exposed surface and the acoustical qualities of the room. David Serero’s Acoustical Domes is a similar but more three dimensional project. Installed in a small room in the Villa Medici in Rome, the ‘dome’ does not actually use curved surfaces but instead uses a series of carefully arranged flat panels to create the aural illusion of a dome overhead. These panels have a certain degree of freedom and can be moved to change the way they focus sound. Serero describes this project as creating an adaptable space for music.

These projects are interesting; indeed they were important precedents early on in the investigation of this thesis. However, IRCAM and Acoustical Domes both deal with interiority and the tight control of sound within a frame. As I explored the site of my investigation and considered other precedents, I moved away from these approaches and toward a fascination with the Greek and Roman outdoor theater.
Precedents: Amphitheaters as ripples in stone

The Greek theater is a venerable and respected form, with some theaters being praised for their excellent acoustical properties and beautiful proportions and craftsmanship. When I attended a concert at UC Berkeley’s Greek Theater, I had trouble discerning the acoustics of the space due to the band’s use of multiple amplified speaker arrays. What I could discern, and what impressed me, was the communal space it created, focusing on the events of the (split-level) stage. The visual effect of the curves and the swaying bodies all directed inward and centrally made the place feel like it was really made for performance.

The Greek Theater at Berkeley is inspired by the Greek theater at Epidaurus, which was designed at a time when the hillside theater as a form seemed to be very well developed: the fan shaped seating, the backing proskenion, and strict symmetry are all in place. Richard Leacroft outlines the development that led to this form in his book *Theatre and Playhouse*. Interestingly, the circular form seems to be a late entry, preceded by rectangular, trapezoidal, and rounded rectangular geometries. (Leacroft points out that circular performances do not have to be made in circular spaces; in the discussion of my design, I will make...
the case that circular spaces do not force simple centripetal/centrifugal performances). In these early theaters, and in Leacroft’s measured drawings of them, one can see negotiations between topography, geometry, audience-performer relationships, the movement of the body and the crowd, and ritual requirements. In my comprehension, the unifying factor was an appropriational approach that sought to find a suitable site and take advantage of its useful qualities, while adding to the site and modifying it to achieve a consonant balance.

The word ‘consonant’ has been used by the Roman writer and architect Vitruvius in describing the design of the Theater (right). In his description of the ideal theater, Vitruvius makes numerous suggestions—some have been credited by acousticians, and some are still debated about, but I believe his core guidelines about the process of theater design are useful and inspirational: follow the natural radiant movement of the voice, choose a suitable and quiet site, avoid echo in the performance space, and above all work towards balance, harmony, and consonance.

Taking guidance and sometimes directly using design moves from the Greco-Roman theater, I am also inspired by the heavily-used and seemingly appreciated terraced seating on the University of Cincinnati campus, and I hope to bring a new sensibility and usefulness to this already established strategy for creating public space on campus.
gathering watching listening: three riffs on "vase painting by Sophilus.

four riffs on 'Eretria, Greece.' Original drawing by Richard Leacroft
Gathering is an elemental and deeply social activity. Successful public spaces attract people to gather in them whether there is a planned event going on or not. While gathering has suggested circular or spiral arrangements, it is not necessarily desirable to create radial surfaces: it must be kept in mind that geometric focal points tend to create aural focal points, and these effects will greatly affect the sound of the space.

The gathering of material, as seen in the mat of coiled newspaper (left) can show us something about gathering spaces. Each unit coils around a single point and is close to circular in form near that point. But when the spiral continues outward and meets other units in the imposed square grid, the form makes a transition to a square to accommodate the context.

This lesson can be applied to the creation of a focal performance space in the midst of an established context: the new space is shaped by its context while it participates in the shaping of the place. My goal is to thoroughly understand the site, recognize opportunities for meaningful public gathering, and adjust the site by addition and subtraction, creating a spatially rich place for performance, listening, watching, and gathering.
The diverse sound-producing and space-producing actions mentioned in this section, from the passive and socially polite to the aggressive and socially provocative, show the potential of music and theater not only to react to architecture, but to subvert and transform it. From here my attention turns to the specifics of place and the role of the architect in the ongoing dialogue involving musicians, actors, and sound artists. Can a space for sound be made that takes advantage of the site while also transforming that site, both physically and aurally? Can the architecture form its own identity while remaining receptive to the unpredictable actions that might take place within it?
In the section on action, I described the various actions that could convene on the site of this investigation.

I see a real opportunity for the outdoor performance space as a site where issues of noise, music, and social space are not avoided or compartmentalized, but allowed to coexist and create productive tension and friction.

With the increased interest in investigating sound and exploration of new ways of revitalizing public space, my research is meant to inform the understanding of a place, in this case on the University of Cincinnati’s West Campus, and the adaptation of that site to enable new possibilities that speak to the interaction of space, ambient sound, and performative events.

All I am doing is directing attention to the sounds of the environment.

John Cage, quoted by Brandon LaBelle, *Background Noise*
The relationships between architect, performer (musician, dancer, actor), audience, casual observer, Nature, Soundscape etc. are extremely complex. John Cage presents an interesting way of addressing these issues in his work and writing. The role is the provocateur, the evocateur, and the maker of space. Cage didn’t make music as much as he made a setting in which music happened. His simplest piece, 4’33”, is probably his most provocative. It consists of a silent performance in a formal concert hall setting; the conductor gives a downbeat but the performers do not make a sound. The quiet of 4’33” speaks loudly and eloquently on the nature of silence (as Cage argues, the impossibility of silence), the relationship between performers and audience, and the definitions, expectations, and conventions associated with music, noise, and performance.

Cage’s work leads me to that I see as my best role: an agent in the active creation of architectural settings that suggest music, performance, and gathering through aural and visual characteristics. I may suggest possible types of performance, verbally and through the designs, but it is up to the performers to use the architecture as they see fit. My task, in the spirit of John Cage’s work and words, is to create a silence that is not empty. I feel that the open vessel of the outdoor performance space is an able vehicle.
to carry these ideas into built form. The history of outdoor performance begins in the minds of many Westerners, perhaps, in the open-air Greek amphitheater. Although an important precedent for the development of public acoustical space, outdoor performance was happening long before the Greeks took advantage of hillsides to carve out their fan-shaped stone theaters. While the ancient Greeks and Romans certainly reveled in outdoor ritual, entertainment, and public life and built lasting monuments to these activities, nearly every society has put on open-air shows. After all, it is a very natural setting when the weather is right: there's plenty of space to play and gather around, watch, listen, and dance. Some music seems out of place in a concert hall, whether for cultural reasons, acoustical reasons, or both. Outdoor performance allows a connection to the sky, the weather, and the unexpected in a way that can prove vital and inseparable to the spirit of the performance. Many outdoor performances are impromptu/emphemeral events, set up in an open field (or desert, or forest...) and taken down soon after. Some, like Greek theaters, have more permanent and non-specialized infrastructure. As I will discuss in the design section, this is the type of structure I'm proposing for the site on UC campus- a structure that encourages performance but can accommodate other uses.

“...how can I speak of a meaning - the specific relation- that exists equally for both space (or objects in space) and sound? Maybe I should say, that the guideline is to speak of meaning as a structural equivalence, a comparison between what change or transformation sound does to space and vice versa. Achim Wollscheid, “Does the Song Remain the Same?” in Site of Sound (Labelle and Roden, eds.)

“This listening experience brings into focus the nature of the relationship of SITE and SOUND. It suggests that they exist simultaneously, as both a social presence and a private experience. This dynamic relationship between SITE and SOUND is also contingent on a SUBJECT— for within this relationship of acoustics and resonance, one is situated both as a receiver and transmitter. Brandon LaBelle, Site of Sound

Normally when we think of a theatrical performance we imagine it taking place within an architectural space designed for that purpose, although history and quite likely our own experience can provide us with examples of theatre taking place in other sorts of locations as well. Marvin Carlson, Places of Performance: The Semiotics of Theatre Architecture
The West campus of the University of Cincinnati has a dense, pseudo-urban character. Its rolling topography and system of interconnected levels has necessitated and inspired a diverse set of relationships between building mass and void, public and private, work and recreation, activity and rest. This is evident and interesting on the new ‘Mainstreet’ promenade running through the center of campus. Depending on the time of day, week, and year, its plazas, yards, and fields can be full of noise and activity, empty and desolate, or any condition inbetween. In the course of researching attitudes towards sound and music, and having spent almost three years attending classes on West Campus, I cultivated a strong yet somewhat unacknowledged sense of the overlapping soundscapes I was immersed in nearly every day.

Mapping the sound of the site was an important early step in exploring the campus and analyzing its character and constituent parts. I began by making a grid of campus, focusing the center near the College-Conservatory of Music’s building complex. I spent a good deal of time listening to ambient sounds in these diverse points. I also systematically made field recordings at each point and listened to them out of context (both spatially and temporally). I also took photographs at each node and ran spectrographic visualizations of each of the sound recordings.

“The University of Cincinnati serves the people of Ohio, the nation, and the world as a premier, public, urban research university... We provide an inclusive environment where innovation and freedom of intellectual inquiry flourish.”
from the University of Cincinnati mission statement
aural and visual maps of West Campus with site circled
This introduction of the visual interpretation or supplement led me to further investigate the relationship between sound and vision, both in my coursework at UC and my design process.

CCM, or the (Cincinnati) College-Conservatory of Music, is a place and an institution devoted to music and the related arts. By attending some classes affiliated with CCM and talking to some of its professors and students, I'm able to understand some of the attitudes and interests that drive the College-Conservatory. First of all, the very name 'College-Conservatory of Music' refers to a merger between two separate institutions: one concerned with training professionals (and maintaining a musical tradition) and one concerned with educating the public (and perhaps experimenting and creating new traditions). According to the College-Conservatory's website, CCM offers coursework in 'one of eight areas: dance, electronic media, ensembles and conducting, keyboard studies, music education, opera/musical theater/drama/arts administration, performance studies, and composition/musicology/theory.'

This large, complex, prestigious, and well-funded institution operates a variety of performance and rehearsal facilities, all of them within the sealed and keycard-protected bounds of a labyrinthine set of buildings. This project proposes a spatial and experiential expansion or explosion...
of the musical experience outside of the bounds of interior spaces. For CCM, this suggests new programmatic and theatrical possibilities, as well as an improved engagement with the public realm and nearby community. For everyone else, this means the establishment of a “musical place” an already active and accessible space that has been endowed with spatial and acoustical characteristics that invite performance and musicality in an open environment.

The Site of this intervention is located between UC pavilion, CCM (Mary Emery hall), and the Tangeman University Center (right). This is a place accessible not only by CCM students, but many other users of the campus from around the university. Currently, this space is a pit that one can cross over on either of two bridges. The site is chiefly used as circulation, both by pedestrians and automobiles, with the rare exception of people taking a break for smoking or conversation (mostly employees working in the bottom floor of University Pavilion). I am proposing to make the site much more accessible and interesting for pedestrians, and to eliminate vehicular access (there are alternate vehicular routes). As is apparent from the sections and photographs, there are multiple levels to negotiate and many adjacent spaces and buildings. Acoustically and spatially, the site ‘opens up’ to the east toward the stadium and to the north toward McMicken Commons. The entries to CCM and UC Pavilion are quieter moments.
The concert’s over.
You aren’t wearing earphones.
You’re walking, alone; you’re in no hurry.

What do you hear?

What does the place you inhabit sound like? How do the materials resonate, how do they reach through the air to set your earbones into motion?

These are kinds of questions asked by those interested in phenomenology, the architects, artists, and philosophers who explore the subtle yet fecund terrain of everyday experience.

At night we seem to open our ears a bit more. We hear insects droning all around us. In Clifton we hear the squeals of railroad tracks miles away. Having visited this site at night, I’ve found it to be an excellent place to listen to the ambience of UC campus. Depending on the night, there might be whistles and muffled yells from a sporting event. There’s always wind through the trees and the distant breathlike hum of HVAC. You might hear voices talking as a couple walks by, the blast of a trumpeter practicing in nearby Memorial hall, or the scraping of crickets. You might even hear the trains a mile down the valley. Depending on where you wander in this spatial hub, you can hear the soundscapes of multiple adjacent spaces. An important goal of this project is to allow one to more fully explore this space in order to take in the ambience of the place.
The program of this project is to set the stage: to accommodate music and theater in a public and open setting that is tuned to the purpose acoustically, visually, and urbanistically. The larger goal of the thesis is to bring numerous issues into, if not resolution, a productive juxtaposition.

Design Approach and Sensibility: Peritheater, Polytheater

Theater or Theatre: 'a place for observation/seeing.'

Amphitheater: 'double theater.' Originally used to refer to spaces made by combining two semicircular theaters into an oval or circular form.

Peritheater: theater in the round, orbital theater.

Polytheater: theater with multiple focal points.

This project draws inspiration and some guidelines from Greek and Roman theaters, but does not seek to recreate or copy any specific theater. Instead I have attempted to choose good guidelines for the design of performance spaces and test these against both the site/context and my own sensibilities and instincts.
The design process began with the relevant and sensible guidelines from J.E. Moore’s book Design for Good Acoustics and Noise Control. The most important guidelines are highlighted in the excerpt to the left.

The geometry of the project is heavily influenced by Greek theaters, using concentric circles in strictly radiating configurations. Wider areas are simply doubled rings. Strange/sharp shapes are the result of overlapping circle geometries.

I also took several cues from the existing terraced seating on West Campus, especially on MainStreet—the levels are nearly two feet tall and over three and a half feet wide, and they tend to meet the ground smoothly or with a set of smaller stairs. This arrangement accommodates a wide variety of sitting positions, as well as allowing one or two people to walk on the broad stone blocks. I chose to use the same granite used on MainStreet, partly for its acoustical qualities and durability, and also to continue the language and materiality of the context; this project can be thought of as a culmination or gathering-in of the Mainstreet as flowing stone and pedestrians. The final part of the process was my own intuition in bringing these elements together. I used my best judgement in trying to resolve sometimes conflicting forces and conditions. When a design move employed in a Greek theater seemed like it would work in a part of the design, I used it (sometimes copying pieces outright), but often I had to do things differently.
CHAPTER EIGHT

Theatre acoustics

The history of the theatre and the development of its architectural form is well documented. As already been mentioned, the acoustic design of theatres is by contrast meagrely charted territory. This would be of little consequence if all theatres provided intelligible speech. The chapter traces the historical development of theatre form, seen from an acoustic standpoint. The argument is illustrated by detailed discussion of 12 British theatres of various stage sizes. It will become apparent that the constraints for speech are deficient in some of the more recent theatres.

8.1 Classical Greek and Roman theatre

How acoustical situations are so enveloped in death as the antique Greek theatre. For some, the Greeks are credited with an understanding of acoustics which still baffles modern science. In spite of our otherwise extensive knowledge of Greek culture, no contemporary accounts survive and much has to be gleaned from archaeological evidence. The earliest documentary discussion is by the Roman Vitruvius (1960). Interestingly his overriding concern is for acoustics, rather than vision, and this even extends to the rules he gives for seating design. Vitruvius presents us with an elegant theory for the manner in which theatre sites can be unsuitable, namely if they exhibit acoustic dissonance, circumstance or resonance. The propitious site is consonant

\[ \text{\textit{in which (the voice) is supported from below, increases as it goes up and reaches the ears in words which are distinct and clear in tone. Hence, if there has been careful attention in the selection of the site, the effect of the voice will, through this precaution, be perfectly suited to the purposes of a theatre.}} \]

"Figure 7.5 Sound-level time history for a speech phrase at low and high frequencies. — in front of speaker, — behind speaker.

Figure 8.1 Sound propagation in the Greek theatre: (a) sound ray paths; (b) the received impulse response for the cave.
to accommodate the site, circulation, or my own ideas about gathering, especially when dealing with multiple focal points. The design achieves its flexibility through multiple zones, of different scales and spatial conditions, centering around these focal points. Through the careful arrangement and interaction of these zones, I aim to not only create suitable and useful center-focused situations, but also relationships between different points, across from, above, below, and between.

The first and most important step in the process was to choose the locations of the main focal points/circle centers. These set the location of the center stage, smaller gathering points, interaction points, and bridging points. Referring back to my sound mapping studies, I established spatial to the different adjacent site conditions, opening up to the northern plaza, aligning with UC Pavilion to the west, anchoring into CCM to the south, and gesturing grandly to the stadium to the east. The diagram at the top left shows an early attempt at locating the points more specifically within the site; the plan below it shows a more recent iteration. Once the points were set, the process is a negotiation between plan and section, using site conditions as a guiding force: for example how do we get from level +22’ to level +26’ and make it to level +16’ inbetween, while also making space for a small gathering space between two buildings? In order to pose these

Both actors and spectators use... intermediate spaces to prepare themselves for their different “roles” in the central confrontational space. In the backstage areas, actors get into costume and makeup and ready themselves physically and psychologically for their upcoming contact with the audience. In their lobbies and foyers the spectators make more modest but parallel adjustments. In a modern theatre they may check their coats, chat with others preparing to share the same experience, read programs and perhaps posted reviews, and generally remove themselves, as these spaces encourage them to do, from their extratheatrical concerns.

from Marvin Carlson, Spaces of Performance
problems to be solved, I first came up with a set of required spaces or elements, and then found a place for them in the evolving design.

These design elements are physical pieces of the Polytheater that have their own spatial requirements but must work with the rest of the elements to form a fluid whole. I’ve described them and shown some of their locations on a recent version of the design.

MainStage(s) - Split level stage at the center of the space. Needs backing walls for sound reinforcement. Avoid echo in the listening zone of this stage.

Overlook - Highest level in the project. Visual and acoustical relationship to the MainStage. Flows smoothly from Mainstage seating.

Conversation/meditation niche - Small, enveloping space. Seating for a few in close proximity. Removed from louder spaces.

Tunnel - A periscope-like space connecting the stadium level to the upper stage level. Allow/encourage strange acoustical effects due to curved geometry.

Sidestage - Addresses McMicken Commons. Connected but facing away from MainStage.

Ramps - Connect levels fluidly.
In the establishment of a listening and performance space on UC campus, I am trying to strike a balance between the desire for an place for events and a place for informal gathering. In the spirit of fluidity, flexibility, and performance, I seek to enrich the place through the collision of apparently conflicting forces and programs. By balancing acoustics, visual aesthetics, geometry, and gathering space, my goal is to design a topography of performance that allows for exploration, experimentation, and discovery, both during theatrical/musical events and outside of the realm of performance. A new ear and mouthpiece for CCM and the University of Cincinnati community.

In the course of researching and designing, I’ve developed and questioned my assumptions and attitudes toward sound, space, and performance. While I was initially interested in sound as an agent of ‘awareness’ or an isolated force unto itself, I became more interested in the presentation of sound as music, and the tensions and interactions between this performed sound and ambient sound. The goals of the project have also changed: as I became interested in performer and audience relationships and less interested in ‘hearing the architecture’ itself, the project changed from an instrument of sound into a vessel of sound and activity.


