

**Sonic Architecture:**  
**A Modulator of Sound and Space**  
– National Gallery of Sound Art

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## **Abstract**

An experiential quality of architecture can be defined through the ambient sounds perceived within the specific spaces of a building. Sound has the capacity to describe architecture's dynamic relationship with physical space, expressing its boundaries and the potential for the movements and activities of the human body. In an experiential sense, sound is a fundamental, though often overlooked, architectural consideration. This relationship of sound and space results in a 'sonic architecture' that responds to, interacts with and ultimately mediates sounds within the built environment. Sound and architecture have the potential to form a synchronistic relationship that has the potential function as both instrument and canvas. The argument formed on the basis of this research of sound and space will be manifest architecturally in a design proposal for a National Gallery of Sound Art (NGSA), will attempt to transform visitors into active participants in their sonic environment.

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## Introduction

One's sense of hearing plays a formative role in how one experiences and interacts with their spatial environment. Our sonic environment allows for a heightened understanding of our physical environment. Acoustical design can make evident characteristics such as the size of a particular room, the materials of which it is composed and the experiential quality of its specific spaces. For example, due to the variables mentioned above, having a conversation in a hotel room 'feels' much different from having a conversation in a performance theatre.

In many respects, aural considerations shape the nature of architectural spaces to the same degree as visual elements. A 'soundscape' can be defined as all perceivable sound in a spatial environment, in much the same way as one visually appreciates natural and man-made landscapes. The urban environment, in particular, is infused and "thickened" with various layers of sound. Every day, the city is filled with the sound of footsteps pounding the pavement of its streets, apartment doors slamming, cars zooming through its streets, and conversations being exchanged among its residents. Urban space is therefore constantly reverberating with the daily activities of its inhabitants.

This thesis explores the influence of auditory sensations in an urban environment and the role of sound-art in the design of a contemporary gallery space for sound. The first component of this research will explore the theory that architecture can form conceptual connections between the sonic environment and the experience of the

viewers and listeners. The first chapter postulates that an investigation of ambient sound allows for an understanding of the dynamic relationships between sound and space by considering sound modulation through both subjective and objective approaches. The objective of this research is to investigate sounds that have been composed for a particular space, and conversely, how designed space can affect the experience of sound. This investigation will allow for a heightened understanding of sound in the design of architectural space. Chapter Two, entitled, "The Inter-Relationship Between Sound as Both a Canvas and an Instrument," discusses sound as an illustrative force in architectural space and its larger environment. "The Dynamic Relationship between Sound and Architecture," forms the central argument of Chapter Three, providing precedents and demonstrating how musicians and artists have tested the boundaries of sound and space. In Chapter Four, "Transformation, Sonic Architecture," the potential for an alchemistic relationship between sound and space is investigated through examining the synergy of theoretical components in the work of Le Corbusier. This argument lays the groundwork for the design proposal in Part Two of this thesis, which, through a specific design, proposes that sound interpolates space in uncommon and magical ways.

The second component of this research explores the concept of the 'spatial impression' in acoustical and architectural design formed by the sonic environment. In order to arrive at the conclusions discussed in chapter four, research was conducted that involving a series of experiments and sound-walking investigations. These

experiments explore the dynamic relationship between sound and architecture, and provided the framework for an acoustic design of a sound art gallery- one which is specifically dedicated to the exhibition and discovery of the "soundscape" art genre.

The design component of this thesis will bridge interdisciplinary aspects of acoustical design in an attempt to increase public awareness of sound as an essential architectural consideration. These ideas will be explored through a set of massing models and the consolidation of architectural principles with due consideration given to site specific sounds. From the basis of the model studies and experimentations, this thesis elaborates a design for the National Gallery of Sound Art (NGSA), to be located on Victoria Island, Ottawa. This thesis proposes a renovation of the mill into a gallery space. The Carbide Mill is of historical importance, an appropriate space to be converted into an auxiliary space for the NGSA. This program, explores the practice of sound art installations and proposes a new understanding of architecture as both an instrument and canvas. Therefore, this project aims to promote an enhanced perception of sound and sonic environments, increasing the public awareness of an idea of 'personal sonic perception' and the subsequent implications for architecture.

## Chapter One: Modulation of Received Sound

### 1.1: Definition of Received Sound

Sound is a complex phenomenon formed by the vibration of frequencies.<sup>1</sup> The vibration of sound waves establishes a precise language phenomenon as a means of gaining access not only to audio, but also spatial information. The way that sound is heard in space is a consequence of the relationship between the number of cycles of the sound generated by the dimensions of individual matter that exist in that space and their unique vibrations.<sup>2</sup> Sound cannot exist in a 'vacuum' condition, and therefore is present in every aspect of modern life. Sound is omnipresent, influencing the lives of people in both obvious and subtle ways. Sounds are regarded as both messengers of subjective inner worlds in the context of music; noises, on the other hand, are usually conceived of as symbols that indicate trivial unintentional occurrences or objects of everyday life.<sup>3</sup>

Sound as a concept encompasses many disciplines and contains many aspects including acoustic sciences that are beyond the scope of this thesis. For the purposes of this discussion, sound will herein be defined as 'audible perception' – all that might fall within or touch upon auditory phenomena, whether this involves actual sonic or

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<sup>1</sup> Perceivable sound, to the average individual, is considered to be between the frequency range of 20 to 20,000 hertz. Sound waves are transmitted through an elastic solid or a liquid or gas (air) into the ear, and vibration inside the ear drum is perceived as sound by the ear's membrane.

<sup>2</sup> Jio Shimizu, Site of Sound: of Architecture & the Ear. Errant Bodies Press (in collaboration with Smart Art Press): Los Angeles, 1999. 151.

<sup>3</sup> Bernd Schulz, "Introduction" Resonanzen. 14.

auditive events or ideas about sound or listening. Sound, however, is limited, whereas noise covers nearly all frequencies within the human hearing range. Sound is defined by that which is actually being heard and therefore, hearing is the process through which we, within our acoustic range, receive sound:

We can learn a great deal about shape, surface, or texture from listening. Perhaps the biggest error of the audiovisual litany lies in its equation of hearing and listening. Listening is a directed, learning activity: it is a definite cultural practice. Listening requires hearing but is not simply reducible to hearing.<sup>4</sup>

This intimate scale evokes different spatial aspects, and has the potential to change the way we perceive sound. Architecture inherently deals with the specificity of spatial conditions, such as room size, volume, material, and program organization and therefore, it is obvious that architecture has the capacity to shape one's auditory experience:

What the sound immediately discloses is not an object but a dynamical event at the locus of the object, and thereby mediates the state the object is in at the moment of that occurrence.<sup>5</sup>

Sonic perception helps to identify the context in which one is situated. One hears sound differently when it is apart from the image and distant from its source. One's eyes allow for a common, immediate recognition of the environment in which one is located, and one's ears function as an additional layer to give us a sense of three-dimensional space, as well as space experienced in time.

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<sup>4</sup> Jonathan Sterne, The Audible Past: Cultural Origins of Sound Reproduction. Duke Univ Press, 2003. 19.

<sup>5</sup> Hans Jonas, "The Nobility of Sight: A Study in the Phenomenology of the Senses". The Philosophy of the Body. 1970. 314

## 1.2: Understanding Sound through Subjective and Objective Means

Can architecture be heard? Most people would probably say that because architecture does not produce sound, [architecture] cannot be heard. However, architecture neither radiates light and yet it can be seen. Elements of architecture reflect light and thereby provide an impression of its larger form and materiality. In the same way, sounds too are reflected off of its surfaces giving us a different, though equally evocative impression of a structure's architectural characteristics. As previously described using the example of the Cathedral, differently shaped rooms and different materials reverberate differently.<sup>6</sup>

- Steen Eiler Rasmussen

We cannot see what we hear. Sound itself is defined by intensity and radiance beyond physical boundaries, synonymous with physical spaces that crack, change or re-adjust their physical limits. We can experience sound in both a scientific and experiential manner within space at the same time, through subjective and objective means. Architecture responds to its unique physical setting, and therefore contextual considerations perform an important role in how architecture functions with regard to the various layers of sound which emanate from the site, such as foreground sound and sounds, sound envelopes, parameters, themes, textures and rhythms, each with spatial associations. These considerations are certainly a part of a 'sonic process', as they possess the ability to transform the modulation of sound while giving form to the spaces that architects and sound artists attempt to manipulate. Considering the above

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<sup>6</sup> Steen Eiler Rasmussen, Experiencing Architecture, Cambridge: The M.I.T. Press, 1962. 224.

argument, one can see how architecture has the ability to expose and reveal, opening one's ears to a new world of space inflected through the descriptive precision of sound.

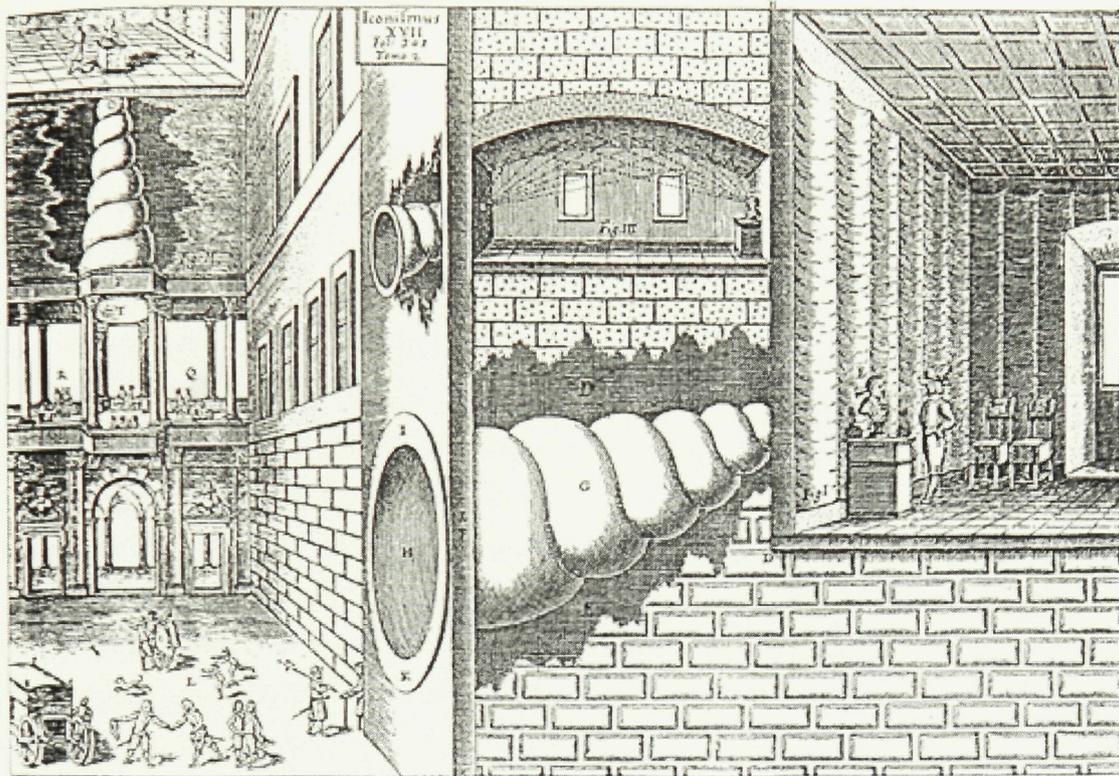


Figure-1 *Draft of a Listening System drawing*, published in Athanasius Kircher, *Musurgia Universalis*, Rome 1650.

Different ways of perceiving and describing sound have developed as human understanding of sound has progressed. For example, the perception of sound can come from a subjective perspective; this would include an understanding of sound that involves our personal, day-to-day, perception of sound based largely on personal experience. Sound in this way is appreciated for its qualitative characteristics, how it 'colours' and perhaps illuminates one's life by drawing out associations among contexts and places. From this perspective, sound is predominantly appreciated through the phenomenological perception of one's environment. For example, the practice of 'sound

walking,' which will be described in a later chapter, is a way of perceiving sound through empirical means. From a subjective standpoint, sound has the capacity to become embedded in one's personal experience. In this long quotation, Russolo describes noise as follows:

Today noise reigns supreme over human sensibility....In the pounding atmosphere of great cities as well as in the formerly silent countryside, machines create today such a larger number of varied noise that pure sound, with its littleness and its monotony, now fails to arouse any emotion....Let's walk together through a great modern capital, with the ear more attentive than the eye, and we will vary the pleasures of our sensibilities by distinguishing among the gurglings of water, air and gas inside metallic pipes, the rumbling and ratings of engines breathing with obvious animal spirits, the using and falling of pistons, the stridency of mechanical saws, the loud jumping of trolleys on their rails, the snapping of whips, the whipping of flags. We will have fun imaging our orchestration of department stores' sliding doors, the hubbub of the crowds, the different roars of railroad stations, iron foundries, textile mills, printing houses, power plants and subways. And we must not forget the very new noises of modern warfare.<sup>7</sup>

To objectively examine sound means to describe it in a way that is not blatantly inflected with the experience of any one person, but consists rather of a sequence of mathematical calculations or measurements. For example, an objective approach could involve the study of acoustics, as the rational experience of sound is technically based on scientific measurements: attributes that are quantitative in nature, having a general, similar meaning to many. From a scientific

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<sup>7</sup> Luigi Russolo, The Art of Noise. New York: Pendragon Press.1986, 7-8.

perspective, sound can be understood as derived from musical notation, a time-based system developed to unify a composer's relationship to sound. A musician may take inspiration from an empirical experience of sound and transcribe it into a form of representation that can be composed and understood by others.

For example, the rational world of sound is described by such man-made qualifiers such as the science of acoustics or the fundamental physics of sound. It can also concern physical events in nature by which sound is propagated through a medium, regardless of a human presence, or it can be described through amplification, a process of increasing the magnitude of a variable quantity, especially the magnitude of voltage, power, or current, without altering any other quality.

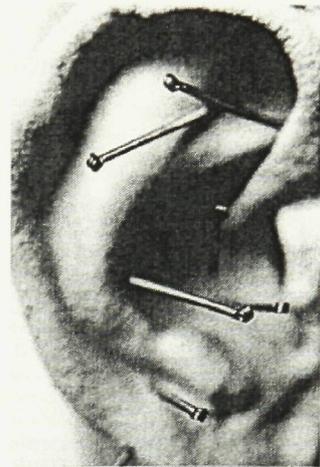


Figure-2. Bogomir Ecker, *Innervation* 1999.  
Modern Art Galerie, Vienna, 1979.

The study of sound phenomenon has been taken beyond subjective observation. In objective observation, hearing, like all sensory experiences, is a personal experience, however, the experiments performed resulted in spatial conditions that apply to the way sound is perceived by more than just one person. For example, an echoic effect can be calculated and manipulated to change perception. Through its materiality, texture and notation, the result of acoustical vibration is a specific architectural environment. [Refer to Appendix A for acoustics]

### **1.3: The Transmutation of Sonic Architecture**

In between both of the subjective and objective means of understanding , perceivable sound, through the processes of hearing and listening, goes through a transformation, which can be defined as a 'transmutation.' In this thesis, transmutation refers to the process of harmonious reconciliation. Transmutation is beyond perceiving or describing sound; rather, it involves the manipulation of sound, in a way that allows for interpretations that are neither entirely objective nor subjective, though they are imbued with qualities of both. In this way, sound can be appreciated by rational control but also allows for the individual to experience sound on a personal level of empirical means.

In a closely related way, architecture too has been defined in both subjective and objective terms. However, it is arguable that architecture is structured through ideas and phenomenon beyond itself. The significance of architecture comes not out of its individual elements, but its relationship to light, materials use, context, and as will be explored in this thesis, sound. It seems to follow that architecture needs something outside of itself, such as sound, to transform it, and take it to a higher level of meaning or significance.

Architecture [is] the static nature of constructed space gains a dimension of perspective through experience and anticipation ... can only be appreciated by transforming size into scale, matter into light, and time into rhythm, color and key. As much as architecture depends on the mysterious intensity of music, which gives it space, so does music depend on architecture for continuing to uphold both the audible and inaudible in time. Without music, architecture would disappear altogether.

Reducing architecture to a material reality only is to create a city of noise.<sup>8</sup>

The simultaneous transformation and transmutation of sound and architecture results in the creation of 'sonic architecture', which is the condition by which sound acts as both an instrument and canvas. These ideas are paralleled to the concept of 'alchemy'<sup>9</sup>, a seemingly magical power or process of transmuting structural and material characteristics, historically in conjunction with numeracy and mysticism. This concept, borrowed from interpretations of contemporary visual art, is used in a metaphorical way in order to speak about the perceptual modification of space by sound and conversely, the acoustical manipulation of sound by space. Transmutation, as in the realm of physics, refers to processes resulting in structural changes in a given condition whereas transformation, primarily describes relational conditions and juxtapositions. Historically, the alchemical condition represented the unification of nature and mathematics. Through numbers, science, and its quantitative aspects, materials undergo a form of magic (mysticism) transformation and/or transmutation not at odds or against science. In contemporary art as in the study of sound, this "magical" process is revealed in the situations and processes by which the medium and its intended subject matter is communicated.

Though generated by measurements and other constructs of scientific theory, architecture depends on a strong experiential aspect,

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<sup>8</sup> Dainel Libeskind, *SoundSpace*, 242.

<sup>9</sup> Definition of Alchemy: Transmutation of metal; mix. Weekley, Ernest; *An Etymological dictionary of Modern English*. 1967.

a truth that ties it more closely to nature. The question remains of how one uses mathematics and numbers to result in a more experiential object: the actual building. Alchemy has a connection through sound or music that can be described with very scientific terms: it can be measured through decibels, frequency, vibration, etc.; but, it also possesses a quality that eludes scientific description: the ability to transform space.

'Alchemy' in this thesis can be understood as that which enhances our awareness of architecture by heightening our senses to elements that could be considered ordinary or common in a different context. It does this by fully engaging the individual in the experiential (situational, relational, structural) qualities of 'present' space, and, in the context of this study, the ambient and generated sounds that occupy it.

## Chapter Two: Sound as a Canvas and Instrument, and the Inter-Relationship between the Two

### 2.1: A Subjective Approach to Understanding Sound

There is no difference between noise and music in my work. I have no idea what you term "music" and "noise". It's different depending on each person. If noise means uncomfortable sound, then pop music is noise to me.<sup>10</sup>

- Masami Akita (a.k.a. Merzbow)



Figure-3. William Hogarth *The Enraged Musician*, (London: J. Major, 1831), Princeton University Library. 138.

<sup>10</sup> Akita, *Audio Culture: Readings in Modern Music*. 4.

### **2.1.1: The Sound of the City Heard Daily**

The sounds of the city constantly mediate the scales of intimacy of the urban environment, and its inherent immediacy. One is able to determine their place in the city from the ambient sounds perceived within its specific spaces. For example, the sound of a residential neighbourhood differs from that of the downtown core. The sounds are of a more domestic nature - the activities of people and daily life - as opposed to the activities of commerce. It is typical that in a residential area, one hears people opening and shutting windows, perhaps the sound of a lawn mover, etc., whereas downtown, one might hear the sounds of construction or of commerce, such as large vehicles, cash registers, buzzers, elevators and escalators. These sounds form a layer of sonic description over the inhabited spaces of the city, and contribute to a larger picture, composed of fragments, that is the urban condition.

## **2.2: An Objective Approach to Understanding Sound - Acoustics**

### **2.2.1: The History and Development of Acoustic Study**

Acoustics has long received attention in architectural design. Vitruvius provided much insight into the Roman knowledge of acoustical study; he devoted a section to music, sound and acoustics in his famous text:

Using the canonical theory of mathematicians and the principles of music, any voice onstage might reach the ears of the spectators more clearly and sweetly. For just as musical instruments achieve the clarity of their sounds by means of bronze panels or horn sounding boxes added to the sound of the strings, so, too, the calculations for theaters were established by the ancients on harmonic principles to amplify the voice.<sup>11</sup>

Acoustic study, which includes sound theories, mathematical calculations, predictions and physical measurements, is the scientific study for sound in architecture. Considering acoustical control within the context of technology, Emily Thompson in her book, *The Soundscape of Modernity*, argues that physical and cultural changes have constantly reformed the relationship between sound and space. Through the development of sound-absorbing materials and electro-acoustic devices, for example, sound could be increasingly manipulated and controlled.<sup>12</sup> In addition, Thompson further postulates that "a fundamental compulsion to control the behavior of sound drove technological developments in architectural acoustics, and these imperative stimulated auditors to listen more critically, to

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<sup>11</sup> Vitruvius, *Ten Book of Architecture*. Trans. Ingrid D.Rowland, Cambridge University Press.1999.

<sup>12</sup> Emily Thompson, *The Soundscape of Modernity*. 2.

determine whether that control had been accomplished.”<sup>13</sup> Therefore, an acoustical study is a significant development to investigate more precisely sound in space that involves technology, and scientific calculations to achieve the desired outcome of sound.

Along a similar line of thought, one can look to the work of Wallace Clement Sabine (1895-1919), an early sound artist who devised a series of experiments and observations on sound. Sabine discovered the inverse relationship between the amount of acoustically absorptive material in a space and its reverberation over time. This calculation, now called Sabine’s Law, is important for calculations regarding the reverberation time for room acoustics. Schafer discusses the importance of acoustics for experiencing a room:

Reverberation and echo give the illusion of permanence to sounds and also the impression of acoustic authority. Thus they convert the sequential tones of melody into the simultaneously heard chords of harmony.<sup>14</sup>

One can sense that the importance of forces that define sound quality as architecture is subject to formal characteristics such as repetition, or ‘visual rhythm,’ which lend a certain solidity and mass to its form.

Sabine’s formula is used to predict reverberation time:

$$T = 0.161 \cdot V/a \quad \text{(metric)}$$

$$T = 0.049 \cdot V/a \quad \text{(in feet)}$$

$T$  = reverberation time (time required for a sound to decay 60 dB after the sound has stopped) in seconds.

$V$  = room volume in cubic meters (m<sup>3</sup>) or cubic feet (ft<sup>3</sup>)

$a$  = total room absorption in sabins =  $\Sigma (S \cdot \alpha)$

or:

$$T = 0.161 \cdot V / (S_1\alpha_1 + S_2\alpha_2 + S_3\alpha_3 + \dots S_n\alpha_n) \quad \text{(metric)}$$

$$T = 0.049 \cdot V / (S_1\alpha_1 + S_2\alpha_2 + S_3\alpha_3 + \dots S_n\alpha_n) \quad \text{(in feet)}$$

Figure-4. Wallace Sabine’s formula.

<sup>13</sup> Emily Thompson, The Soundscape of Modernity. 2

<sup>14</sup> R. Murray Schaffer, The Soundscape: Our Sonic Environment and the Turning of the World. Rochester: Destiny Books, 1994, 219.

## 2.3: Instrument and Canvas in Architectural means

### 2.3.1. The Architectural Canvas in Objective means

Through the development of art, media such as painting and sculpture are highly influenced by object-based spatial organization. Structuring devices assume a level of stability. A canvas conventionally provides an even and stable surface for the artist create. This provides a medium on which for the artist can work, but its also limits and binds the artwork to a two dimensional space, within a frame.

The concept of an 'architectural canvas' can be understood as combination of both painting and sculpture in a way that extends the limitation of the painter's art, by extending the work surface into the third dimension.<sup>15</sup> Artist such as the cubists, Ernst and Picasso have tried to challenge the two dimensional limitations of their medium,



referring to a canvas as a 'planer compositor.' Architectural canvases, therefore, comprise a three-dimensional space for artwork, for an artist to 'draw' content; objectively transform their imagination into a three-dimensional experience to include considerations of space and time.

Figure-5. *La Toilette de la mariée*, 1940, by Max Ernst, exhibit in Peggy Guggenheim Collection.

<sup>15</sup> To testing this bounded spaces, by referencing its three

### **2.3.2 Architectural Instrument in Subjective Means**

Subject-based organization is a concept that invites one to look towards the 'movement of environment,' which an environment defined as a describable image that gives meaning to the movement, rather than a natural 'given.'

Architecture has the capacity to act as an instrument to provoke individual experiences of space, in the way that architecture is a function of how buildings are seen and understood.<sup>16</sup> We can see materiality used by architecture often changes one's perception of space; the essential qualities or composition of the specific materiality communicates through architecture in many untold ways. An Architectural instrument therefore has the ability to capture perceptually an idea of individuality of experience.

### **2.4: Soundscape: an Aural Landscape – Architecture act as both Instrument and Canvas**

For the purposes of this thesis, the term 'soundscape' will be defined as 'all the perceivable sounds from the surrounding spatial environment.'<sup>17</sup> A created soundscape can be understood, for example, by exploring the sonic possibilities offered by the specific spatiality, volumetricity, and materiality of a cathedral. The example

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<sup>16</sup> "Architectural Theory." September 26<sup>th</sup>, 2005.

<[www.archpedia.com/Architecture-Theory.html](http://www.archpedia.com/Architecture-Theory.html)>

<sup>17</sup> The word "soundscape," referring to the sonic environment was first defined by Murray Schafer; is the sonic environment. Technically, any portion of the sonic environment can be regarded as a field for study. The term may refer to actual environments, or to abstract constructions such as musical compositions and tape montages, particularly when considered as an environment. (Schafer, *Tuning*, 274-275.)

of a cathedral is used because it is an architectural illustration where it is important that spatial characteristics are exploited, and, as postulated by this thesis, sound very effectively accomplishes this aim. The sounds that we hear in a cathedral are extraordinary, and provide the individual with a very different experience of space than that of a theatre or class room, for example. The design of a typical cathedral results in a sonic environment that makes apparent the importance of God and the grandiosity of communal worship, providing the necessary element of wonder that allows for a vivid experience of divinity.



Figure-6. St. Peter, Rome, 2004, photograph taken by author.

The physical components of architecture have specific tectonic or functional elements are transcended by an acute phenomenological awareness of the surfaces, and their contributions to the materiality of the space. Thus, elements such as stained glass and stone become beautiful for reasons beyond their physical characteristics. These elements contribute to the spatiality of architecture by functioning as instruments. The quality of sound transmitted within the cathedral is a function of the specific materiality and scale of the space. In this way architecture acts as an *instrument* that transmits sound and as the *canvas* that receives sound. Thus, the sound in the church cannot be re-created precisely by technological means.

### **Chapter Three: The Dynamic Relationship between Sound and Architecture**

Sound and space are linked through media, which modulate sound through vibration, and are affected by time and movement within space. *Vibration* is the vocabulary of sound, and a medium is the *message* of different materiality expressed by the notations of sound. Architecture, like sculpture, lies at the frontier between the spaces of sight and sound. Around and inside a building there are certain places that function as both visual and acoustic action points.<sup>18</sup> This suggests that sound is sculptural in ways that can be identified through a series of experiments. Specifically, we can see ephemeral qualities of sound illustrated through the spatial conditions of represented materiality, texture and notation. Conversely, sound under manipulation is an architectonic element that defines space. Therefore, architecture can be a modulator of space occupied by sound. Architecture is therefore a *medium*, which vibrates about their equilibrium positions, receive momentum from collisions, and pass it on to other particles thus transmitting the affected sound waves.

#### **3.1: A Shift in Aural and Visual Experience of Space –Sound Art**

Sound is a powerful tool that enhances human perception while playing an important role in the perception of three-dimensional spaces. Sound, therefore, can be understood as an added dimension that shapes one's perception of space. Visual experience has traditionally been considered fundamental to architecture. A shift to

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<sup>18</sup> Murray Schafer, *The Soundscape: Our Sonic Environment and the Turning of the World.*, 222.

experiencing architecture from an aural standpoint, freeing it from a total dependence on visual experience, therefore, suggests a new and fruitful way of exploring space.

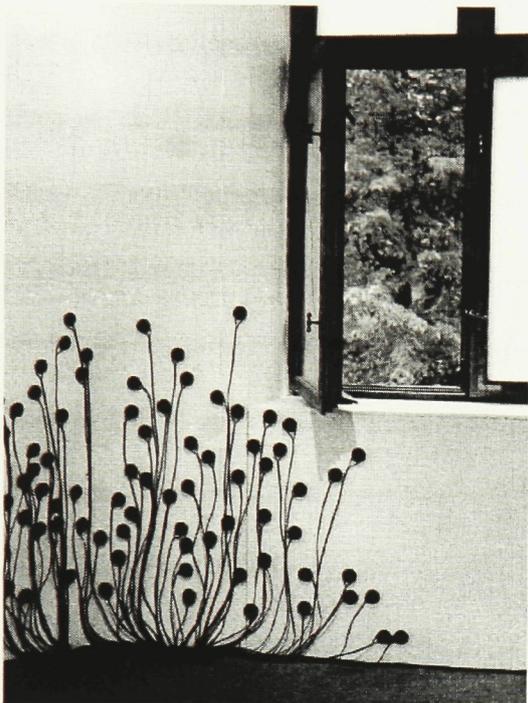


Figure 7. *Silent Music*, by Robin Minard, Warsaw Autumn Festival. Photo by Lidia Karbowska. 1995.

The translation of architecture from a predominantly visual experience to an aural event is possible through exploring the similarities between the two modes of perception. The experience of sound art results in the 'appearance' of sound being changed. Sound art therefore sets up the conditions for a temporal art form, one that engages the audience to the extent that the experiential transformation it undergoes defines its essence or meaning. The experience of architecture can be understood in similar terms, sharing the capacity to impact the individual who experiences it. Space, in the broadest sense, is the core of architecture, from intimate body-related space to the large cityscapes.<sup>19</sup>

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<sup>19</sup> Bernd Schulz, "The whole corporeality of hearing: an interview with Bernhard Leitner" *Resonanzen*. 81.

### 3.2: Sound Artist, Bernhard Leitner

Many contemporary sound installations deal with landscapes of sound that bridge ideas of space, movement, as well as auditory and visual perception. Visual artists no longer have a monopoly on structuring space, just as musicians are no longer only concerned with the aspect of temporal change. This realization has given rise to a new form of art, sound art, which is defined as the art of sound that lays claim to a simultaneous existence in space, time and body movement.

For these reasons, artists have recently become interested in how sound can govern movement, flow and circulation. The work of architect and sound artist Bernhard Leitner (b. 1938) introduces new forms of expression fundamental to the creation of spaces using the vocabulary of sound. Leitner postulates that the perception of spaces unfolds over time with the movement of 'lines' or points of sound, which perceptually modify our experience of space, making the whole body a permeable acoustic depository, in effect, a 'big ear' for three-dimensional space. The sound space confronts us not only with the objective qualities of physical objects and spaces, but also with the resonance of our own bodies and the perception of our own selves.<sup>20</sup>



<sup>20</sup> Schulz, Resonanzen. 16

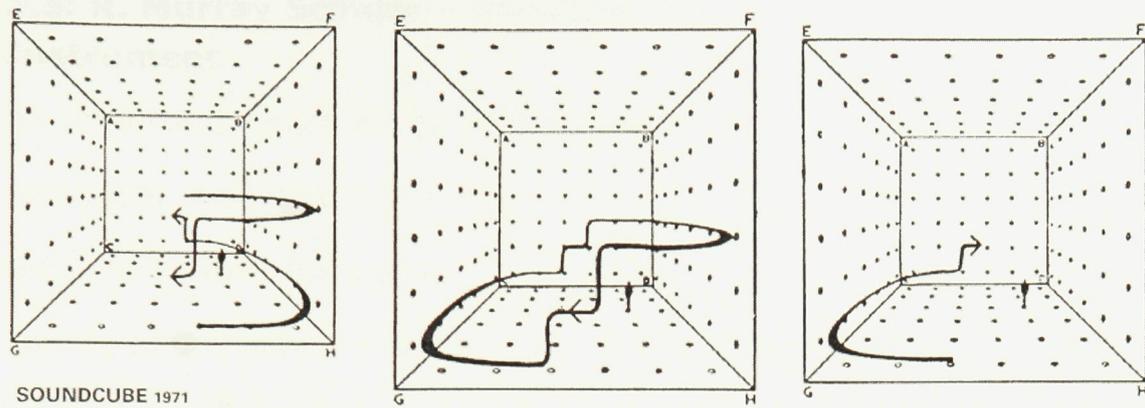


Figure 9-11. Sound Cube by Bernard Leitner, 1971

The architectural implications of the idea of a 'big-ear' that deposits itself within a permeable sonic environment invites architectural speculation about its possible manifestation. Leitner has explored the idea that space unfolds over time (as does music) and locates points or lines of modulation within this relationship. Architecturally, one could translate Leitner's ideas into the demarcation of architectural space; this can be seen as a threshold condition and programmatic functions of the transmutation of sound as it changes within architectural space, due to the considerations of acoustics, materiality, volume.

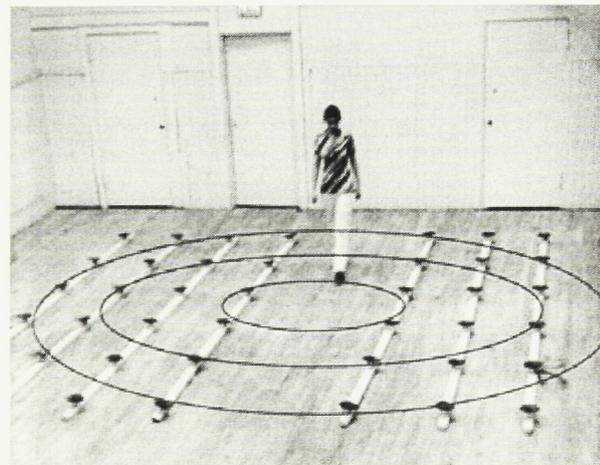


Figure 12. Sound Tube. 1973.

### 3.3: R. Murray Schafer – Our Sonic Environment as a Musical Instrument

An important figure in the context of sound art is Murray Schafer, a composer who has performed numerous “soundwalk” exercises in order to explore the potential of sonic environments. In his book, *The Tuning of the World*, Schafer defines aural existence through concepts such as “soundscape,” “keynote sounds,”<sup>21</sup> “signal,”<sup>22</sup> “soundmark,”<sup>23</sup> and “archetypal”<sup>24</sup>, and posits that sound is an entity unto itself and can therefore be defined neither as ‘music’ or ‘noise’. It is rather a function of the environment or situation from which it results. Another important contribution made by Schafer was his definition of Hi-Fi and Lo-Fi soundscapes: “The hi-fi soundscape is one in which discrete sounds can be heard clearly because of the low ambient noise level,”<sup>25</sup> whereas, “In a lo-fi soundscape, individual acoustic signals are obscured in an overly dense population of sounds.”<sup>26</sup> An example of hi-fi soundscape, (specific to the chosen site), is the Peace Tower bell that sounds from parliament hill, whereas a footsteps could be an example of lo-fi soundscapes.

According to these ideas, a chosen site for a design project, due to its specific sonic environment, is a musical instrument that allows for the perception of the ‘music of the environment.’ A sound art/

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<sup>21</sup> Keynote refers to the fundamental tonality of the composition, sometimes unconsciously heard.

<sup>22</sup> Signal refers to the clear foreground sound consciously listened to

<sup>23</sup> Sound mark refers to a characteristic community sound which related to the notion of landmark.

<sup>24</sup> Archetypal, is a term to describe sounds that are primordial in nature, and usually symbolic.

<sup>25</sup> Murray Schafer, *The Music of the Environment*, 11.

<sup>26</sup> *Ibid*, 11.

architectural intervention would respect the environmental considerations by acknowledging existing and modified pathways that the individual uses to traverse the site, while “framing” ambient sounds in a specific ways.

Architecturally, Schaffer’s work is very important, as it encourages one to consider the different sounds that contribute to the site. From the work of Schaffer, we can understand that a sonic environment is made up of both ambient and directed sounds that can be defined as hi-fi and lo-fi soundscapes. One could therefore ‘direct’ more prominent sounds into the building, aligning them with appropriate architectural programs, in order to enhance the overall effect of the building.

Sound can thus be considered architecturally as having the capacity to heighten the connection between the work of architecture and the site within which it is situated. Therefore, sound has the potential to be a powerful tool in informing architectural design, as it has the capacity to enhance the ‘situation’ in which our architectural perception takes place. The ears as well as the eye need to be more fully engaged in designing the environment.

## **Chapter Four: Transformation, Sonic Architecture**

### **4.1: Process of Transformation in Sound and Space, Le Corbusier, and Alchemy**

Given the above example of sound and space, it becomes apparent that alone, these two elements cannot convey the same experience as when they are alchemized, transmuted, transformed, combined or mixed into the creation of a sonic architecture. Alchemy occurs between sound and space in the sense that each reveals something about the other that is not apparent alone. As previously mentioned, the co-relationship of space and sound promises an alchemical potential whereby one can witness the perceptual modification of space by sound and conversely, the acoustical manipulation of sound by space. While these sound-space instances can be intricate or vast, stable or fluctuating, they are nonetheless available to sound artists and architects alike as experimental conditions. Sound experiments and spatial manipulations are intrinsically linked and both can be transmuted (processes resulting in structural changes) and/or transformed, (modified by relational conditions and juxtapositions). Another third force is evoked, and it serves to intertwine sound and space in an experience that has the qualities of being both subjective and objective, though neither effect adequately describes the transcendence that space and sound create together.

Alchemy was important to architects such as Le Corbusier, as the idea suggests creation through processes of production and assembly. Therefore, one can see a connection with the processes of production. It was necessary for the architecture of Le Corbusier, whose work was very industrial, to be concerned with that which came forth from the

factories, assembly lines. But it was a different sort of production. Le Corbusier looked to the alchemists because they used a similar method of creation; believing in process, but to achieve a knowledge and experience that was "mystical".

In *Poem of the Right Angle*, Le Corbusier has his own form of iconography; a visual code well concealed through both self-referential, alchemic and mythical means: "The result of all this was he revolutionized the aesthetic experience itself. No longer is it objects that presented themselves for appraisal, but an entire process, to be experienced and used as such.<sup>27</sup> Sound in this context heightens the experience of architecture, bringing to the forefront the cathedral's spatial and material qualities. Another crucial architectural element, lighting, can be understood in the same way as sound. Light, an immaterial quality like sound, affects material and surface volume, time and space, and results in different perceptions. Lighting is an optical sensation affected by spatial qualities.

For example, the chapel at Ronchamp (1950-1953), despite its Christian identity, is in fact a kind of 'sky worshipping church,' more aligned with the pagan or esoteric inclinations of Le Corbusier. Le



Corbusier's fascination with alchemy is described architecturally in moments such as the bell towers-which are in fact light wells-elements that sublimate sound into light. His ideas regarding capturing the essential, immaterial qualities, such as sound, light,

<sup>27</sup> Tafuri, *Form as Regressive Utopia*, 21.

color and rhythm, can be seen in his work, *The Philips Pavilion (1958)*, [Figure-13] which he designed with Iannis Xenakis, and Edgard Varese. It was a unique among early modern works in that the concept dealt with immaterial quality, and was conceived from the start as both an aural and visual experience. In this pavilion, the space itself changes, and sound and film projections are added. Le Corbusier designed this 'electronic poem' by drawing scripts. By projecting different sounds in different places there is an overlapping of many soundscapes, and each listener perceives the music in a different way according to his or her location. The acoustical space is no longer homogeneous, but divides itself into different spatial areas.<sup>28</sup> Therefore, when sound undergoes a transformation, it becomes engaged with its environment, carrying with it information of narrative and experience.

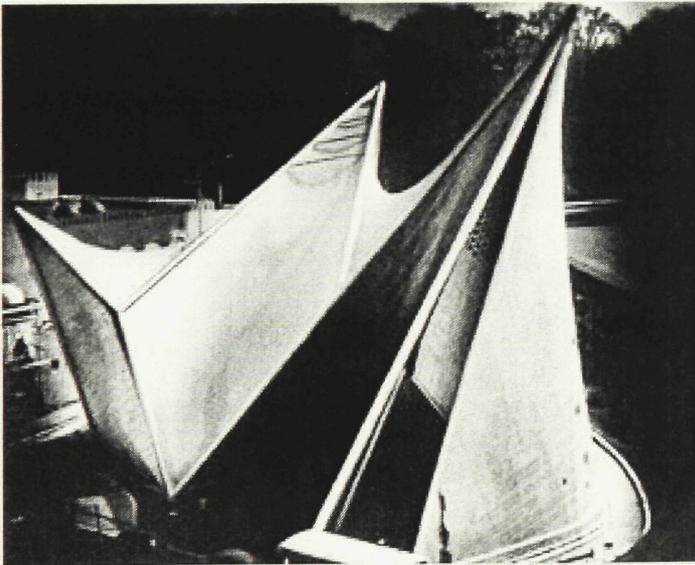


Figure-13. The Philips Pavilion 1964-1965 World Fair.

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<sup>28</sup> Oswalt, Philipp. "Iannis Xenakis's Polytopes." Trans. Tas Skorupa. *Contemporary Music Review*. Vol. 21, (Nos2/3 2002) 35-44.

#### **4.2: John Cage and Pierre Schaeffer: Sound Source, Interpolated.**

An early pioneer in the formation of soundscapes was John Cage (1912- 1992). He was the first to entertain the idea of a silent composition, with his work *Silent Prayer* (1948), as well as in his most notorious composition, *4'33"* written in 1952.<sup>29</sup> In his performance of this composition, Cage sat down in front of the piano and performed by not playing for exactly four minutes and thirty-three seconds. The intention of this performance is for the audience to hear the unintended, surrounding sounds, the noises, and ultimately the total environment.<sup>30</sup> In this way he fostered an awareness of the often overlooked sonic environment. His works are known for stepping outside the usual confines of Western art music to allow noise and worldly sounds into music. Indeed, his music proposes a new mode of being within the world, based on listening: through an active interaction with the sounds of the world. In this way, Cage's concept of treating noise and sound as equals, as well as his new definition of silence, has had a great impact on contemporary sound artists. He declared that "Sound is music, sounds around us whether we're in or out of concert halls."<sup>31</sup> The importance of the concert hall therefore becomes secondary to the sounds of the street - the ambient sounds perceived within the built environment. But sound is not necessarily music. As Cage illustrated, sound can also be ambient noise. The

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<sup>29</sup> Douglas Kahn, Noise, Water, Meat: A History of Sound in the Arts. Cambridge, Mass: MIT Press, 1999. 165.

<sup>30</sup> Ibid, 183.

<sup>31</sup> Murray Schafer, The Soundscape: Our Sonic Environment and the Turning of the World, 5.

difference is that the marriage of architecture and sound has the capacity to heighten our awareness of our environment, if only for a moment, or more precisely for Cage, for four minutes and thirty-three seconds.

Cage attempted to erase the distinction between silence and music, while simultaneously noting that perfect silence is never more than a conceptual ideal, an aural vanishing point.<sup>32</sup> Schaeffer's work proposes architecturally that sound is regardless of the architect's intention or nature of an environment. Architecture aims to enhance the freedom of its aesthetic attitudes of form, movement and passage, has ability to shift the dynamic relationship through its circulation and passage. This similar to the way that Cage abstracted background sound as music, to emphasize the surrounding sounds captured from the landscape, or the built environment.

John Cage's work influenced Pierre Schaeffer's work *Musique Concrète*, which elaborates on Cage's ideas by inserting sounds that were generated from the environment into a composition via a tape recorder. The result is electronic music, a genre that incorporates a whole gamut of new musical sounds, many of them related to industrial and electric technology in the world at large.

The term "acousmatic listening" as defined by Schaeffer, is listening to sounds without their original sources and visual context, a listening that thus gives access to sound-as-such. This point of view is at once a contradiction and an elaboration of Cage's thought that, "sound is not music", by positing that found sounds can be musical.

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<sup>32</sup> Christoph Cox, *Audio Culture*, 6.

Schaeffer's concept of a sound without relation to its source creates a concept of sound-object detached from any association with its source or cause. The sound-object is thus to be appreciated for its essential acoustic properties and not in relation to the instrument or physical cause which brought it into being. The result is a production of a new sound. The way that music is produced, and its source is a secondary issue, when considered in tandem with procedures and processes.

#### **4.3: Guiding Principles Derived from Experimentation in Sound Art**

Cage and Schaeffer's ideas on the use of musical devices applied to the "entire field of sound" suggests that music is not only produced by traditional musical instruments. Many sound fragments come together, each sound having its own autonomy. As Murray Schafer points out, "our buildings are thus acoustic as well as visual spectacles...but when such buildings...became merely functional spaces for silent labour, architecture ceased to be the art of positive acoustic."<sup>33</sup> He then goes on to say that "the best way to comprehend what I mean by acoustic design is to regard the soundscape of the world as a huge musical composition, unfolding around us ceaselessly."<sup>34</sup> Thus, the natural environment of this area functions as a musical instrument emanated from different sound sources.

This bringing together of normally unrelated objects in a soundscape can be closely compared to the technique of bringing

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<sup>33</sup> Murray Schafer, The Soundscape: Our Sonic Environment and the Turning of the World, 222.

<sup>34</sup> Ibid, 205.

together unrelated visual objects in a painting or sculpture. This technique, well known to surrealism, cubism and purism, discovers and proposes imaginary landscapes created by reconciliation through the assembly of discrete fragments or parts. Similarly, musical compositions have evolved to include collages, samples and mixed sounds from numerous sources, reconciled in composition and process-based (re)assembly.

Surrealism did little to shift from a visual to an auditory mode for perceiving the world, despite its roots in the chattering unconscious of automatism. There was after all, a certain prohibition of auditory, reflective of the surrealist antipathy toward music.<sup>35</sup> The "interpolation of noise" was a means by which meaning was generated from abstraction and thus corresponded directly to Surrealism's larger project of bringing realms of reality hitherto guarded or unknown into mimetic practice.<sup>36</sup> The interpolation existed in works of Max Ernst (1891-1976), a collagist and one of the great Surrealist painters. He composed unreal imagery from its fragments, then collaged the result and interpolated his manipulated world into the painted collages which produced a visual effect of autonomous image made up of familiar, individual elements. The purpose of these collages was to provoke vision, to stimulate thought and force inspiration. The "model of reconciliation," a later section of this thesis, will explore and liberate the fragmented ideas and interpolated in the new form of NGSA.

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<sup>35</sup> Douglas Kahn. Noise, Water, Meat, 33.

<sup>36</sup> Ibid, 31.

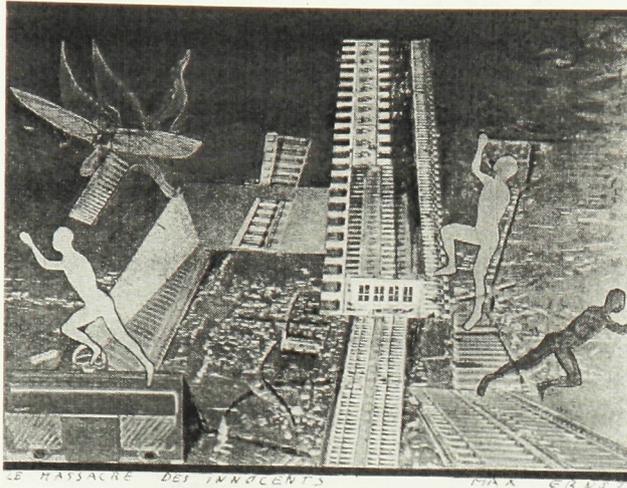


Figure 14. *Massacre of the innocent*, by Max Ernst, 1920.

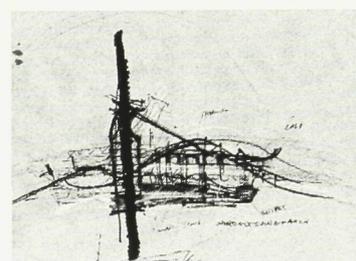
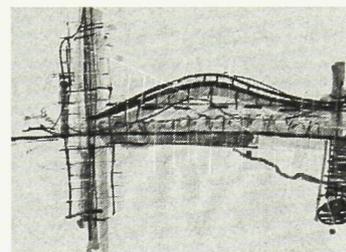
Similarly, the architectural design process, makes both visual and aural connections using fragments, collage and forming, as elaborated in Part 2. This is an important process for uniting objects in space. The influenced sound on architecture can be based on investigation in terms of following:

1. A directional expression of its planar relationships - How the plan is generated through line.
2. A contained generator of programs - Spatial boundaries
3. A partitioning of segmented flows - Thresholds and implied spaces.
4. An anchoring and absorption of public and private space - Purposeful segregation and overlap of architectural programs.
5. An indicator of movement orientation
6. A rupturing of building envelope fenestration breaks openings.
7. The passage of circulation stairs, ramps, journey, moments.
8. Continuous programs, relationships between indoor and outdoor spaces. Views - spatial slippage.
9. Visual cues and fragmented trace journey, time, change transition moment.

## Conclusion of Part One

Part One of this thesis has investigated that sound and architecture are parallel to both subjective and objective approaches. The path of transmission through a medium and to a receiver is influenced by the environmental context; in other words, these aspects constitute our sonic environment. The implications of the design decisions are determined on two scales: first, the scale of specific sites for sound space and public spaces used to develop the broader Victoria Island/downtown precinct; and second, the scale of the human sensation, in order to perceive sound from the inner ear-membrane to hear the wider implications of interactions between sound and architecture.

Throughout the research and design project, I have attempted to present, architecturally, both subjective and objective ways of approaching the sonic perception of sound. Sonic perception is personal, individual; even through everyone can be situated in the same location, their sonic perception is difference. The need to explore the project at



two contrasting scales can also be appreciated in terms of the sonic experience those scales. The image of sound can be visualized through various ways of experimentations. Through the process of transformation or alchemy, the architectural project proposes a National Gallery of Sound Art – for public display and dissemination of sound art experiments and installations, with the specific aim to

re-awaken our sensibility, and re-introduce the nature of urban sound and of sound itself, often ignored in the city fabric.

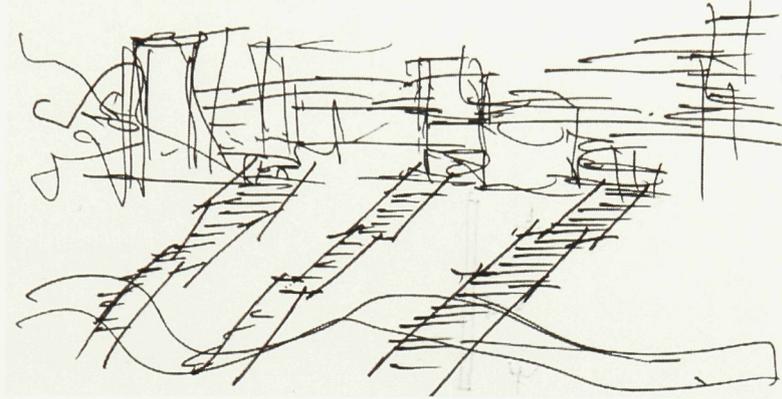


Figure-17. Conceptual Sketch, image by author.

**Part Two**

Listen.  
Words on this printed page are sound.  
Listen.  
The quiet voice on this printed page is sound.  
Listen.  
Life in your neighborhood is sound.  
Listen.

- Hildegard Westerkamp<sup>37</sup>

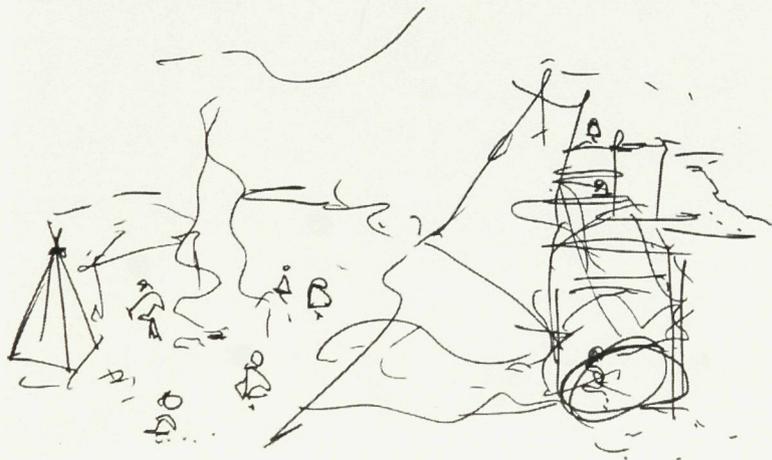


Figure-18. Conceptual Sketch, image by author.

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<sup>37</sup> Hildegard Westerkamp, "Say Something About Music." Site of Sound: of Architecture & the Ear. Errant Bodies Press, L.A., 1999. 22.

## **Chapter One: Site Specific Sound**

### **- Soundscape and Sonic Perception of the City Fabric**

Hearing is done not only with the ears, but also with every fiber of our beings as vibrations of sound move into our bodies. Sound touches us, inside-out. And this feeling of being touched by sound is heightened by technology: when microphones amplify and record sounds, they not only involve the ears, but also every other part of the body.<sup>38</sup>

- Andra McCartney

#### **1.1 The Soundwalk as an Exploratory Tool in Investigating the Sonic Perception of the City Fabric**

As one walks through the city, one is surrounded by noise, often unwanted sounds that one chooses to ignore. However, if one closes their eyes and listens carefully, they may find this 'unwanted' noise to be quite fascinating and full of potential. Furthermore, the sound around us gives us an orientation as it reflects the pre-existing ambience of the space that surrounds us.

Contemporary sound composers, such as Hildegard Westerkamp and Andra McCartney have based their work on transferring their sonic experiences from soundscapes into musical compositions by means of recording and audio manipulation. The focus of their research is the capturing and transformation of the soundscape by means of recording technology as well as through architectural compositions. This bi-faceted exploration starts with a "soundwalk,"<sup>39</sup>

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<sup>38</sup> Andra McCartney. Soundscape Works, Listening, and the Touch of Sound. Aural Culture, 179.

<sup>39</sup> Listening walk is just a walk concerning base on listening and is different than soundwalk.

defined by Andra McCartney<sup>40</sup> as “an exploration of, and an attempt to understand, the sociopolitical and sonic resonances of a particular location via the act of listening.”<sup>41</sup> In extreme examples, some individuals, such as those with limited eyesight, navigate the city solely through familiar sounds – gauging distance by assessing the quality of echoes, for example. In essence, the way a blind person navigates a city is almost entirely dependant on sound. They rely on sound to judge distances and to identify the nature of the area in which they are located. At certain points of their journey, ‘obvious’ orientation cues have can be recognized. For example, the familiar chirp of the cross-walk sound, whereas other sounds, descriptive of urban space, are less apparent, and in effect, ‘drowned-out’ by sounds less easily ignored.

Therefore, the act of sound-walking is useful in order to explore the sonic environments around us as a compliment and contrast to the visual experience. In response to this, Westerkamp describes “bridge music” after she walked across the Alexandria Bridge in Ottawa.

It is quite a windy day and I am assuming that it is the wind howling between the pillars of the museum wall. But the longer I listen the less I can find a connection between the patterns of the wind gusts and those of the sound. After a few minutes I walk on and suddenly, as I walk around the building I hear the same wind sound more loudly and clearly. It is not wind that is producing the sound. It is the traffic on the

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<sup>40</sup> Andra McCartney is a professor of Communications at Concordia University, in Montreal.

<sup>41</sup> Andra McCartney. Soundscape Works, Listening, and the Touch of Sound. Aural Culture. 179 – 180.

Alexandria Bridge. It had echoed off the museum wall. Now I hear it in stereo, with the direct sound from the bridge in my left ear and the reflected sound from the museum in my right ear.<sup>42</sup>

In her description, the perceived sounds, the site's aural coordinates and qualities, are described as a piece of music. Throughout the text, original sounds increase the correlation between sound and the visible spatial and activity to form the proposed site in downtown Ottawa. Aural sensibility could be affected by the sound generated, *modulated* within the environment in which we dwell.



Figure-19. Aerial photo of immediate site, Victoria Island.

### 1.1.1: The Value of Conservation of Victoria Island

Sound-walking is becoming an increasingly important way to describe the sonic environment of urban space. Located west side of Alexandria Bridge, Victoria Island is situated in the Ottawa River on the boundary between Ontario and Quebec connected by Pont Du Portage Bridge; currently, a zone of recreation and cultural activities. It is an island punctuated by Chaudière Falls, and occupied by a power generator building to the west. The site contains various layers of sound both natural and artificial. It is not totally removed from the man-made sounds of the urban space of Ottawa, but with the additional layers of natural elements such as the rapids, it witnesses an orchestra of sounds from the landscape and the city. This remote unpopulated location is close to downtown and connects other recreational tourist facilities, such as Canadian War Museum, Canon Park and various Bike Paths.



Figure-20. Site and relevant structures.

Soundscape is a field of interactions, determined by the way in which sounds affect each another and ourselves as listeners. This

condition is 'found' and captured in a less controlled way than it would be in a laboratory situation.<sup>43</sup> Therefore, the soundwalking exercise can help to verify site specific sounds, and while exploring the spatial impressions through constant sound-walking exercises of a selected site, in this case, Victoria Island. In order to provide responsive settings for design a proposal, a series of soundwalking expeditions to the site have been carried out. **[Refer to Appendix B. Soundwalking in Victoria Island]**



Figure-21. 360 Degree view out from Victoria Island. 2005.

### **1.1.2 The Renovation of Existing Carbide Mill**

The existing Carbide Mill located in Victoria Island, owned by the National Capital Commission, is located on the east end of Victoria Island, and was originally built in the industrial quarter during 1899-1900 by Thomas Leopold Wilson.<sup>44</sup> The mill is attractive in appearance with its thick gray limestone rubble stone work. There is a fine use of stone craftsmanship and the rhythmic order of windows along the building. The site is a prime example of the architectural style typically used at that time by Public Works Canada. Also its characteristics describe the situation in Ottawa at the time.

<sup>43</sup> R. Murray Schafer, *The Soundscape: Our Sonic Environment and the Tuning of the World*, 131.

<sup>44</sup> Ottawa Carbide Company. Letterbook 1-3. The Bronson Collection M.G. 28 III 26 vol. 546, 549-553.

It is connected to a larger network of manufacturing sites in Hull via the Pont Du Portage and Chaudiere Bridge that included a mix of manufacturing, distribution, railway yards and water treatment plants. The utilitarian style of the surrounding buildings, with their low density and random assemblage of the landscape, additionally inspired the massing and materialization of the proposed project and influenced the formal characteristics of the Mill.

The existing conditions are a function of production, manufacturing and storage space. However, this initial analysis is derived only from a land-use perspective, and the proposal for the NGSA should not be limited to these conditions. The site should evoke other conditions, like cultural and social activities, as an addition to its industrial past. The architecture of the Carbide Mill provides significant evidence of various periods in the formation of the city. The mill has an interesting and storied past; it was conceived that Victoria



Island be involved in the infrastructural joining of the island from the Hull side of river with a bridge in the year of 1926.

Figure-22. Aerial photo at 1926, Canadian topographical Maps, Natural

Resources Canada. 2003.

Through its compartmentalized layout, [see to **Appendix C** for existing Carbide Mill's floor plans] the mill was planned with the functional aim to mitigate the dangers of acetylene gas production:

Here was produced carbide, a class of chemical compound in which carbon is combined with a metallic or semi-metallic element that when mixed with water produces a very bright flame; when this is combined with a reflector, it makes a very efficient light source. With over 60 patents to his name Wilson made a fortune. One patent, for mixing oxygen and acetylene, resulted in a torch that would cut through heavy steel and would revolutionize the industrial world. Another important patent was for a new type of navigational marker, which effectively functioned as a mini-carbide-acetylene factory. It generated its own light and never had to be refilled. Wilson's company, the Marine Signal Company, filled orders from all around the world.<sup>45</sup>

The production of acetylene gas was already a kind of alchemy going on at the site; materials were being changed into new materials. It held the potential for uncommon transformation through the alchemical process and production of oxygen and acetylene. This supports the argument about why this existing building is appropriate



to use for sound and architecture.

Figure-23. Carbide Mill earlier in the twentieth century.

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<sup>45</sup> Harry Foster. Architecture of Old Hull. 17<sup>th</sup> June, 05.  
<[http://www.civilization.ca/hist/hull/rw\\_19e.html](http://www.civilization.ca/hist/hull/rw_19e.html)>

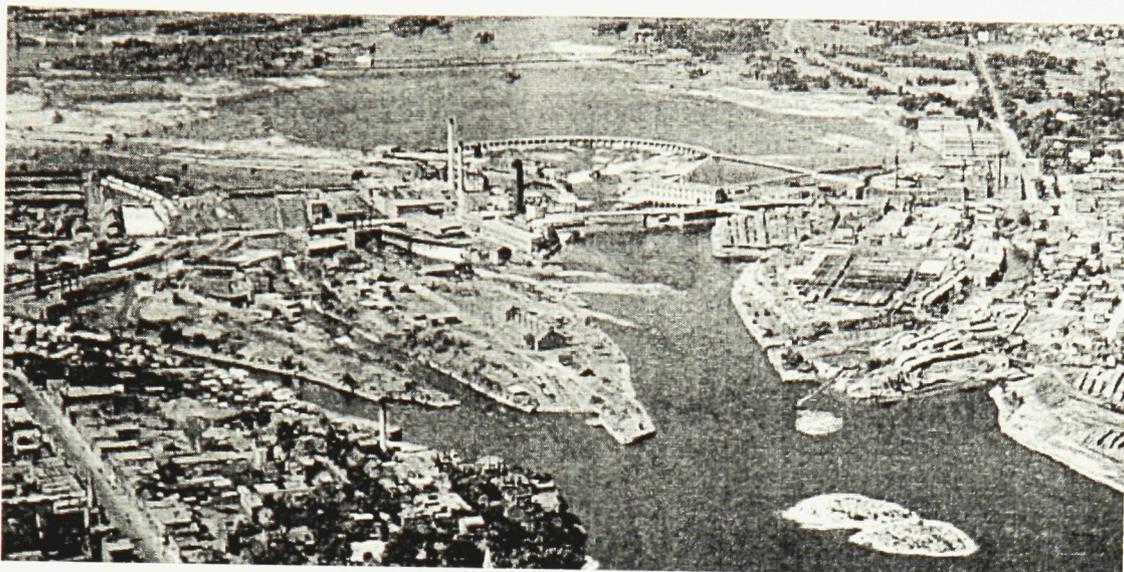


Figure-24. Aerial photo at 1968.

The mill escaped destruction on several different occasions; a fire in April 1900 damaged the machinery used to create power from the rushing water, causing another setback in the opening date of the mill and its interior and most of its roof structure was destroyed by a fire in 1975.<sup>46</sup> The mill was also the site of a revolt during the two world wars and the time in between them, the building was used for storage by the Navy. What was stored there is unknown but the entire island was used for this purpose. In late 1975, the Carbide Mill taken over by the native people's caravan, a political Native group which was protesting in Ottawa at the time.<sup>47</sup> They were in residence in the building until the end of February. The mill escaped fire again in 1978 and has been abandoned since 1975 and stands empty until now. The

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<sup>46</sup> City of Ottawa. Inquiry into the fire and explosion at the Dominion Carbide Company of the City of Ottawa. The Bronson Collection. M.G. 28 III 26 vol. 554. 7.

<sup>47</sup> City of Ottawa. Inquiry into the fire and explosion at the Dominion Carbide Company of the City of Ottawa. The Bronson Collection. M.G. 28 III 26 vol. 557. 4.

conversion of the historic Carbide Mill into a sound art gallery can be considered an intervention for the preservation of Ottawa's industrial heritage. While respecting its rich loci, it is necessary to renovate certain aspects of the existing building condition.

### **1.1.2: Victoria Island – Sounds Like City**

The conditions of inhabitation on Victoria Island provide an excellent quality of space for sound art programs. The various layers of sound are the most important component of the site's context because the existing landscape provides an enriching opportunity for visitors to experience the natural and urban sounds, indigenous to this area. In her writing, *Sounds Like City*, Sophie Arkette argues that:

Sound, especially within the context of the urban environment, is never a neutral phenomenon. Each sound is imbued with its own lexical code: sound as sign, symbol, and index; as ostensibly defining a personal territory in the case of the ghetto blaster or car stereo; as creating a portable soundscape in the case of the Walkman.<sup>48</sup>

Arkette suggests that the sound phenomena and sound-spaces can be investigated on numerous scales in tandem with the physical shifts of scale in architecture. Such a shift situates language within a context of environmental organization. The need to leave a physical trace of the existing building will, in the final engagement, elicits certain visual and aural experiences where it has located vulnerabilities. These vulnerabilities can be technically examined through its historical and structural work in the existing building:

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<sup>48</sup> Sophie Arkette, "Sound Like City." *In Theory, Culture and Society* London: Sage. 21.1 (2004):160.

- Existing building in the exhibition of sound
- Existing materiality; inspired by the mix of materials
- Assemblages of materials already in part of this building
- The quality of sound that comes of the stone.

The existing building provides a perimeter of stone. The space enclosed within this perimeter is the focus of the new construction. Although this wall no longer forms a substantial enclosure, the stone is more than a wall, as it discloses a longing for greater inhabitation. In this way, the stone already provides or exists as a canvas for the site. The stone registers its unique place through the sounds that resonate off it, (as described in soundwalk) which are not limited to the water, parliament bells and the bridge, but include the varied scaled activities associated with them. Therefore, the site, through its unique song, has 'painted' the stones.

The walls of the existing carbide mill are in good condition, made out of 2'0" thick un-coursed thick *gray limestone*. The walls form a perimeter of which the East end wall is missing. A potential use for this perimeter is as a part of acoustical treatment and structural support for existing and proposed additional spaces. This 'sonic perimeter' provides conditions ideal for acoustical separation: it extends itself to be used for sound studio.



Figure-25. East end of Carbine Mill. October 26<sup>th</sup>, 2005, photograph taken by author.



Figure-26. East side of Carbide Mill, October 26<sup>th</sup>, 2005, photograph taken by author.

The Roofs of the mill are incomplete as the steel super-structure is missing, having been destroyed during a fire in 1975. The existing corrugated sheet metal roof is in poor condition, perhaps meant as a temporary fix, and is therefore potentially dangerous to keep. In my design scheme the roof will be repaired for safety and the shape will be partially kept. All of the Floor slabs are in poor condition, and potentially dangerous to keep; therefore, they will be repaired for

safety reasons.

The windows have been filled in with stone rubble. My scheme calls to keep them filled and additional acoustical panels can be installed for acoustic purposes. The doors too have been filled in with stone rubble and are in poor condition. The Doors at west side of the mill are useable and will be kept.



Figure-27. West End of Carbine Mill,  
photograph taken by author.



Figure-28. Existing loading zone. The loading zone is in good condition; it's an optimum size for the proposed building, and therefore will be kept and used.

## **Chapter Two: The Design Proposition**

### **2.1: Design Proposition – National Gallery of Sound Art (NGSA)**

The surrounding area of proposed site could be reawakened by the proposed NGSA. The design of the NGSA invites people to visit and experience works of sound art; artists will also be given the opportunity to rent the studio spaces, in order to re-inhabit this abandoned area, and strengthen the district. The site can support a series of sound-walking sonic experiences to elicit individual impressions and responses based on psycho-geographic discovery.



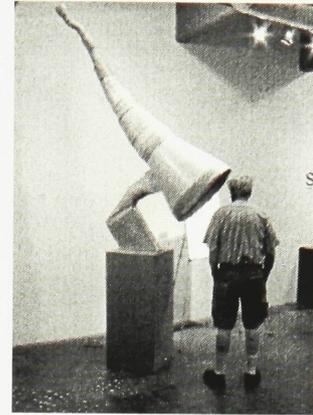
Figure-29. Victoria Island looking toward native center and Parliament. 2005.

#### **2.1.1: Sound Art**

Sound art goes beyond the limit of music, to develop new art forms. "Sound art" could be music, but also could be more than music: it could be noise, unorganized in new and unconventional ways. To appreciate music, people traditionally sit down in a concert hall and listen to musicians. To appreciate the works of sound art, visitors should engage their bodies in order to hear, see and explore the changing sounds.

### 2.1.2: Uttering Spaces

Architecture insinuates itself into the perception of the sonic environment by bridging the relationship between interior spaces, structures and materials. The design strategy for the NGSA will maintain the functional clarity, the aesthetic value, and the acoustical performance defined by



the program. The most important programmatic consideration is the varied acoustic qualities of the sound galleries and the public spaces. Although the concert hall has traditionally been considered necessary as a main space for the composers and visitors to communicate, this design instead proposes a series of 'Interactive SoundLabs.' These SoundLabs serve to engage one's body movement with the sonic environment, to a greater degree than what would be possible by just sitting down in a concert hall and listening to a work of sound art.

In order to bridge the relationship between the existing building and the additional proposed construction, the circulation of gallery visitors and the composer's lounge form a connection, linking and merging these two spaces together. The existing conditions allow for sound to bounce off the existing gray limestone, creating a space for both composers and visitors to experience the slight differences in sound quality (footsteps and voices).

These qualities therefore have a substantial impact on the way in which the sound designer (composer) and instructor work to achieve the desired outcome and to re-awaken our sensibility. A new experience of space can be manifest through these fragmented

sounds, composed and organized into a new music or sound art piece. This would provoke a new understanding of music, in the same way that fragmented forms, and abstract creative processes, could be a transform a building, and thus offer a new understand of space. These different spaces can modulate the different 'feelings' of sound that for people perceive.

All of the performance and exhibition spaces can have the sound quality carefully controlled and manipulated by composers. Then, visitors need to move their bodies to 'listen' to the work; the body as a physical presence is thus implicated in the spatial situation. For example, in *Sound Chair*<sup>49</sup> by Bernhard Leitner, seating arranged according to the axis of sound movement; the materials used on each of the chairs is different so the reverberation each member of the audience feels is unique. Although auditor-participants hear the same thing, another of their senses is 'reawakened' in a different and individual way.

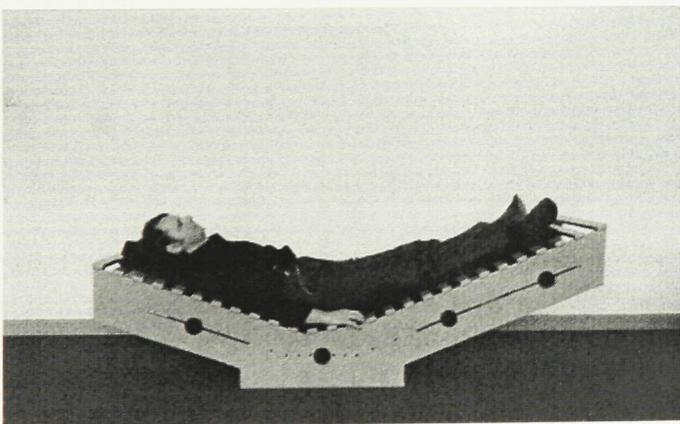


Figure-31-32. Sound chair 1983 (Left). Firmament 1996 (right).

<sup>49</sup> Bernhard Leitner, *Sound Chair*.

<<http://www.bernhardleitner.com/en/76tonliege.html>>

## Chapter Three: Consolidation of Architectural Principles

### 3.1 Massing model studies

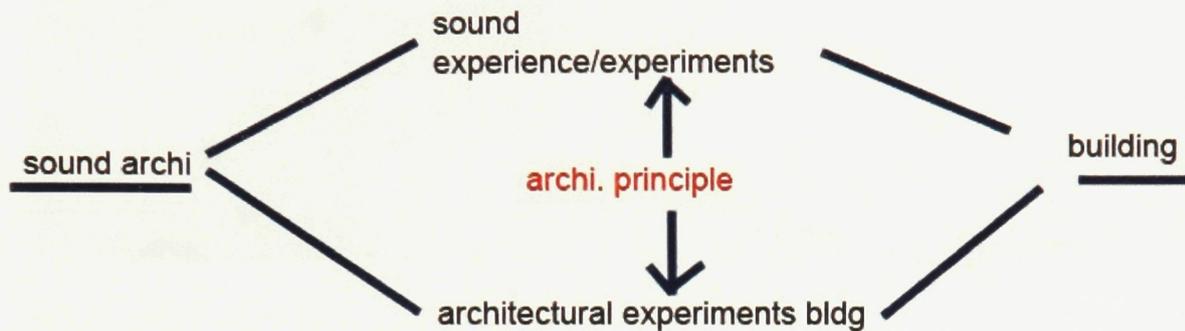


Figure-33. Relationship Diagram of sound and principles.

The above diagram illustrates the structure of this chapter, particularly the inter-relationship between architectural and sound-principles that serve to filter the ideas that further the focus of this thesis. The following massing models attempt to conceptualize the union of architectural and sonic composition.

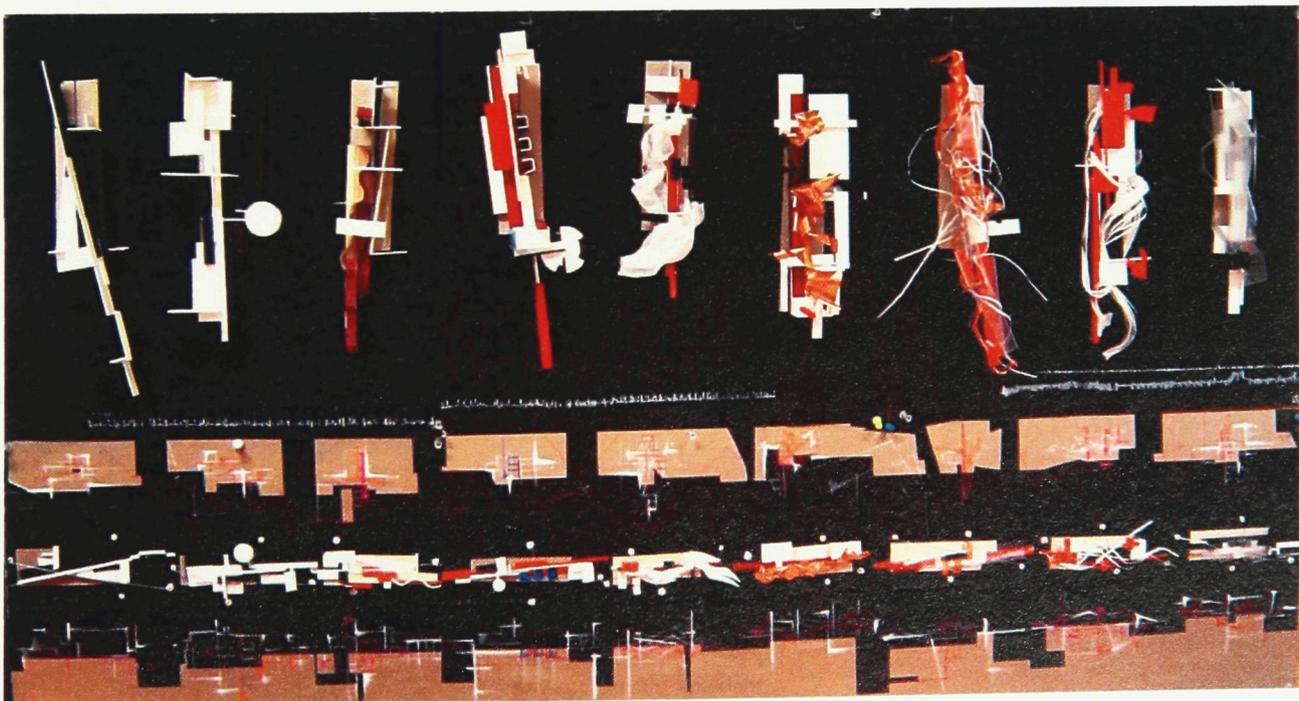


Figure-34. Overall massing models.

### 3.1.1 Sound as a directional expression of planar relationships

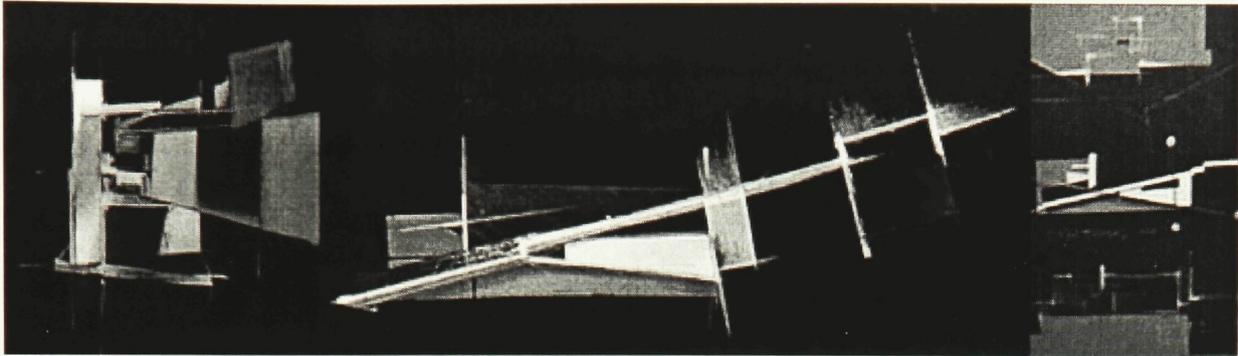


Figure-35. Mass model 1.

The formalistic qualities of this study demonstrate a strong axial assertion. A diagonal slices through the entire composition parallel to the view from the War Museum to Museum of Civilization, intersecting several planes. The spaces to either side become supporting functions created by this 'bisection,' and are sometimes formed by an inconsistency in the direction of this axis (a disruption) or act as appendages that have become detached from the central axis. Although the axial component delineates the organization of architectural programs, it also exists as a continuous element throughout the formal study, bridging diverse programs. Where programs are of greater magnitude, the axis appears heavier or thicker, and, in essence, 'anchors itself' to these planes. The largest plane is a representation of the existing building; the axis therefore seems to be derived from this. Beyond this plane, where it moves seamlessly between two appendages, the passage is thin, and uninterrupted. One could imagine that this axial component would serve to direct and organize circulation within the actual building,

providing a referent that would guide people through the planar and volumetric components of the program.

### 3.1.2 Sound as contained generator of architectural program

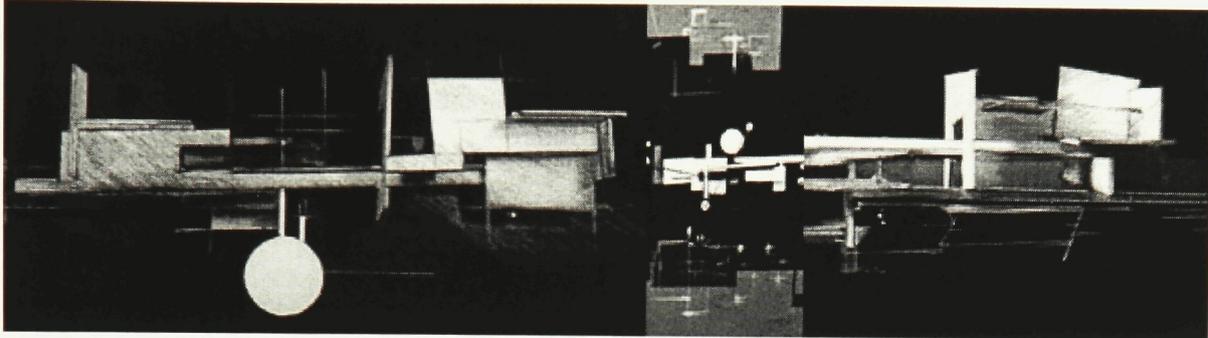


Figure-36. Mass model 2.

This study shows the multiplication of planar relationships in relation to each other through overlapping or layering that results in a transformation of architectural space. Each program is organized in relation to another through overlap and layering. There is an indication, through strong vertical elements, that these programs are at times separated by a monumental threshold condition which link through walkways. Other programs separations would be somewhat more subtle, through the overlap between spaces. Where these separations take place, a program transformation occurs. There are two sides to this study, both linked by a strong orthogonal 'bridge.' This linking occurs between the two spaces where there is most density of program. This link could be seen as space of circulation. Sound in this case could be understood as something that 'grows' upon itself. Sound creates sound, and in turn, sound creates space. This transformation results in certain pieces of the plan 'escaping' the confines of this proliferation, striking the outside of the compounded spaces, providing views to the surrounding outside landscape.

### 3.1.3 Sound partitioned into a segmented flow

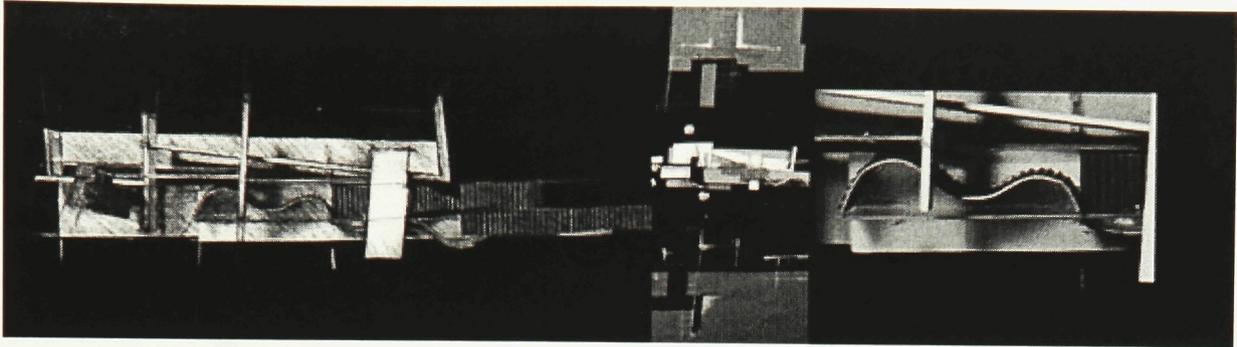


Figure-37. Mass model 3.

This study is descriptive of the element of sound that is segmented by vertical planes. These segments compose a rhythmic unfolding of spaces within the building. The rhythm is formed by a series of divisions, each forming a chord, in the sense it exists as an experiential measurement of spatial geometries. If the entirety of the building could be considered an instrument, these divisions could be considered 'strings,' that can be considered individually or as a 'part' in relation (forming a composition) with the larger whole. These vertical planes could later be considered walls or divisions in space. These walls do not necessarily divide program, but perhaps change or enhance the quality of sound as it passes through. These divisions could function similar to the 'frets' on a stringed instrument, and when emphasized, produce a different architectural experience. The potential of this study to perform this way is supported by the use of several different materials. Each could provide a very different quality of sound. People would notice the slight variations in sound as they passed through each space.

### 3.1.4 Sound anchored and absorbed

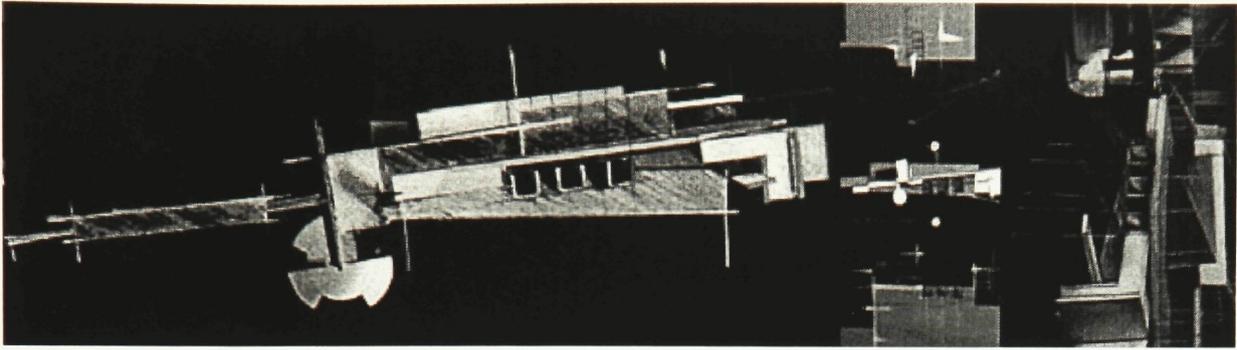


Figure-38. Mass model 4.

This study shows a more formal organization of planes and vertical elements. Three cubic components located at the centre of the study, serve to anchor the otherwise floating planes. These could be considered the sound wells, unique spaces possible used as an introduction of the building, the entrance. The solidity of these three components emphasize the lightness and variation in the size of the adjacent planes. There is a greater density of planar components at the side where the existing program is located. An appendage branches out from this study, somewhat removed and abstracted from the ground plane.

### 3.1.5. Sound as indicator of movement

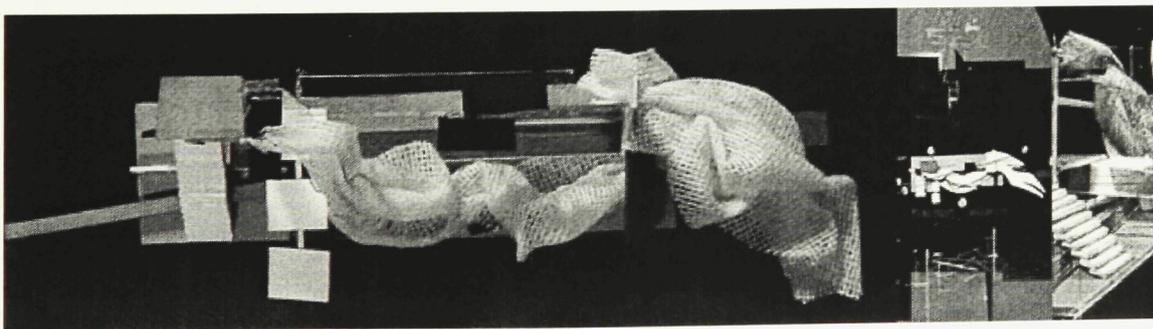


Figure-39. Mass model 5.

Movement throughout the different aspects of the program is

represented in an abstract way through a piece of material. This study suggests a volumetric and directional inhabitation of sound in architecture volume. This material weaves through the study, finding places through which it can permeate from one space to another. In this way, sound can be understood as an organizing factor and an element that establishes hierarchy.

### 3.1.6. Sound ruptured

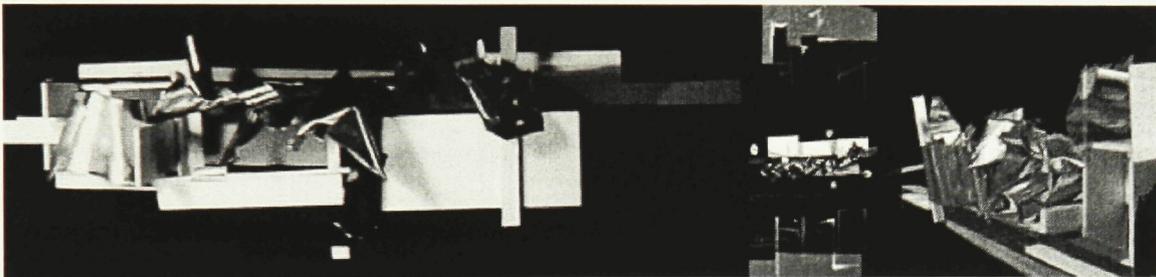


Figure-40. Mass model 6.

This study shows how sound could test limits or expose inconsistencies in a building envelope. Sound erupts from certain programs where sound is concentrated. This eruption is a condition of both vertical and planar conditions, and the spaces or programs of this study are organized around these eruptions. How these eruptions/disruptions would be manifest is interpretational. The possibilities include, but are not limited to, breaks in fenestration, sculptural sound wells, and large installation pieces. These disruptions

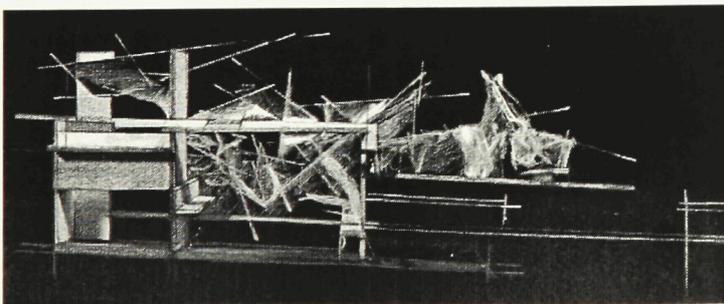


Figure-41. Model sketch.

would inform visitors that sound is something malleable, that it can be harnessed, and that it can perform.

### 3.1.7 Sound as passage

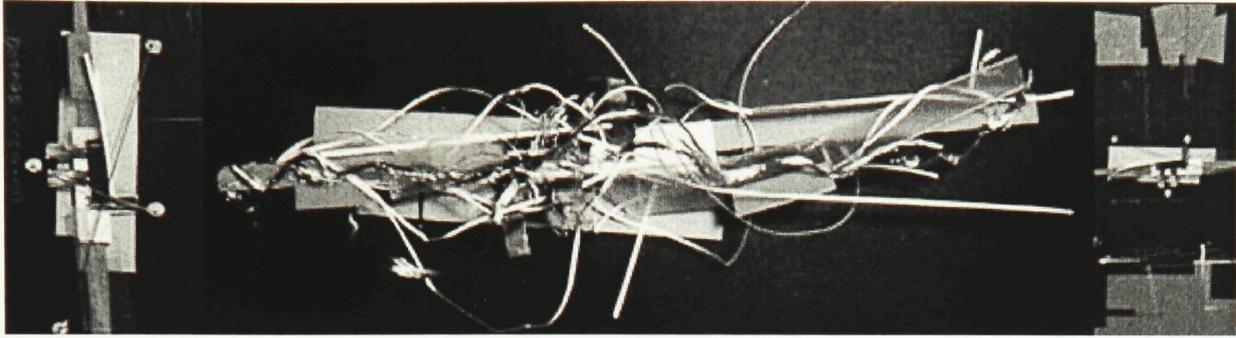


Figure-42. Mass model 7.

This study explores the potential of sound to weave in and out of programs providing emphases and enhancing the passage through the building. Sound has the potential to travel through several programs, revealing certain aspects of architectural conditions, spatial relationships and materiality as sound makes its sonic journey. Various materials were used in this study.

### 3.1.8. Sound continuous

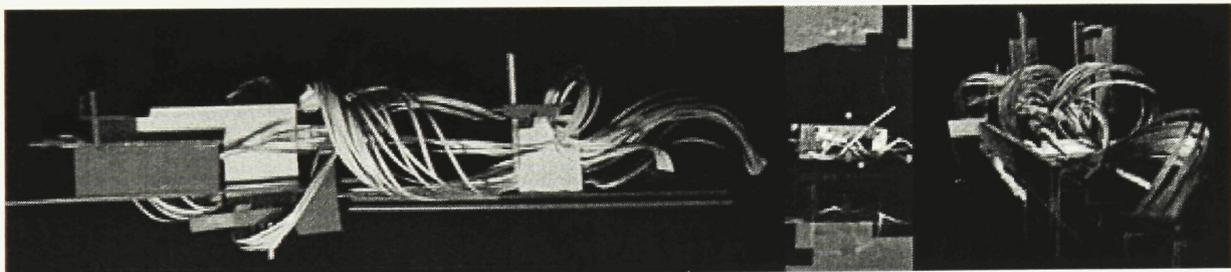


Figure-43. Mass model 8.

This study is characterized by the juxtaposition of planar components and the free-form nature of sound, represented by a thick weave of string. It asserts linear, perhaps narrative qualities, as its density is indicative of a beginning and end. The planar density located at the left side is representative of the existing building. There is an overlap created by multiple planes that indicate that this part of the study is composed of the overlap of several floors. There is a strong

orthogonal axis that extends out from the location of the existing building. This could potentially be the portion of the building where circulation is organized.

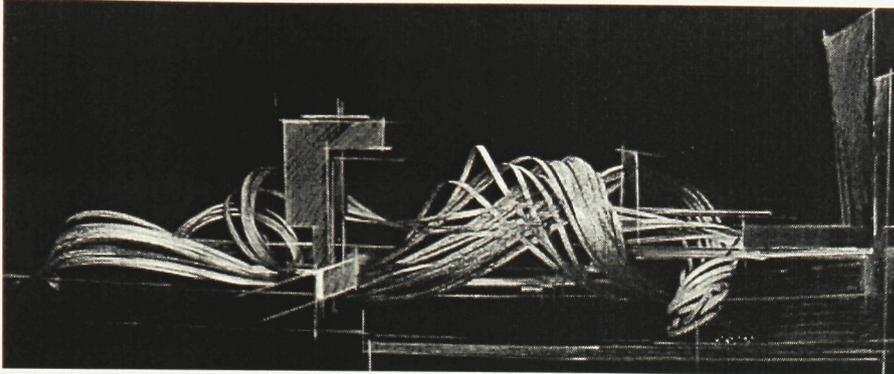


Figure-44. Model sketch.

From this linear component, an appendage branches out to receive the sound (string) that has passed through the building, presumably having its apex in the portion where the existing building has staked ground. The sound eventually leaves the building and dissipates into the surrounding landscape. On this model, the appendages jut out of the building into the landscape. These appendages could provide a connection between indoor and outdoor spaces, perhaps functioning as balconies or outdoor walkways.

### 3.1.9 Sound as a fragmented trace

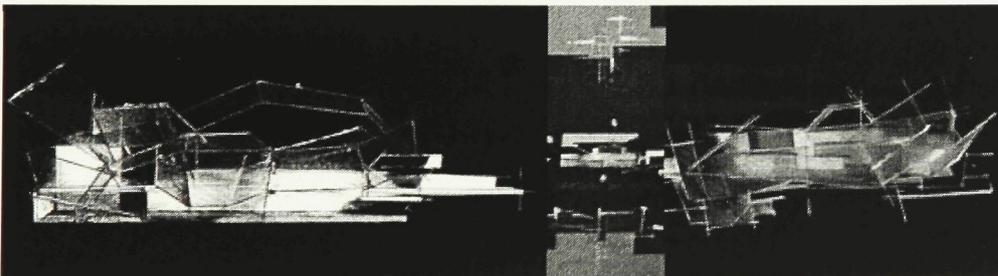


Figure-45. Mass model 9.

In this study, sound is depicted as a descriptive and sometimes disruptive force. It tests architectural limits and boundaries,

fragmenting programs and envelopes, leaving traces. More so than others, planar relationships are most equally distributed and shifting elevations of planes that provide views of this disruption. The solid void relationship is manifest architecturally through experimentation with fenestration.

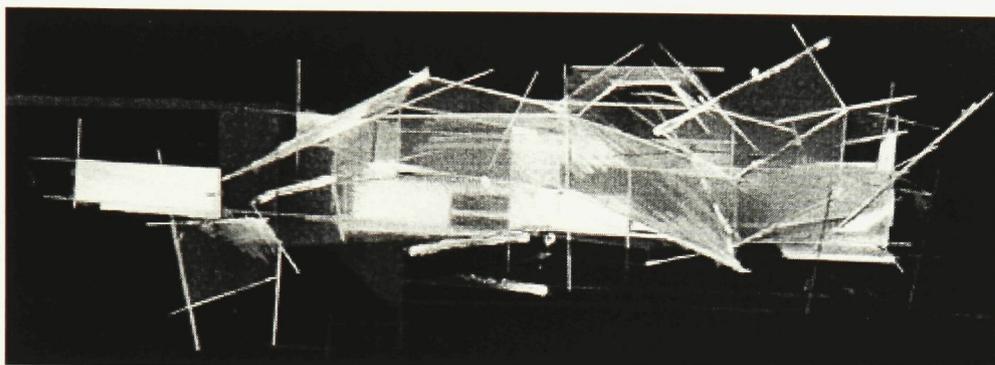


Figure-46. Model sketch.

This model has an abstract relationship with the landscape. The focus is upward, toward the sky, and on the effect that changing light has on the architectural space within. In this model, connections between the properties of light and sound are made to emphasize that architecture is a fragmented canvas that is penetrated by the exterior, as a disruptive forces collide. Also, architecture is considered as an instrument that fragments sound through by angular walls and volumes that slits allows for sound to penetrate from the exterior.

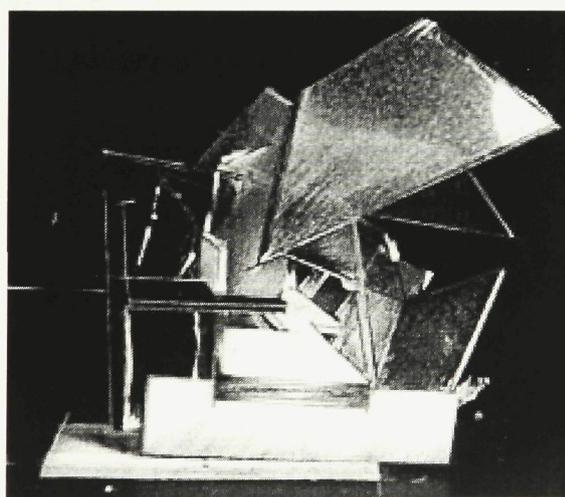


Figure-47. Model sketch.

### **3.2: Mode of Reconciliation**

The previous studies highlight unique relationships between sound and architecture. From them, I have ascertained certain principles where shapes and forms are considered together as assemblages, into a total programmatic meaning with a process transformation,

#### **3.2.1. Axial direction as an overall circulation**

The axial component could serve as a 'collector' of circulation within the building, with components of the program located off of it. How sound would behave in a building like this is that it would move through, at times subjected to a careful interruption (perhaps at moments of interception with other programs), where certain spaces would provide opportunities for sound to be collected, or 'registered.'

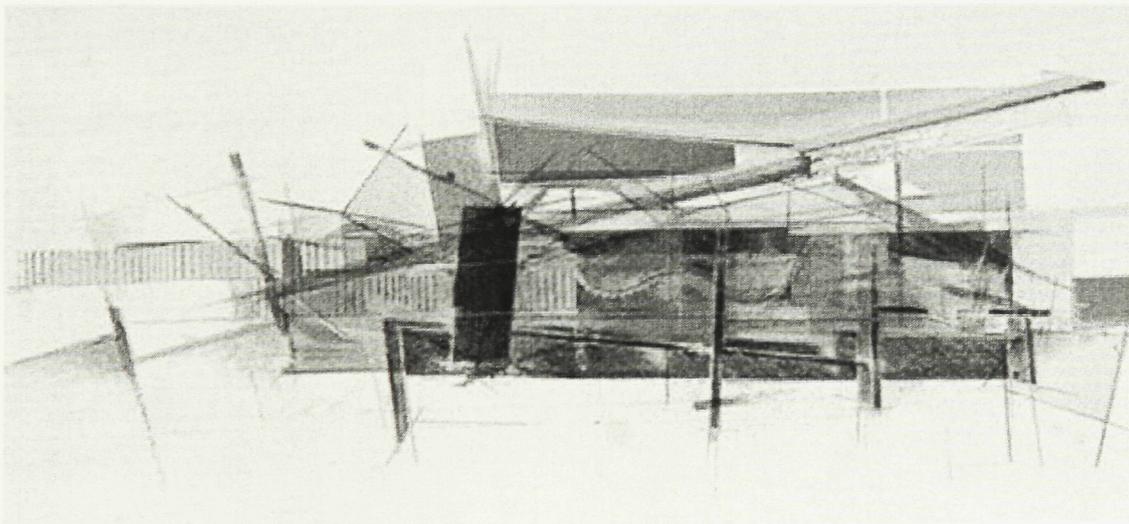


Figure-48. Collage 1: *Axial direction as an overall circulation.*

### 3.2.2. Programmatic generator – an atrium as a linkage of overlapped space

The places where the program seems to multiply could be understood as spaces where there is a strong interaction or relationship between different programs. This overlapping could give rise to a sense of 'shared' space, while maintaining a physical 'separateness,' that allows each program to function according to its purpose, mindful however, of the other activities of the sound gallery.

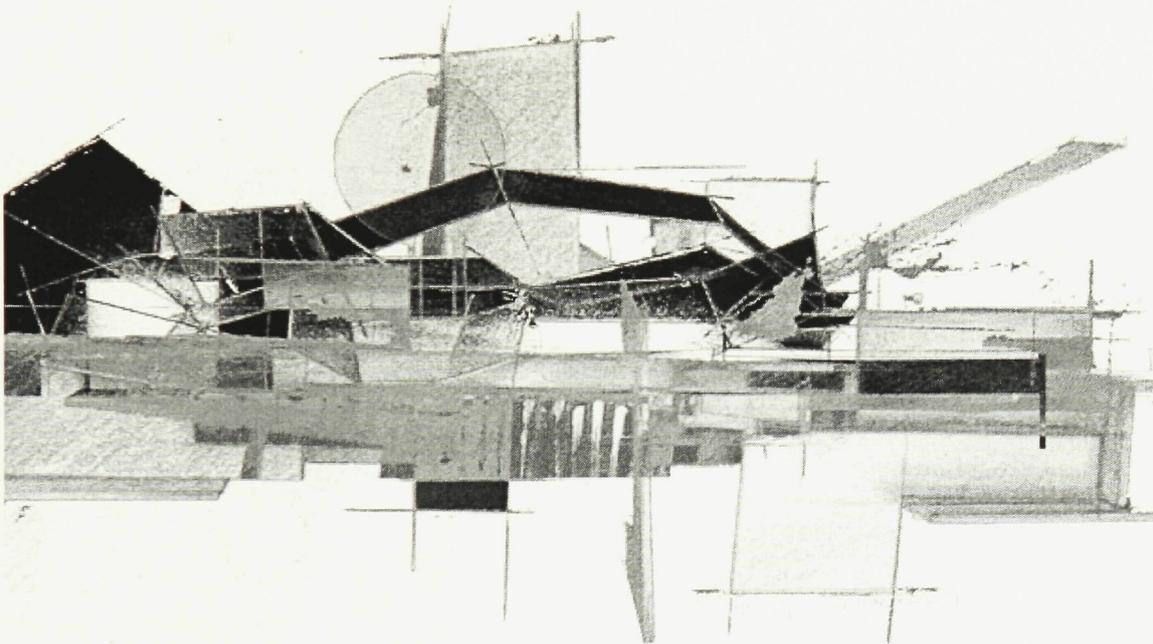


Figure-49. Collage 2: *Programmatic generator*.

### 3.2.3. Partition flow – sound studio

The divisions are much more apparent at the portion where the existing building is located. From there, the divisions become much more loosely spaced, eventually giving way to the exterior landscape. These divisions could carry through, beyond the confines of the building, to shape and form the surrounding landscape. These

exterior divisions direct environmental factors- elements that create their own unique sounds, such as rain and wind.

### **3.2.4. Anchored and absorbed in public and private space**

The public and private spaces within a building could be considered the same as sound: as a component that has a *dual nature*. They perform much like the instrument and canvas, having a 'source' as well as an 'outcome.' Perhaps the source takes on a more organized structure, and the outcome is much more loosely organized and more experiential.

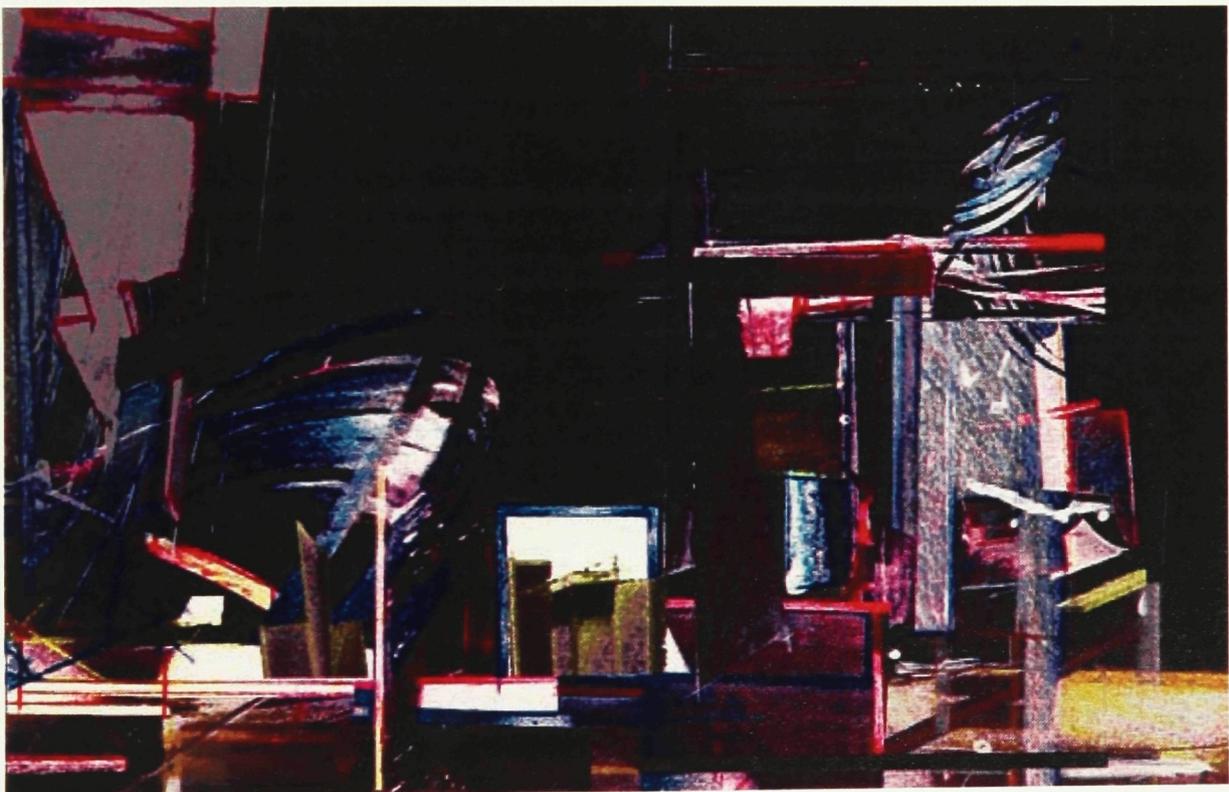


Figure-50. Collage 3: *Dual Nature*.

### **3.2.5. Body movement – specific circulation; ramps and transitions.**

Sound and space can behave in this way, joining and bridging architectural programs, despite changes and variations in elevation, or divisions in rooms. A piece of material could be understood as a transition, how circulation would be organized in the building, not

necessarily following a linear path that unfolds on one consistent plane, but moving in a way that bridges architectural programs.

### 3.2.6. Ruptured – walkways

The program is organized quite simply in order to observe the occurrences where the eruptions or disruptions in the envelope occur. At certain instances, narrow planes or bridges or walkways (defiantly) cross these eruptions. Perhaps they form the walkways, from which one can observe the contrast between the calm and linear organization of the programs amidst the more experiential quality of the disruptions in the architectural program.

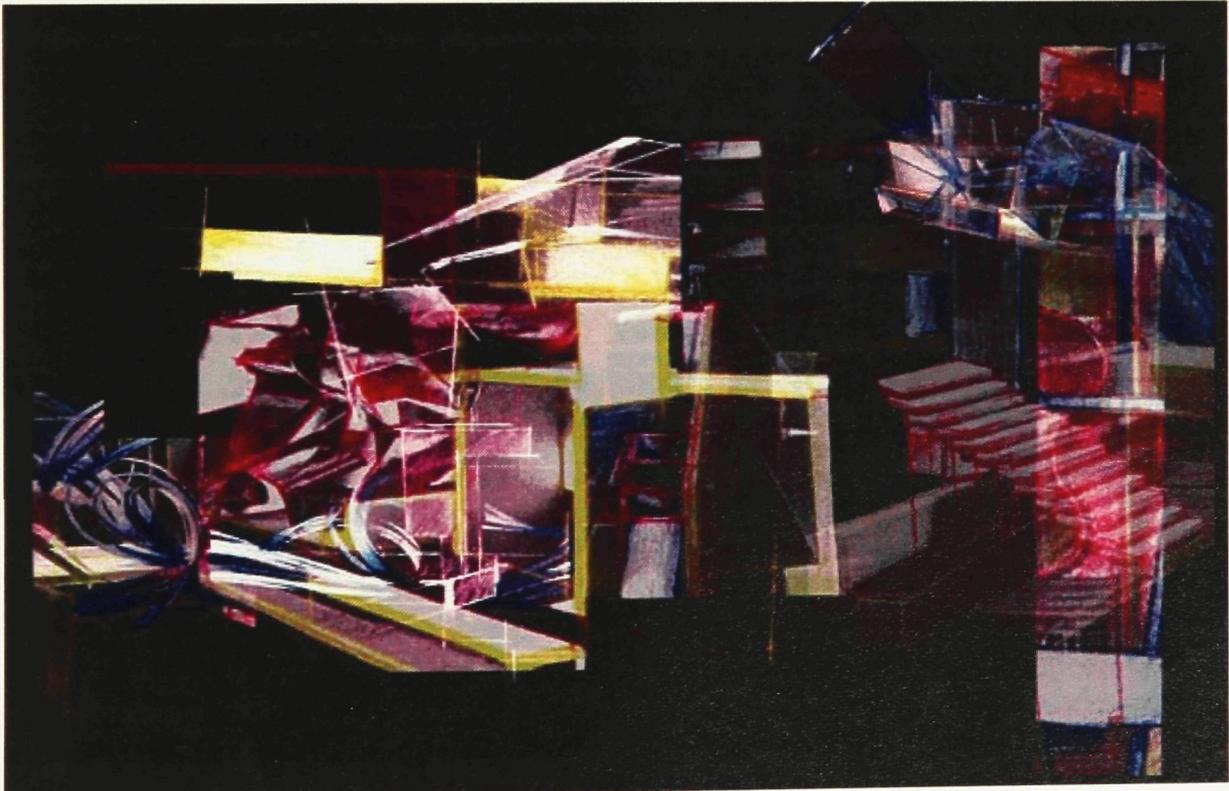


Figure-51. Collage 4: *Circulation in passage ways.*

Sound has the capability to make apparent shifts in materiality. The passages, therefore, have chaotic nature of weaving in and out of spaces.

### 3.2.7. Continuations of outdoor space

The sound eventually leaves the building and dissipates into the surrounding landscape. The appendages jut out of the building into the landscape, Sound thus provides connections between indoor and outdoor space. For example, there will be balconies that connect to the outdoor walkways.

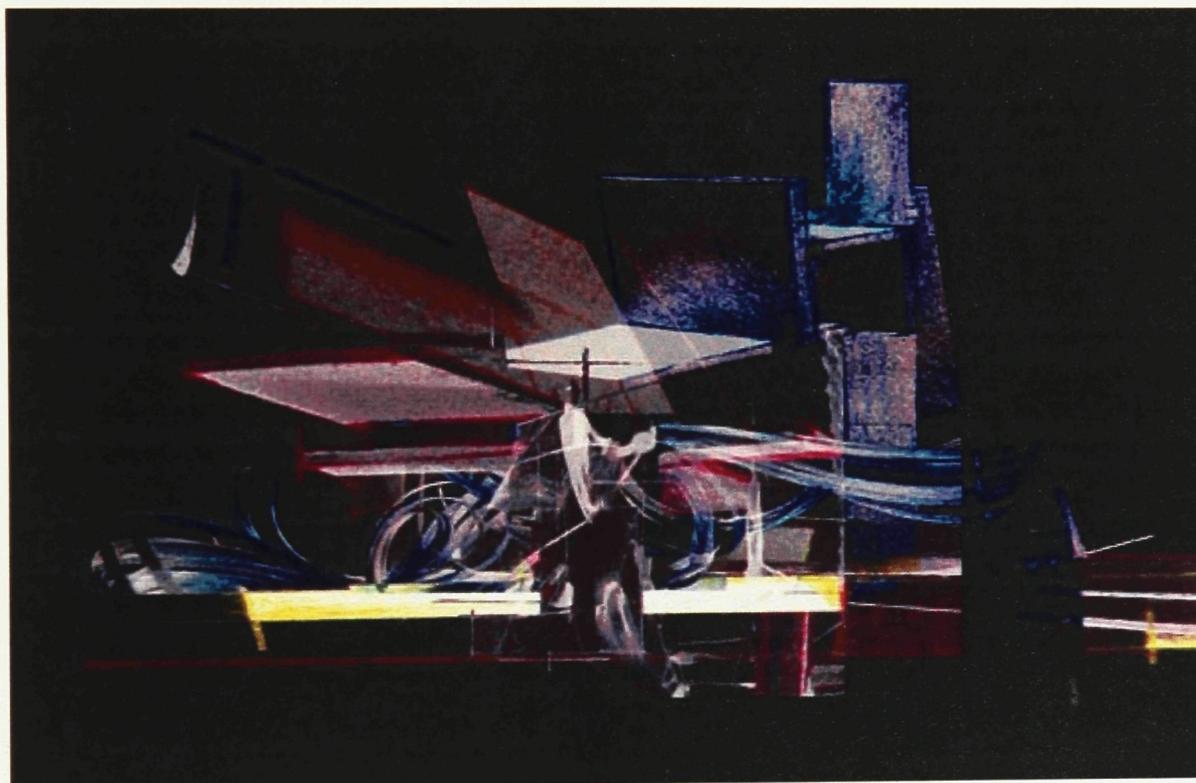


Figure-52. Collage 5: *Continuations of outdoor space.*

### 3.2.8. Visual Cues

Exterior surroundings also influence the formal characteristics of the plan. For example, the outside axial and land formations inform the places where this interchange occurs. Plans are both protected and made vulnerable by this exterior relationship, at times architecture encloses and envelopes, then suddenly exposes breaks. This variation, where one condition proves or negates the other, emphasize the qualities of both.

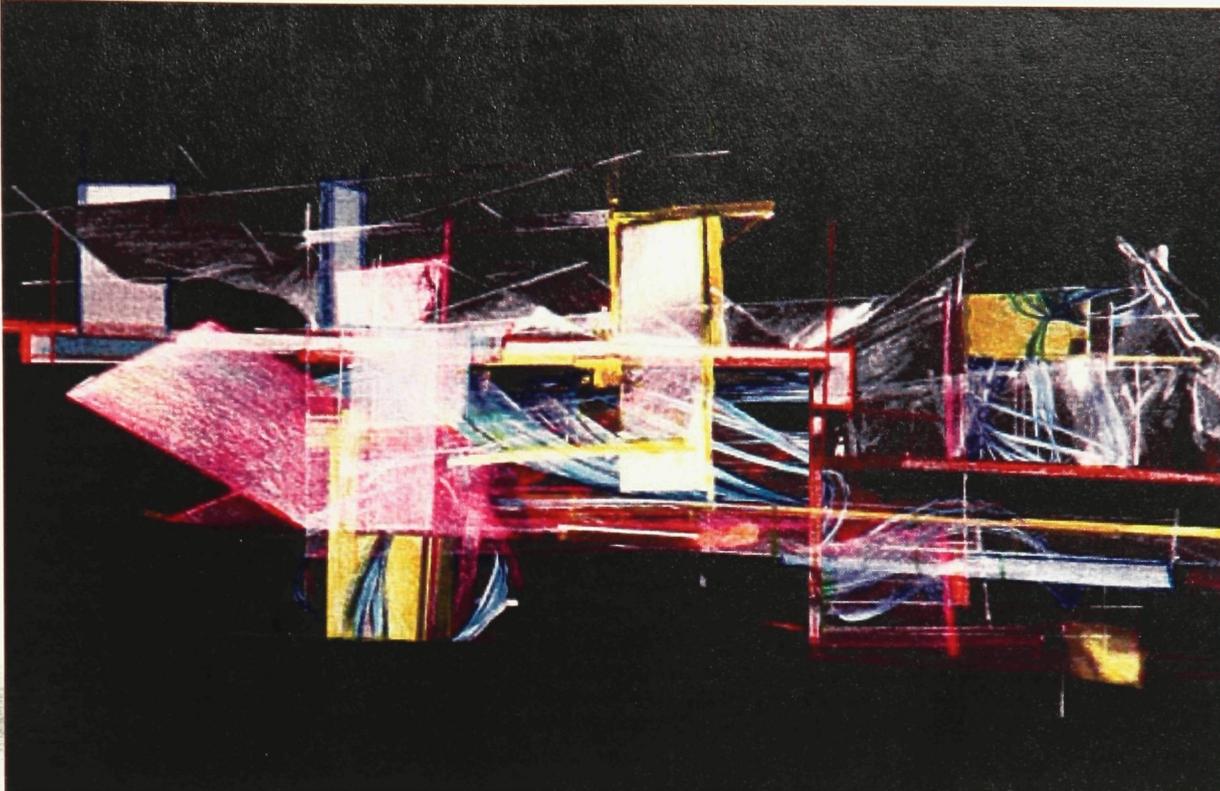


Figure-53. Collage 6: *Visual Cues*.

In this model each element has the potential to erupt into a careful orchestration of a select 'kit of parts.' Transmutation and sublimation is achieved through the continuous separations and unification of opposites.

### **3.3: Transformation to NGSA**

The following collages depict areas of the proposed design through which I will explore the concept of alchemy. The potential for alchemy to animate these spaces will be registered through the careful introduction of architectural components such as materiality. Additionally, these drawings make evident the importance of sectional considerations on the design of the building. Spatial overlap, examined through changes in elevation, demonstrate the consistency of alchemic themes throughout the proposed building.



Figure-54. Conceptual site plan.



Figure-55. Studio and office.

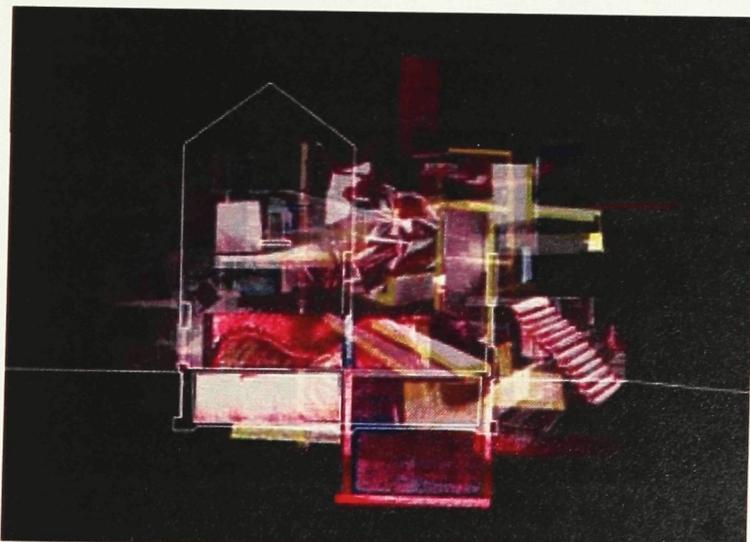


Figure-56. SoundLab and atrium.



Figure-57. New entrance and access to the shore.

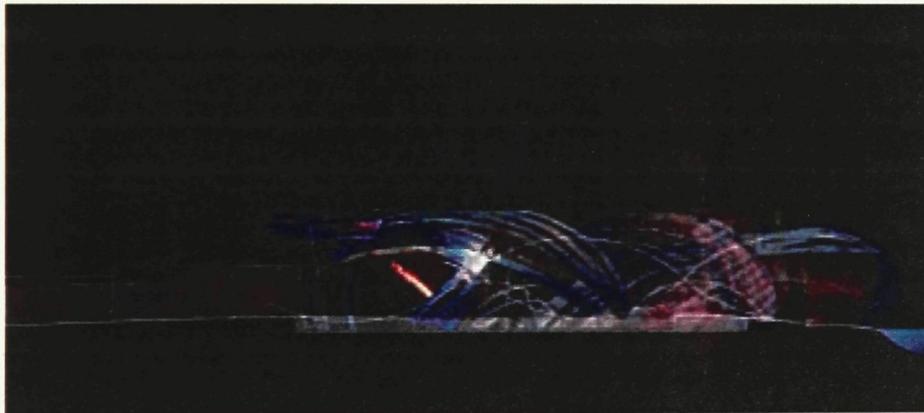


Figure-58. Garden, Native center and the shore.



Figure-59. Longitude section.

## Chapter Four: Building Design

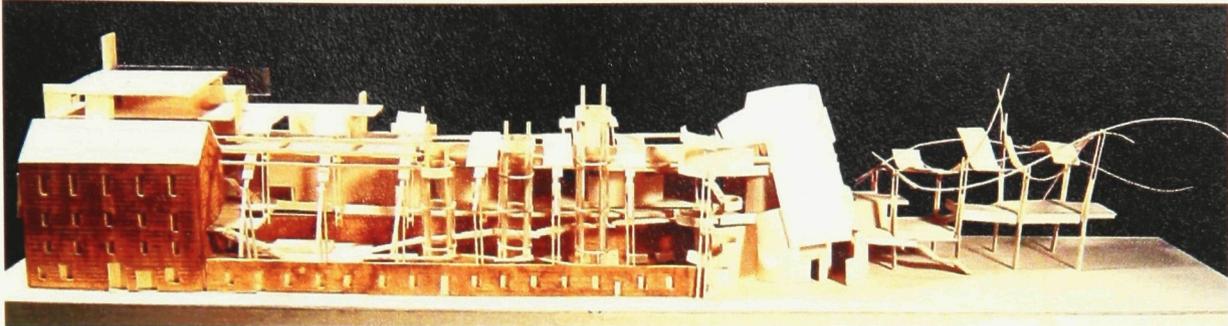


Figure-60. Exterior view of the building model.

### 4.1: Sonic Quality in Space

Indeed, architecture can function as a canvas and an instrument through both objective and subjective means. In this situation, architecture proves sensitive to its organization of space, which presupposes a kind of fluidity. In the galleries space, the alchemic union of sound and built form - its dimensions, uses, occupation - resonates through the orchestration of materiality.

#### 4.1.1: Programmatic Organization

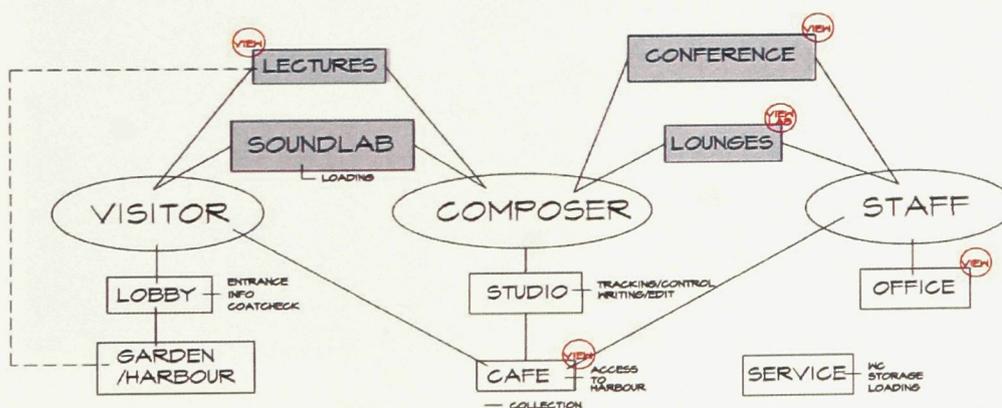


Figure-61. Program organization diagram.

Space overlapping is highlighted in blue. Each program is organized in relation to another through overlapping and layering. SoundLabs and multi-media lecture rooms provide overlapping spaces for staff and composers. These programs are at times

separated by a monumental threshold condition. Other programs would be somewhat more subtle, weaving through the overlapping space. The programmatic organization of this gallery including the following components:

### **Public Settings**

The **Lobby**. This will be the main public entrance, 8m<sup>2</sup> in diameter and made of concrete. There will be Sound Wells 4 levels down and 4 m<sup>2</sup> in diameter opening to connect. This room will also include ticket booth, the main entrance to gallery and a passage to the café.

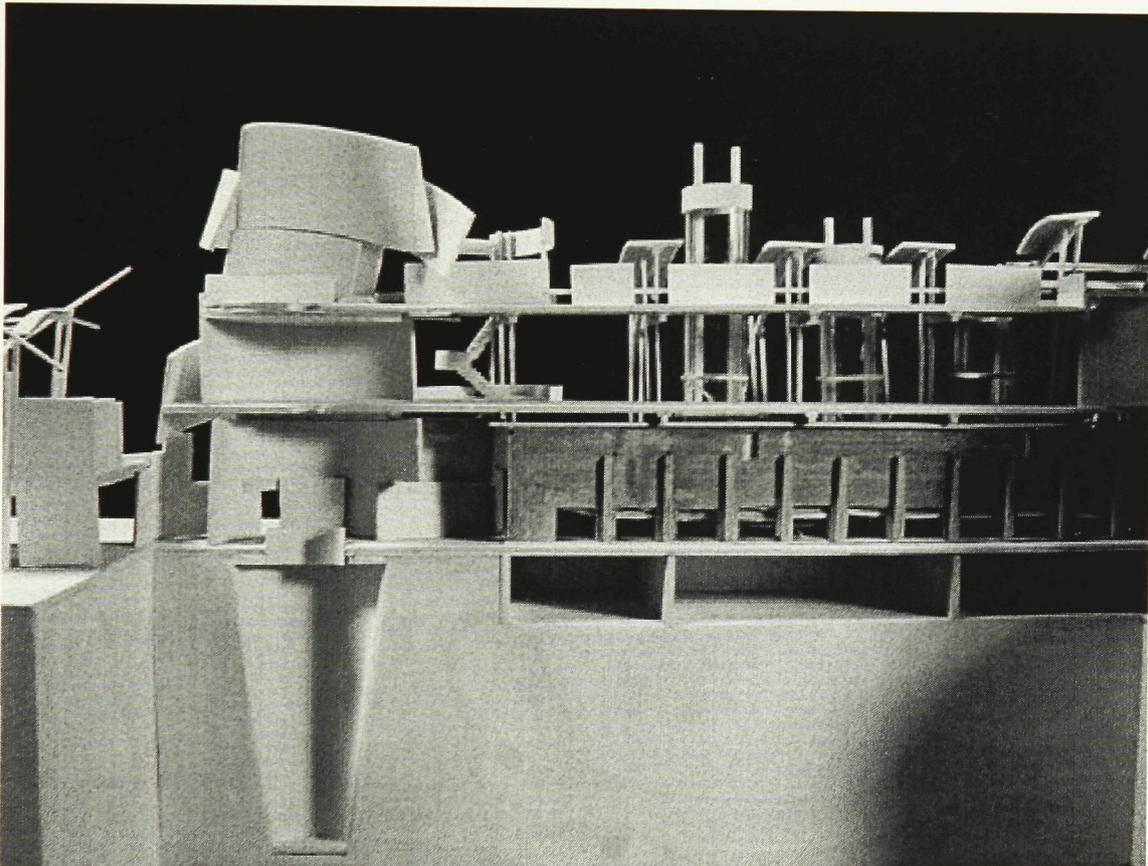


Figure-62. Sectional view of the building model.

**The Atrium.** Sitting, waiting and circulation to this space will be organized through a series of ramps that connect all the exhibition spaces within the gallery. Located adjacent to these spaces are the SoundLab. In the atrium, one can observe the contrast between the calm and linear organization of programs amidst the more experiential quality of the disruptions in different programs.

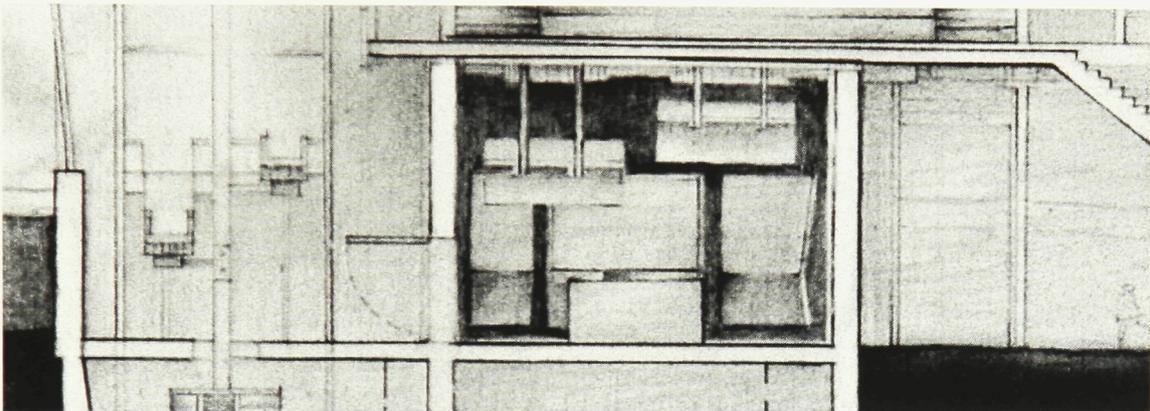


Figure-63. Detail section through sound studio and atrium, image by author.

The atrium connects to the **Interactive SoundLab**, where increasing attention toward the sound art exhibits on the first floor. An existing 7'0" wide opening will be preserved and equipped with a new rotating door that opens or closes in the direction of the atrium and is lined with acoustic material. The double height of the SoundLab includes acoustic panels for adjustable views and sound quality, suitable to various sizes of performances from 200  $m^2$  up to 500  $m^2$ . An attached control room of 150  $m^2$  allows the composer and staff to control the sound quality and equipment, as well as making it accessible for installations of various sizes. This SoundLab is intended to host temporary exhibitions, communicating to both the visitors and composers through works of sound art.

**Permanent Exhibition Space.** This space is intended for permanent sound installations, and because of its specific use, sound and light control are required. In order to accomplish this, permanent exhibitions should have the most convenient spot of the building for support, service and fewer windows than other spaces. This allows visitors to view the working process of the sound engineers through the translucent material used on the walls.

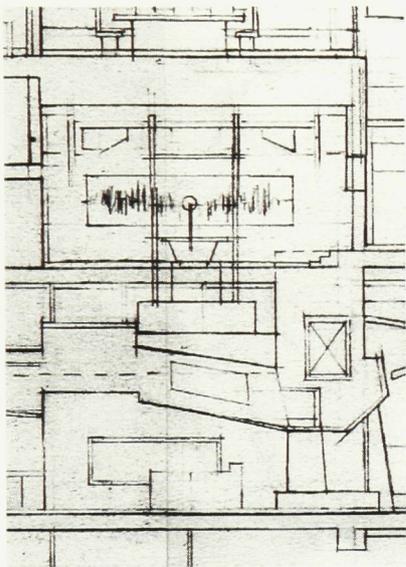


Figure-64. Detail section through permanent exhibition.

**A Special Exhibition Space,** located above the lobby, is the most visible exhibition space for special sound events. It is located at the east end of the existing carbide mill, adjacent to the Native Center. It can be seen from as far away as Parliament Hill and the Supreme Court building.

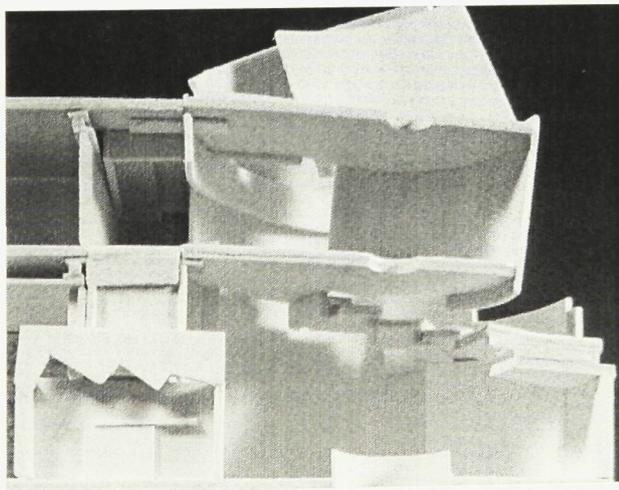


Figure-65. Detail section through special exhibition.

The counterpoint of the translucent material in the space is the copper used on the floor. The rich, timbolic sound created by footsteps on the metal accentuates the activity of the gallery space. The use of this metal is reserved for the threshold of these gallery spaces – utilized, for example in thin strips leading to the lobby. In this way, architecture sonically 'marks' itself.

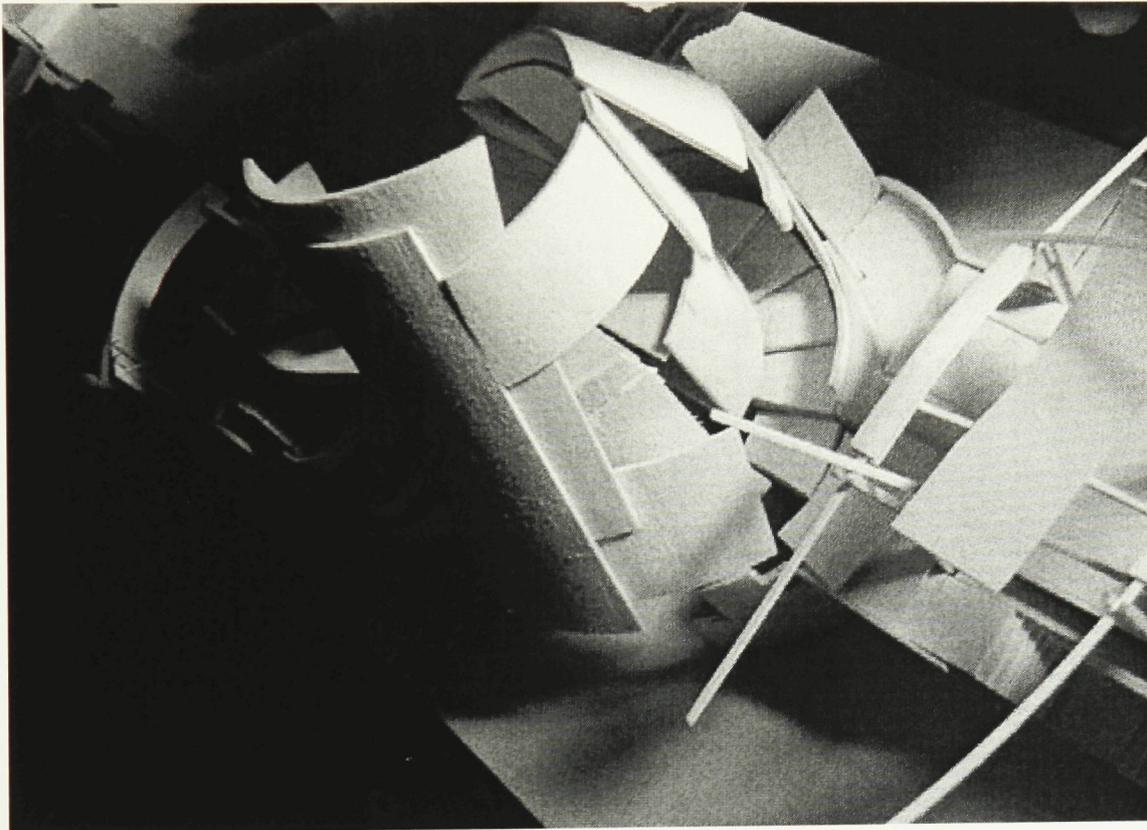


Figure-66. Exterior view to special exhibition.

**The Cafeteria** is a gathering space is meant for use by the general public and gallery staff for the purchase of coffee and snacks, accessible from the exterior and interior. The fenestration frames a captivating view of the shore and Parliament hill, because of its orientation towards Hull, providing apertures that open to the Museum of Civilization and the Alexandria Bridge.

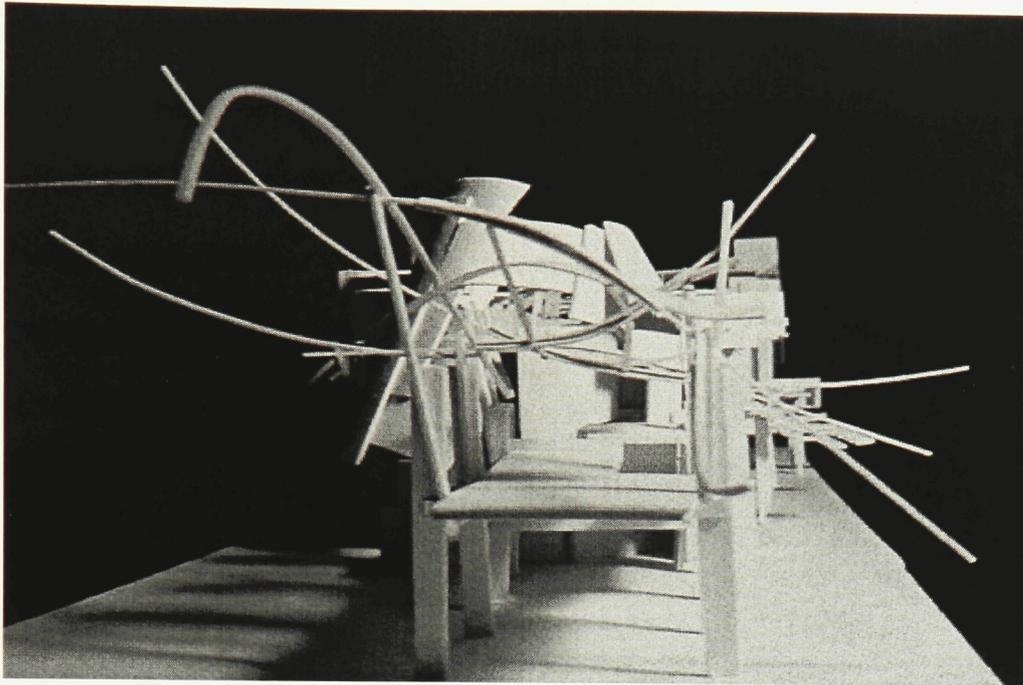


Figure-67. View to Cafeteria from eastern end.

**The Sonic garden** is recreational space opens to the public, where a curved structure provides shelter for sitting and occasionally merges the aboriginal music from the native tents. It provides pathways to the gallery and harbour. This space receives even light due to its largely northern exposure, making it an appropriate space to display artifacts that relate to the visual understanding of sound and space, an interstice between indoor and outdoor.

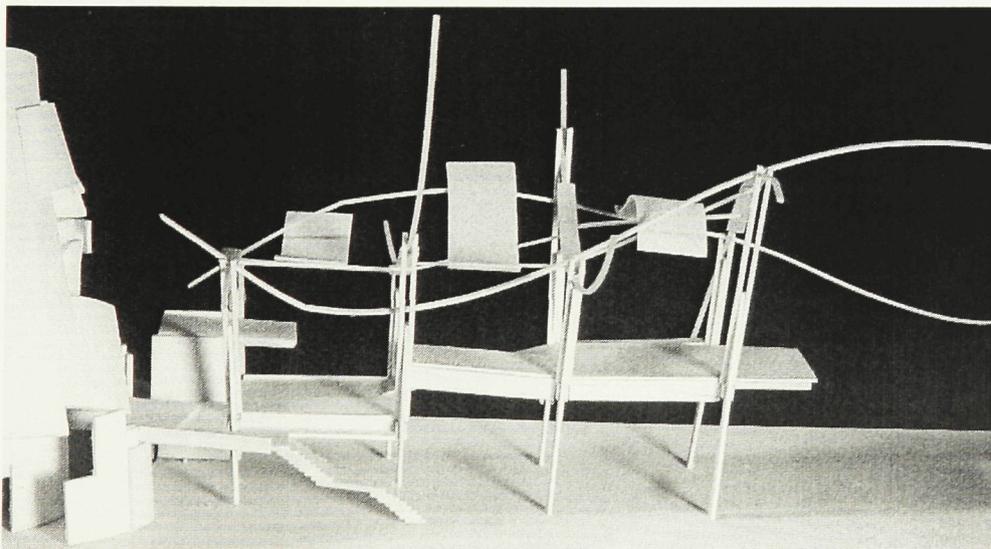


Figure-68. View to Cafeteria from southern end.

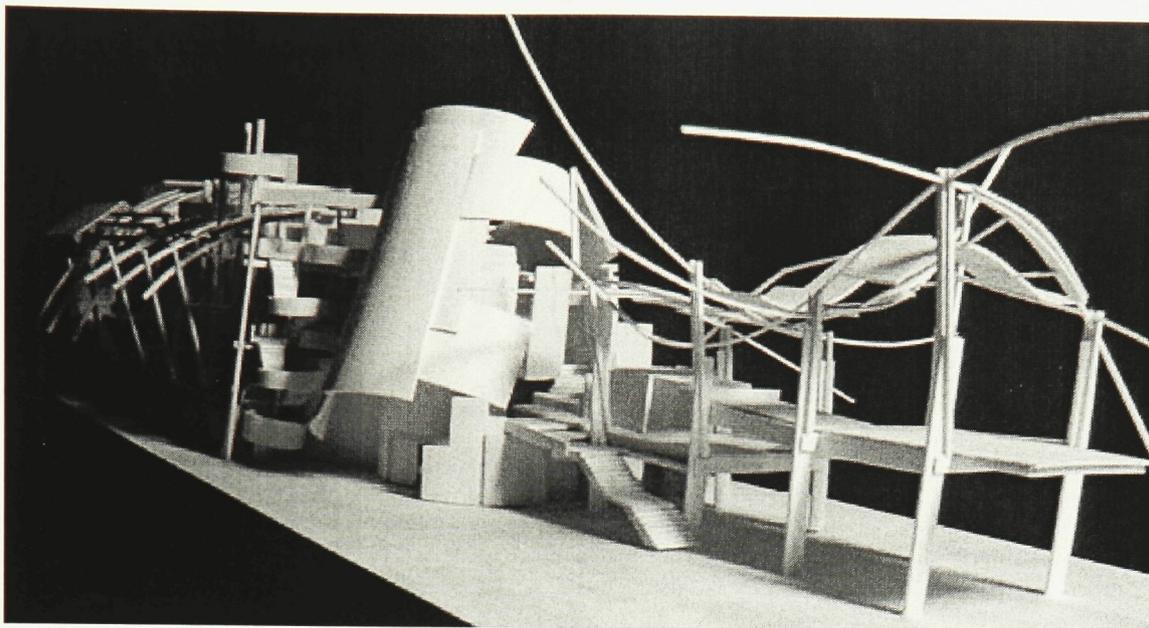


Figure-71. View from the native center.

The **Multi-Media Lecture Room** is intended for educational purposes, and meant to accommodate a maximum of 35 people, an optimum class size. In addition, there is a support room attached, as well as projection screens and facilities for multi-media service.

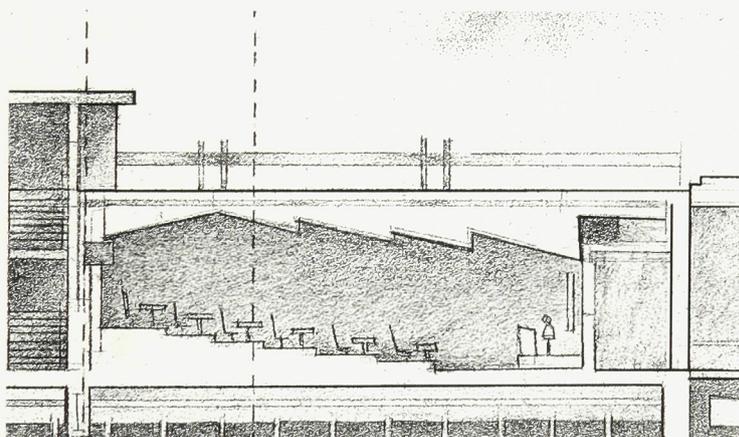
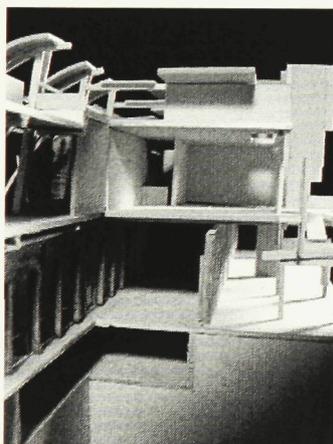


Figure 72-73. Multi-Media lecture room.

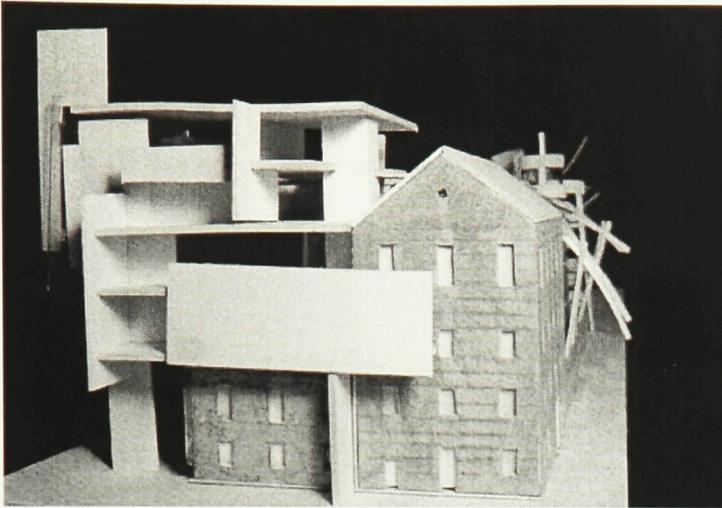


Figure 74. View to western side of the building.

### **Private Settings:**

**Studio-** The composer's overall working space occupies the existing building and includes a series of tracking, control rooms and isolation booths, all of which require professional acoustic control, as no reverberation should occur.

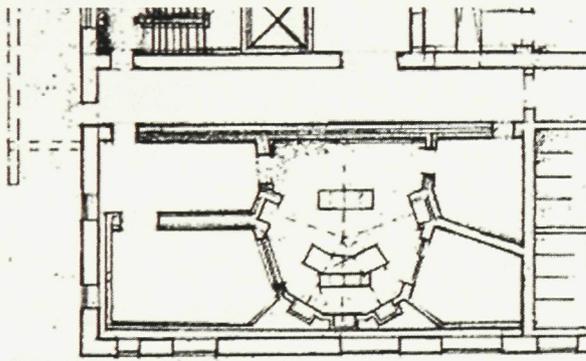


Figure 75. Detail section of studio.

**Offices** are working spaces for staff to operate the building are placed near the entrance. View toward the shore.

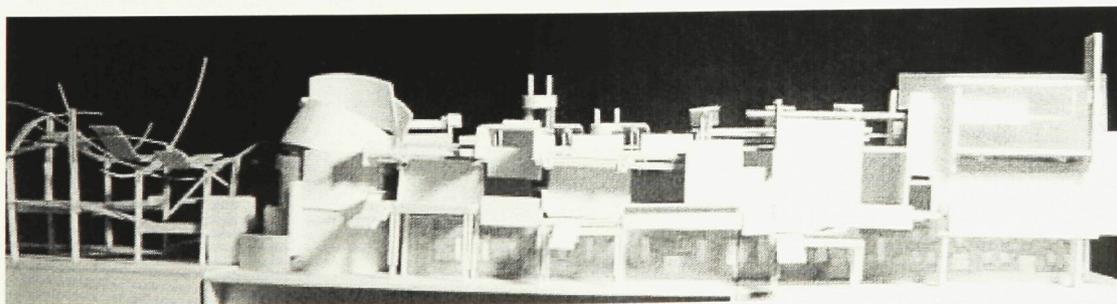


Figure 76. View from the shore.

**The conference Room**, provides another meeting space for staff and composers to communicate, viewable and direct access toward the roof garden (the staff lounge).

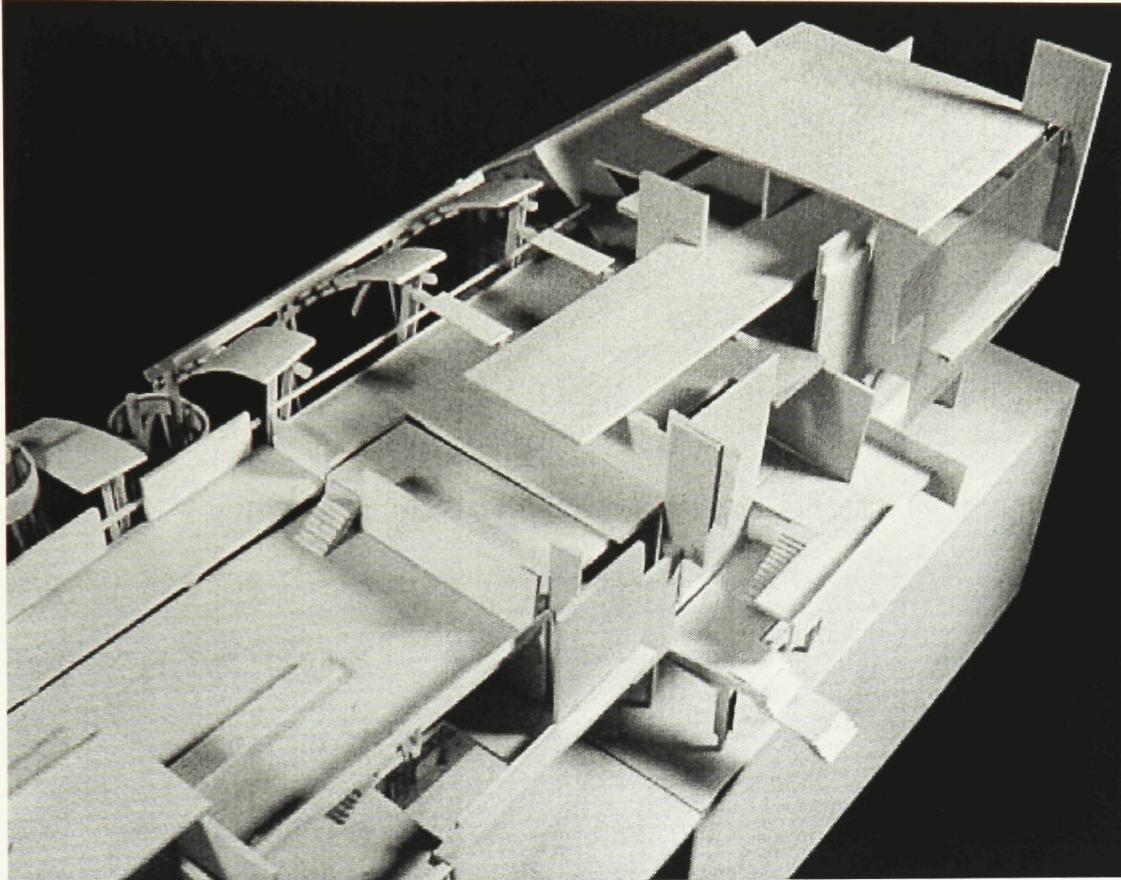


Figure-77. Exterior view to conference room and roof garden.

**The Staff Lounge** offers a dining and meeting space for staff and composer, [figure-78] viewable toward parliament.

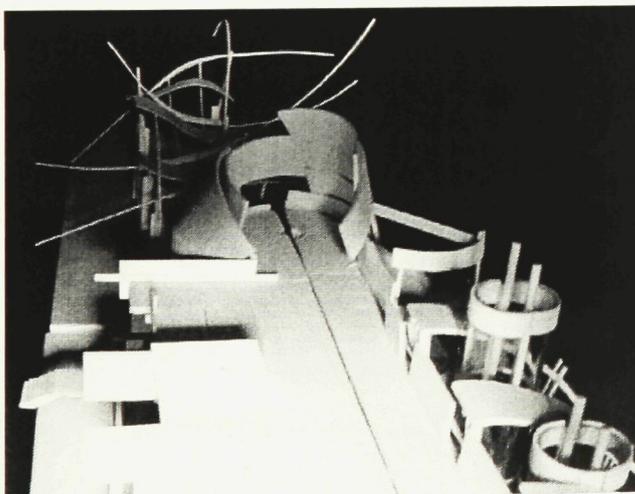


Figure-78. View to staff lounge and roof garden.

#### 4.2: Narrative: A Sonic Journey through Architecture

Space and time, in the moment of their perception, from out of the sound motion, are connected with one another in such a way that it creates a secure feeling of being imbedded in the "depth" as the basis of existence.

- Bernhard Leitner

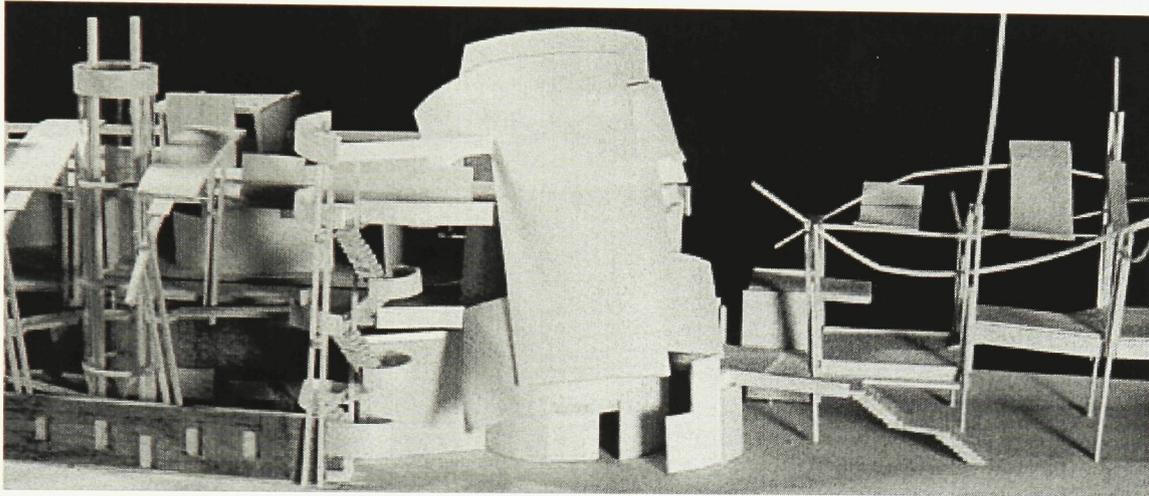


Figure-79. Entrance of the building.

This journey starts at the entrance, where the sound changes from the ambient noises of the outdoor environment to the controlled interior sounds of museum mixed with those heard in the lobby. Movement from the lobby follows an axis, and it is here, where opportunities for sound start to be collected, or 'registered.' Once the visitor has entered the museum through the lobby and approaches the ticket booth, an echoic sound is created by footsteps and reverberates from the sound well. A cylinder shape made by concrete, extend 20 meters down to the ground, it can reverberate about 16 times. This serves to introduce the subtle differences in ambient sound as visitors walk from outside.

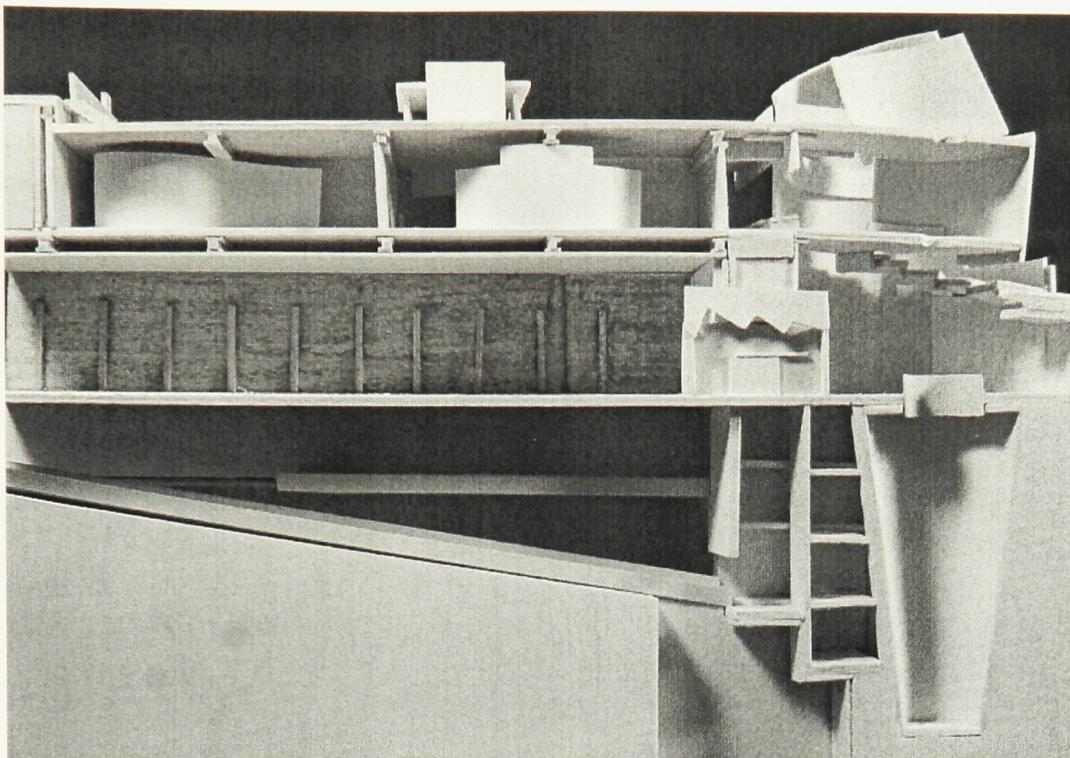


Figure-80. Sectional view to lobby and SoundLab.

After the lobby, one enters the anechoic chamber room, a transitional space suggesting a moment of silence for visitors before they walk toward the atrium.

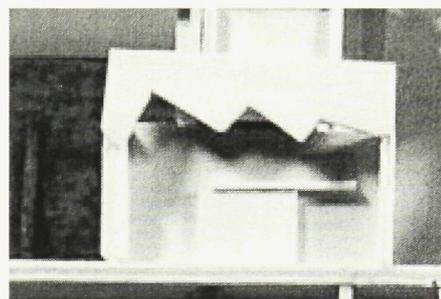


Figure-81. Anechoic chamber room.

Sound art galleries generally occupy a hierarchy of space, as they receive and transmit sound in a 'privileged' way. In this way, architecture can accommodate sound and sound can affect architecture, through this communication. This differs from the normal way that the activities that take place in these sound labs because experimental body movement is required. Visitors have an opportunity to experience the potential of sound to weave in and out of programs. As visitors pass from the atrium, into the waiting area,

they have the choice - either the spiral stair or the glass tube ramp to the upper floor.

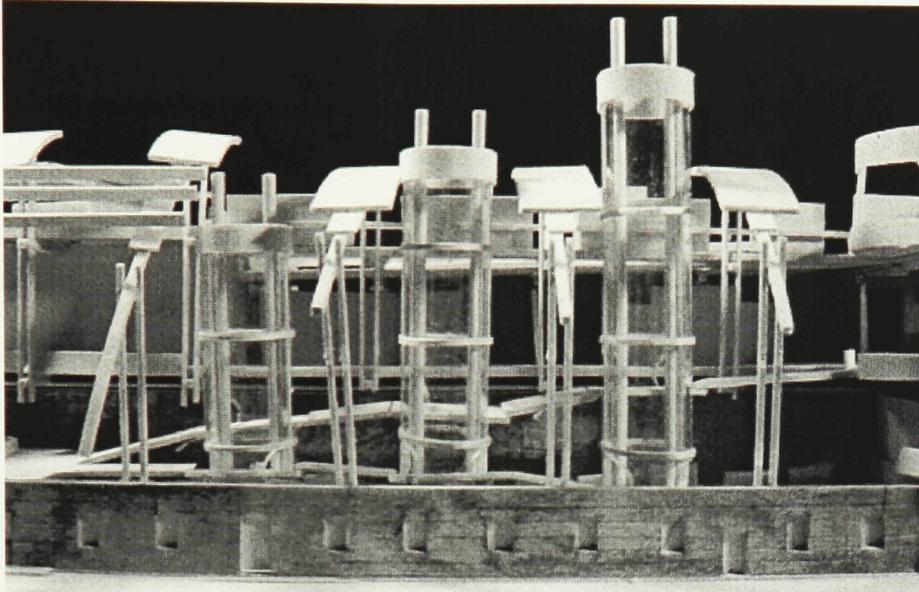


Figure-82. Glass towers, view from exterior.

Other than the path that connects the SoundLabs, there is a long ramp leading the visitor to the upper floor, with three glass towers in between, that allows the visitor to walk underneath the ramps.

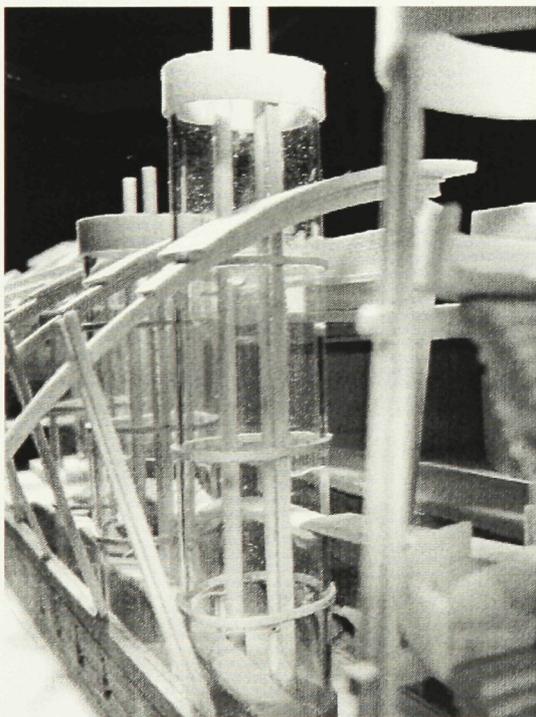


Figure 83-84. Glass towers and gas bottle experiment.

Inside each of the glass towers, reverberations are generated from within spaces inside the towers by visitors' footsteps on the ramp. These gaseous forms are instant expressions of pressure that disappear within seconds of their formation. In this way, architecture structures the ephemeral moment of sound, captured in gas form, and transmute movement through vibration to gaseous information. [See to **Appendix D.1** for small scale experiment]

In this space, a change in materiality, and the volume in between the glass tube tower will influence how sound changes or transforms-in effect, exhibits an awareness of its surroundings. The sound is generated in the basement, and controlled by the floor slabs. Visitors in atrium and lounge can also see these gaseous forms through the glass tubes.

As the ramp leads up to the mezzanine floor, I have designed a ripple pond for the visitor to circulate around before continuing up the remainder of the ramp up toward the special and permanent galleries.

In this ripple pond, ripples from oscillations produced on the water's surface move horizontally from the epicentre to where the sound is emitted. A disruption in the dialectic of sight and sound occurs, as the oscillations transmit sound while

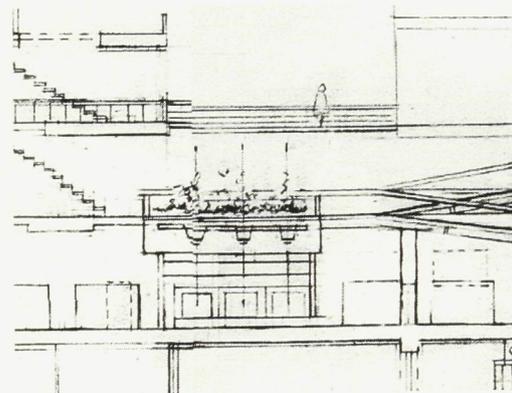


Figure 85-86. Ripple pond detail and experiment.

allowing visual information to be processed linearly. Water patterns created by sound are three-dimensional. Different patterns are created by water even though they have the same sound source. Rhythmic vibration has a notation of a spatial pattern in liquid form, thereby suggesting a relationship between material state and sound.

[See to Appendix D.4 and D5 ] This ripple pond on the mezzanine floor is located directly below one on the second floor. The pond also indirectly connects the staff lounge to the sound studio, allowing visitors to view both in synchronously.

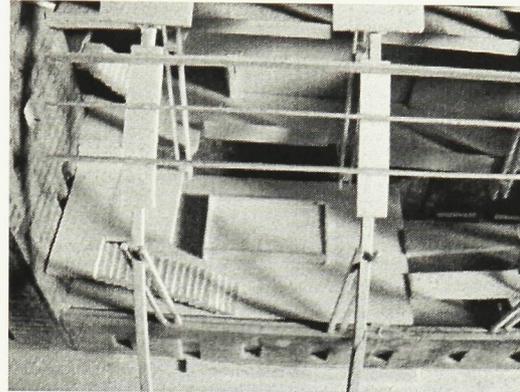


Figure-87. View to ripple pond.

The permanent exhibition space is located on the 3rd floor, along with the service support area. A corridor connects this space to the special gallery and multi-media lecture room. Speakers are installed along this corridor, spaced a meter apart at ear level. This placement allows visitors to 'break' the boundaries that created by sound. [See Appendix D.6]

In the waiting area at outside of the permanent gallery, one can see the pond a floor below. The special exhibition room right above the lobby connects to the café and collections.

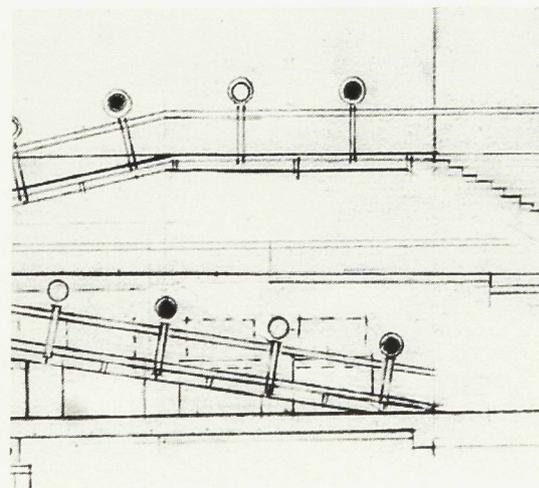


Figure-88. Lamp zone corridor.

At the transition between the permanent gallery and lecture rooms; three staircases go down to the harbor walkway. The architecture that frames these experiences is characterized or influenced by several factors. For example, there is a gap between the new and old building that preserves the material of the existing building. It is also for the visitor's experience that the sound "bounces off" the wall.

For composers, the sound studios located inside the existing building, have walls of 12" stone, which is an excellent condition for acoustical purposes. [See Figure 96-97. First and second floor plans]

The staffs have a separate entrance, and the offices are located on the upper floors, allowing the meeting rooms to have a panoramic view to the shore and parliament, accessible to the stair toward the harbor walkway.

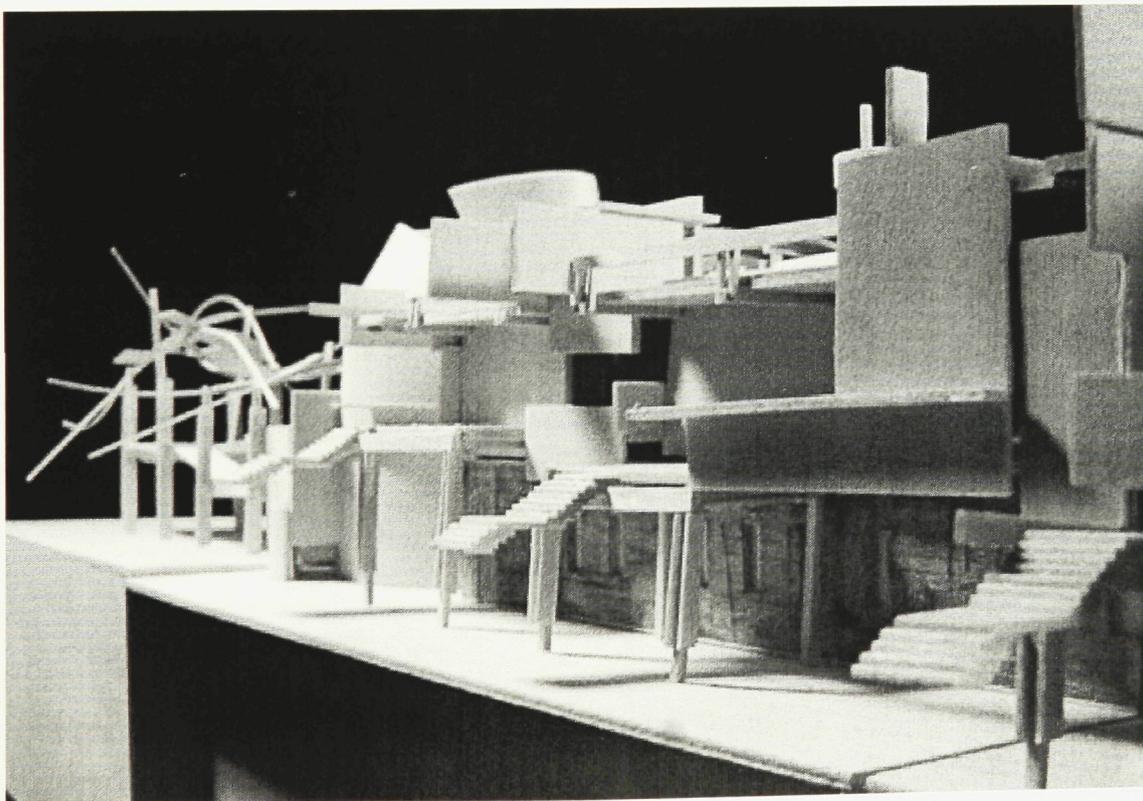


Figure-89. View from Pont Du Portage Bridge.

Architecture can function as an instrument through subjective means. In this situation, architectural conditions, such as spatial relationships and materiality, affect one's perception, and reveal the images drawn by sound. In this way, sound has the potential to travel through several programs, providing emphasis and enhancing the passage through program, in order to make its *sonic journey*.

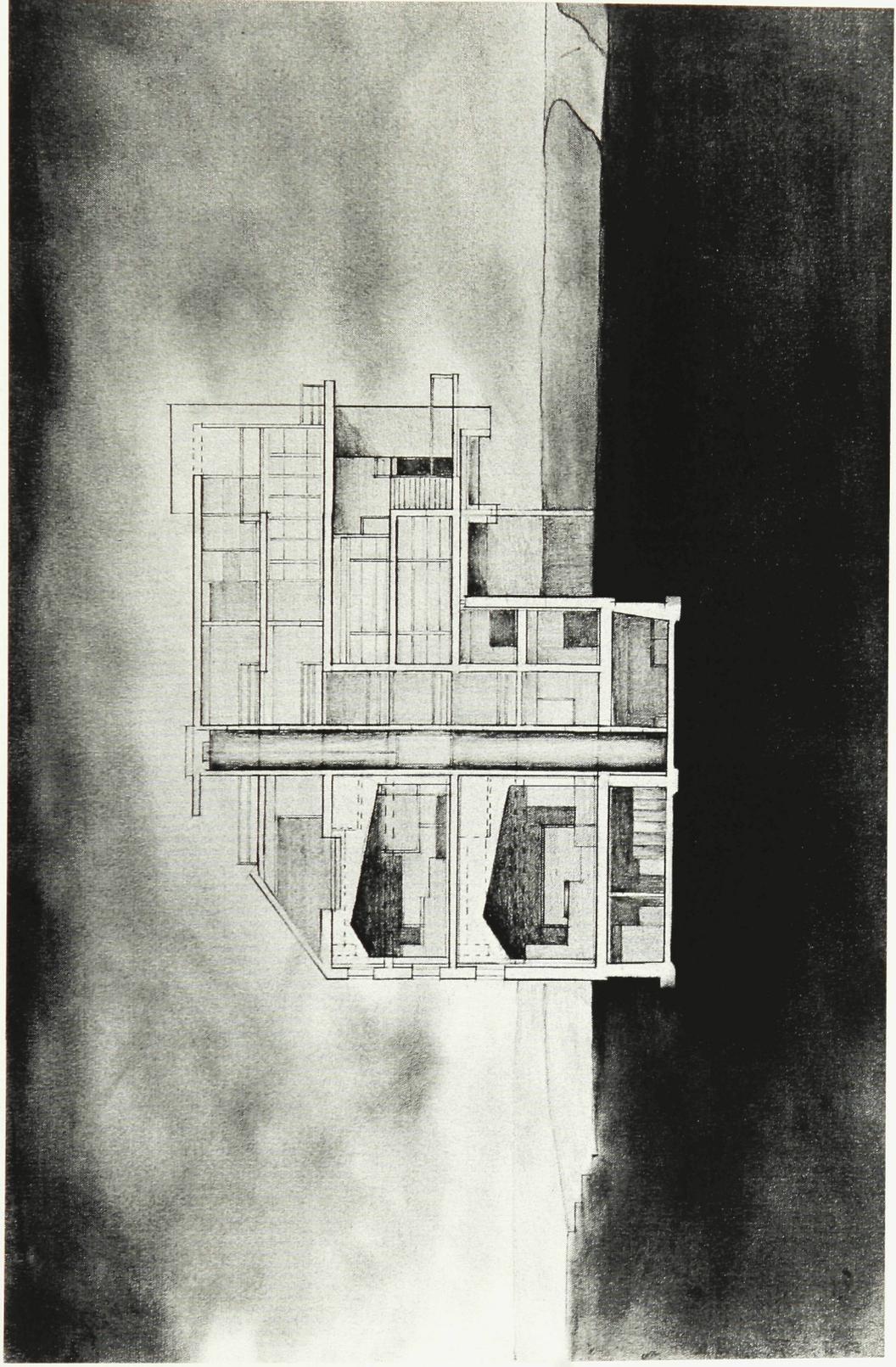


Figure-90. Section A-1: cut through studio and office.

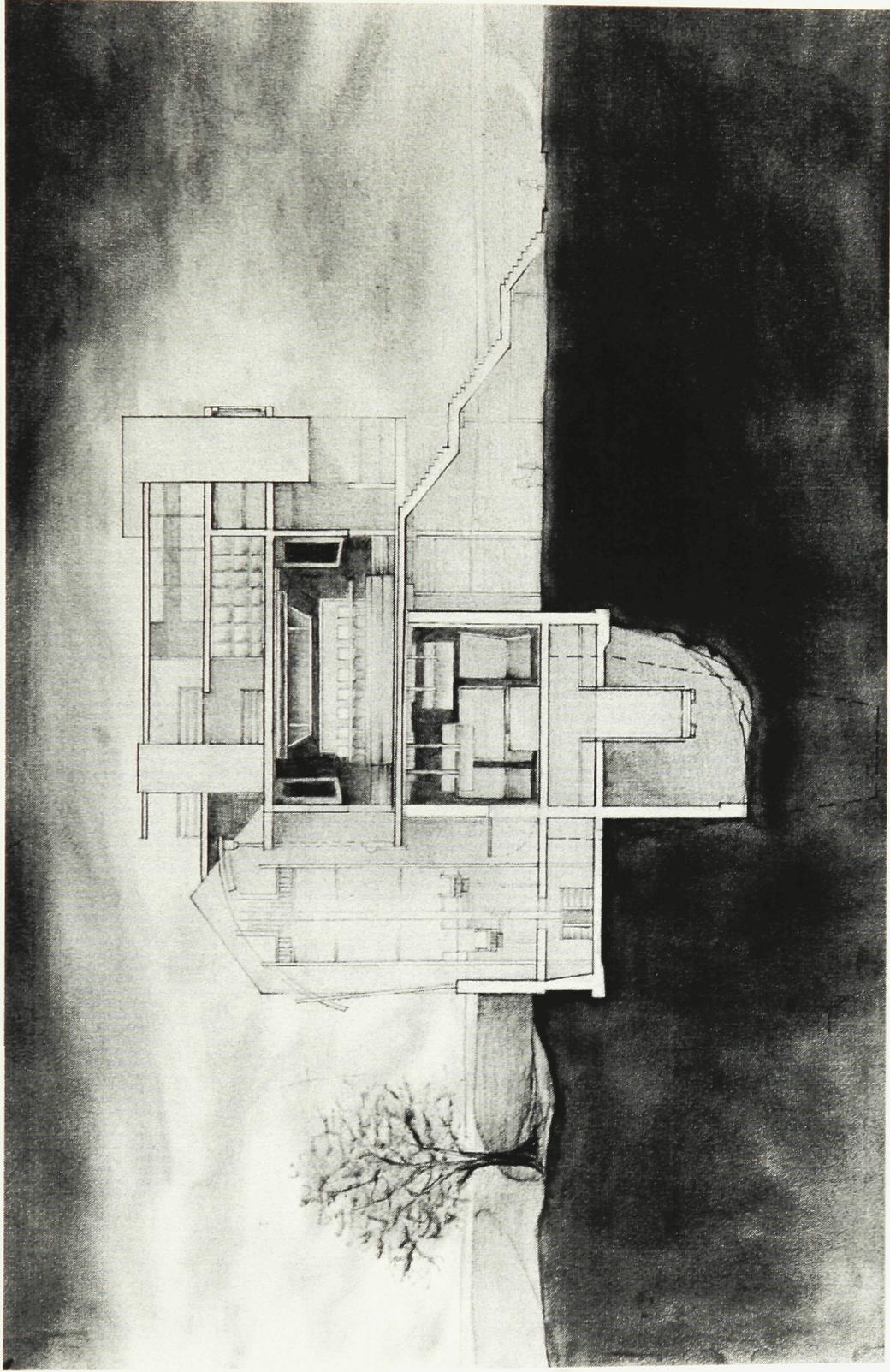


Figure-91. Section A-2: cut through Atrium and SoundLab.

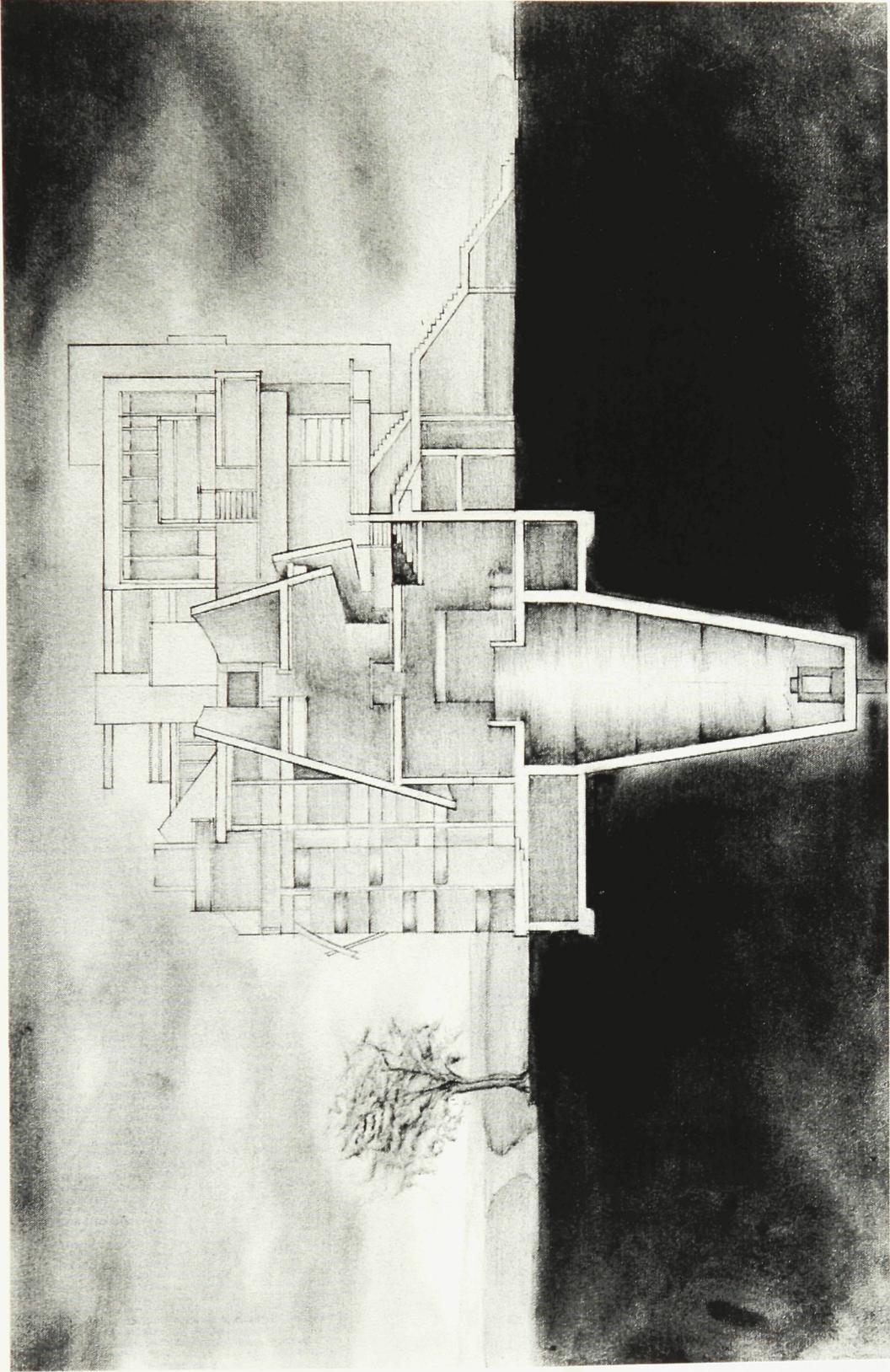


Figure-92. Section A-3: cut through entrance and special exhibition.

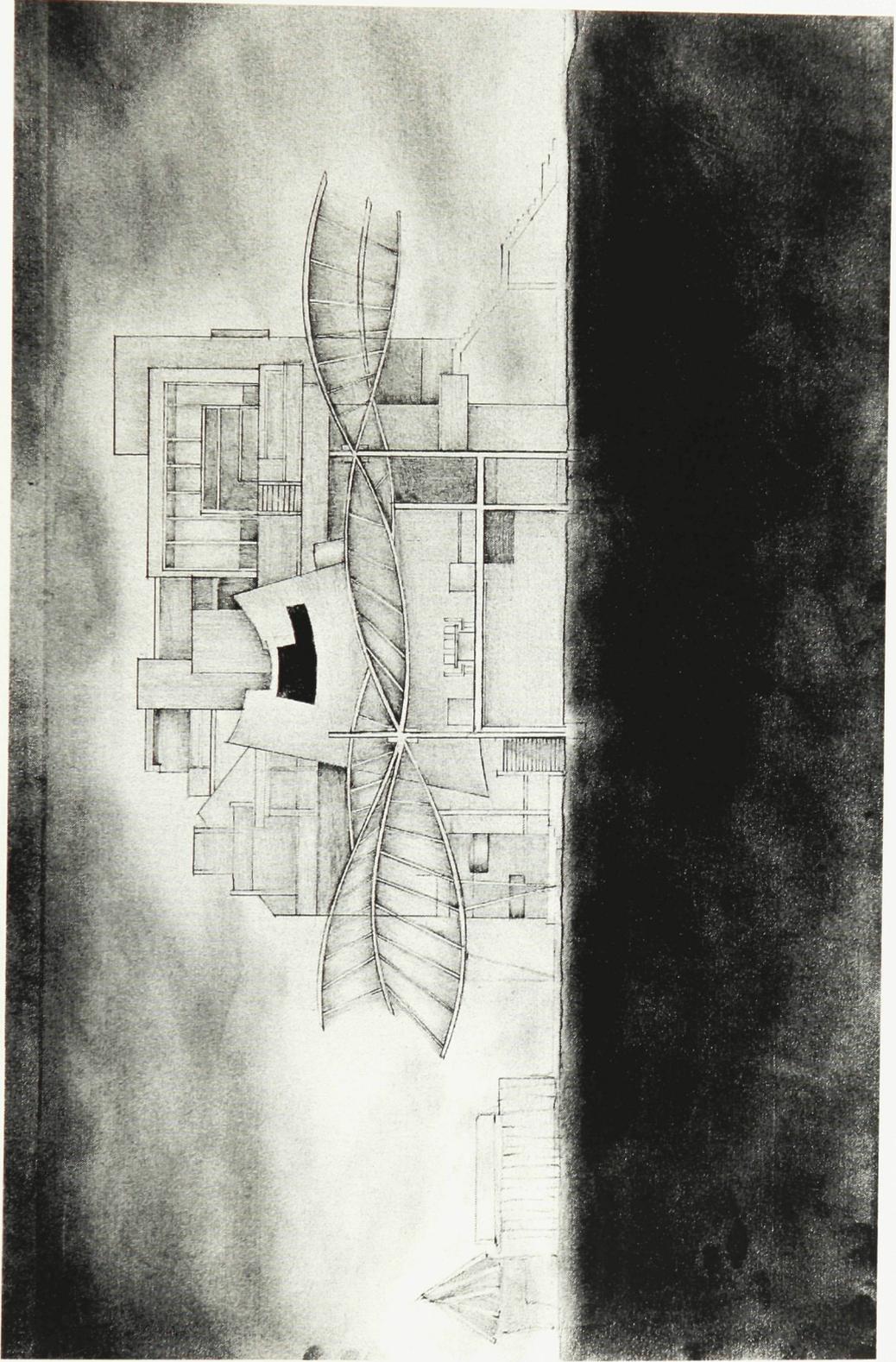


Figure-93. Section A-4: cut through Native center and Café.

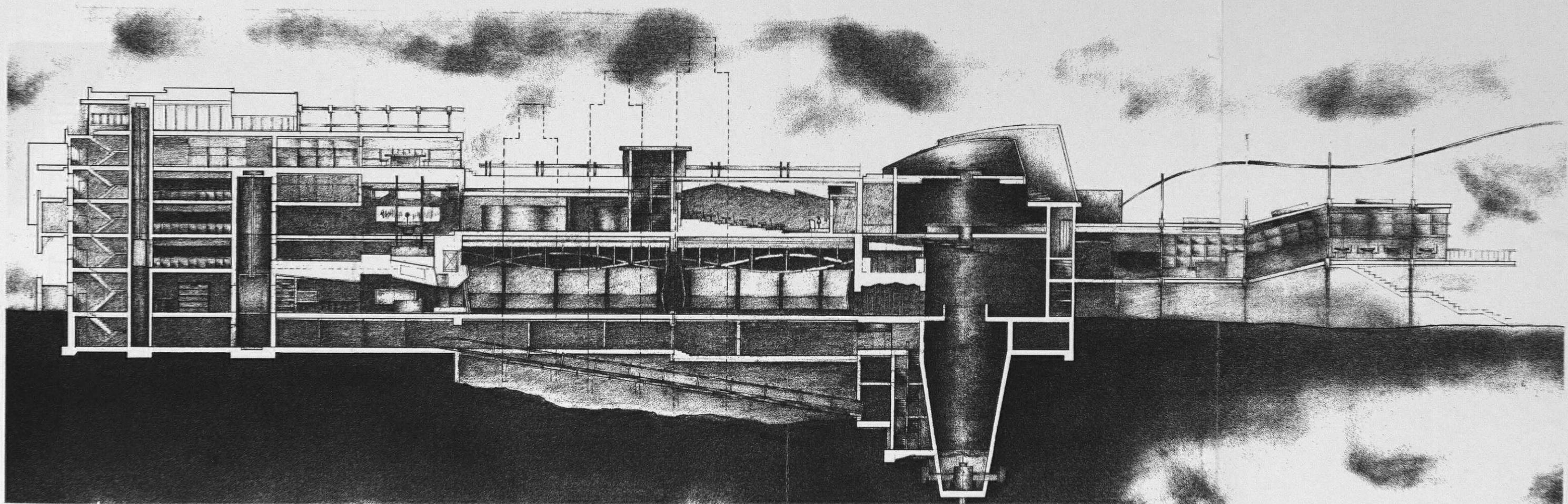


Figure-94. Longitudinal section through interactive soundLab and sound well, image by author.

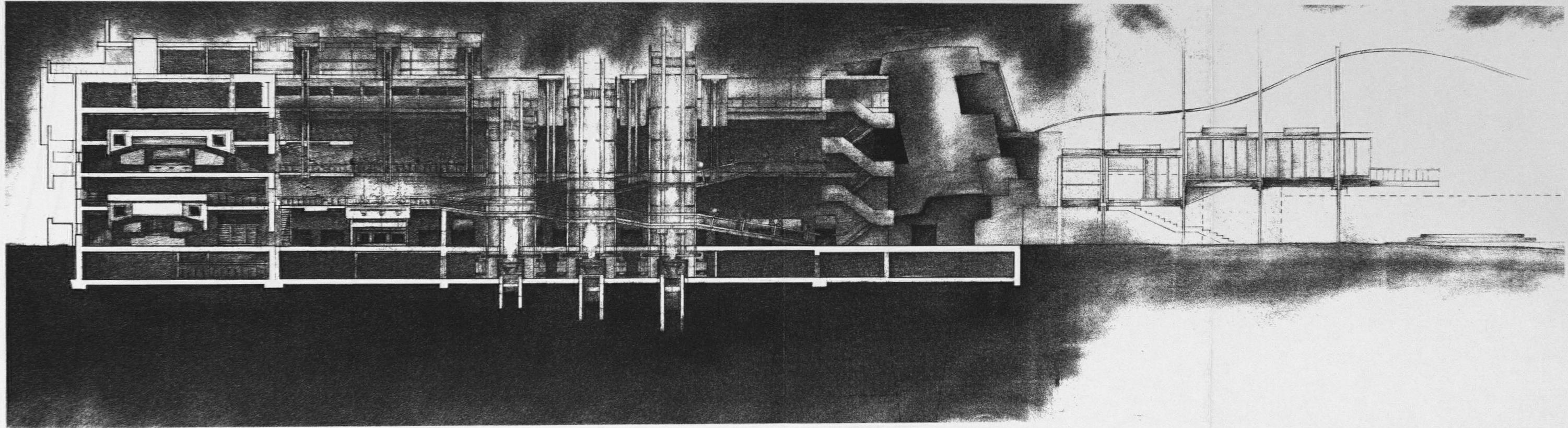


Figure-95. Longitudinal section through sound studio and atrium, image by author.

1. Public Entrance
2. Lobby
3. Atrium
4. Sound Studio

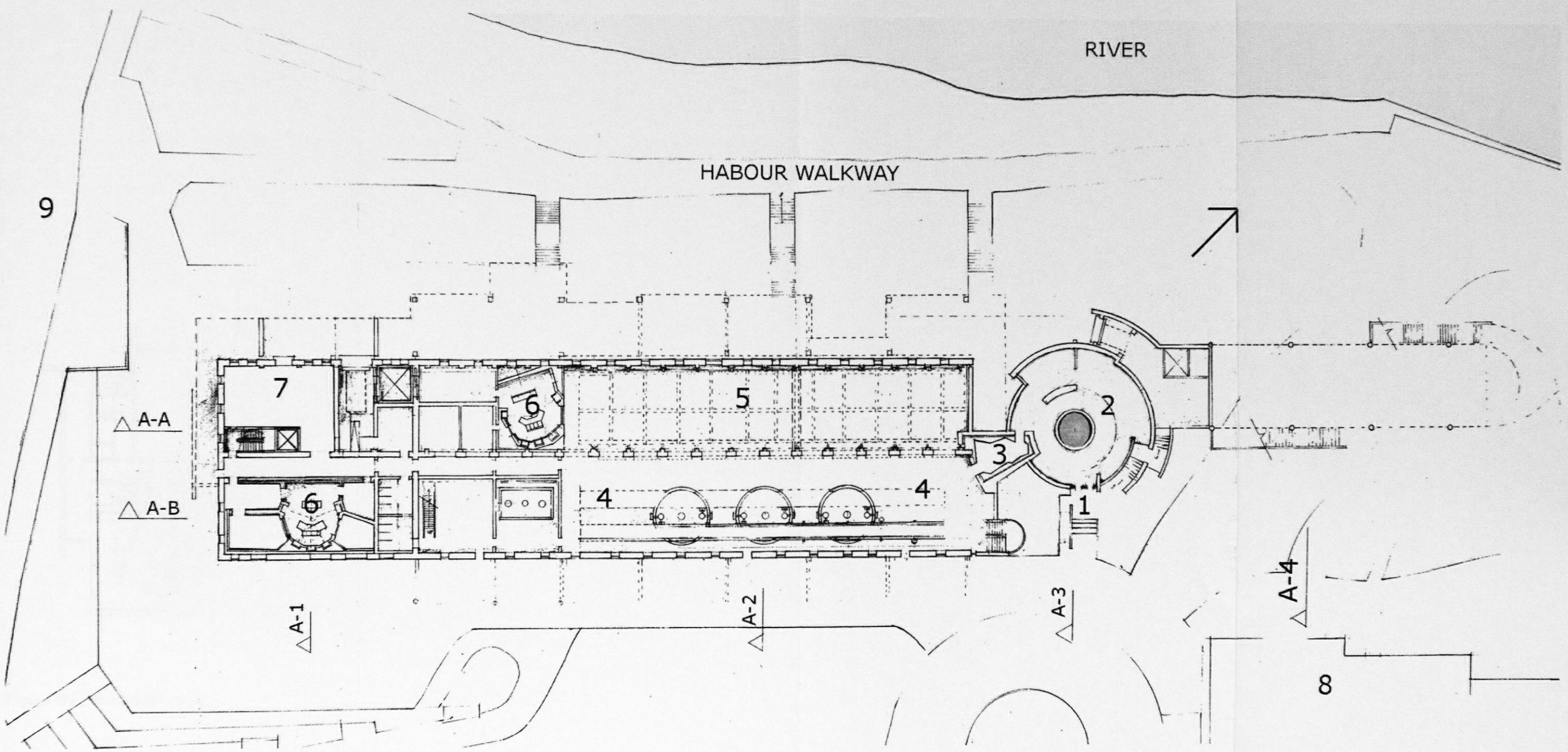


Figure-96. Site and ground floor plan

- |                                 |                                |                                  |
|---------------------------------|--------------------------------|----------------------------------|
| <b>1. Public Entrance</b>       | <b>4. Atrium</b>               | <b>7. Private Entrance</b>       |
| <b>2. Lobby</b>                 | <b>5. Interactive SoundLab</b> | <b>8. Native Center</b>          |
| <b>3. Anechoic Chamber Room</b> | <b>6. Sound Studio</b>         | <b>9. Pont Du Portage Bridge</b> |

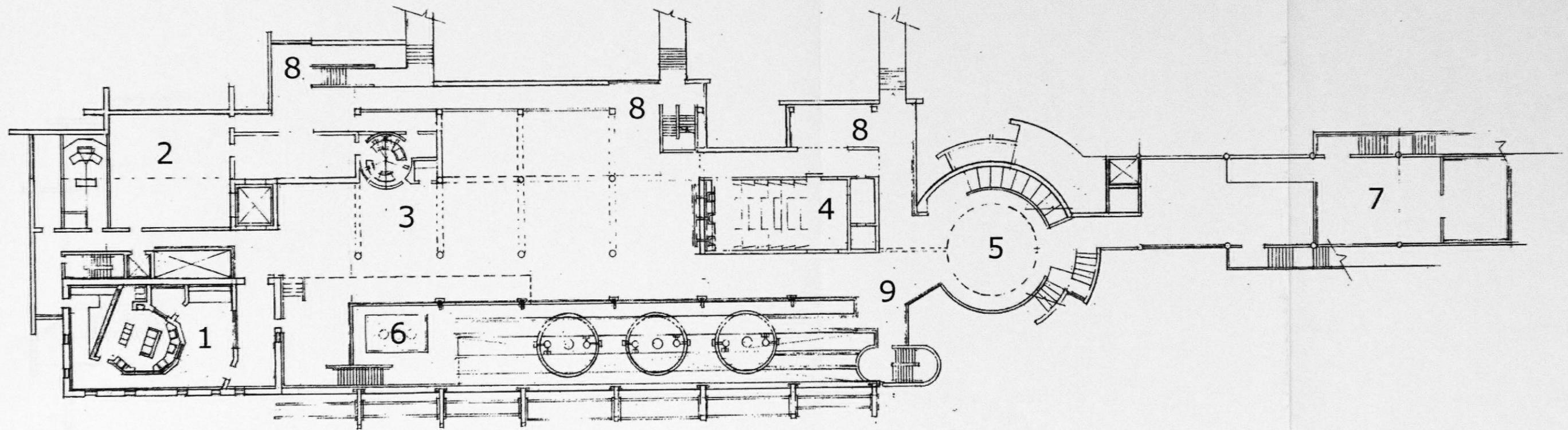


Figure-97. Third floor plan.

**1. Sound Studio**

**2. Editing and writing room**

**3. Permanent gallery**

**4. Multi-Media Lecture room**

**5. Special gallery**

**6. Ripple pond**

**7. Café**

**8. Terrace**

**9. Lamp zone ramp down**

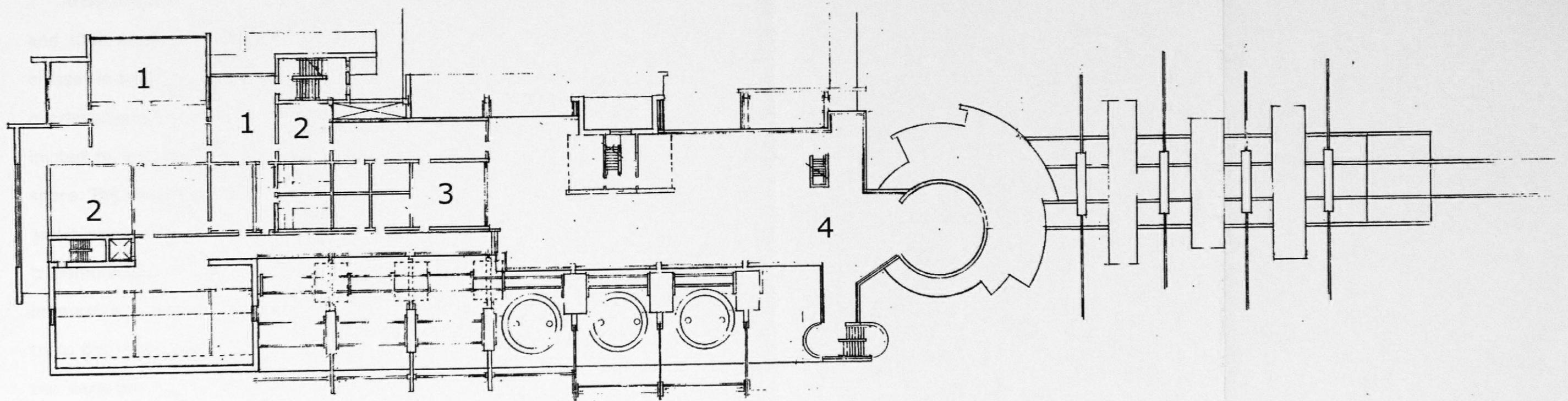


Figure-98. Fourth floor plan.

**1. Offices**

**2. Conference and meeting rooms**

**3. Lounge**

**4. Roof garden**

## **Conclusion**

The design for the NGSA has demonstrated the influential role that sound plays in enhancing the experience of architecture. Sound has the capacity to vividly describe certain architectural elements in a way that evokes both a subjective and objective understanding of our physical environment. This design of this project clearly describes the inter-relationship of both subjective and objective means in both sound and architecture

Architecture is caught in the realm between that which is steady and that which is unstable; thereby, its very nature necessarily crosses in and out of the acoustical and visual elements. Through the overlapping of spatial elements evolves a 'sonic journey', the visitor is invited to experience architecture as a fully sensual awareness of space. The varying stability- the work in flux- heightens the aspects of architecture that are transcendent: it is therein through the transmutation of common parts that architecture's indescribable, immutable identity is revealed. In the subtly way Le Corbusier points us to the skies overhead Rochamp, this project urges us to uncover our ears, and trust that the noises architecture permits here are a careful and purposeful orchestration of those formed by earth, movement, and ritual. Awareness has been directed to the sites positioning: caught between the ebb and flow of the surrounding water body; the solidity it provides as the foundation below the intricacies of the bridge connecting two provinces; as witness to daily reminders of confederacy. In this way the visitor's journey manifests

through material and visual elements, however transformed through a performative role as it is rendered through sound (noise).

This thesis has determined that architecture, accommodates sound in the ways that express ideas such as a directional expression of its planer relationship, a contained generator of programs, being partitioned into a segmented flow, an anchored and absorbed in public and private space, an indicator of movement, a ruptured of building envelope, the passage of circulation, continuous of programs, a linear relationship of indoor and outdoor space and leaves visual cues, such as a fragmented trace.

When we focus on sound, our perception of the built environment changes because we relied more on ears than eyes. Sound is an attractive field for experimentation because it elicits a primordial response within us.

In conclusion, sound is something that is within us, that ultimately connects us to ourselves, it is primordial, awakens something in us that connects us to nature and our environment and reminds us of a time in the past when our relationship with nature was much more immediate (survival), when our awareness of the seasons, of light, were the basis of life, death, ritual, etc. architecture is a human elaboration of place. Sound in architecture is beyond the visual distractions of implied symbolism. It constitutes a closer connection with place. Alchemy is an accurate experiential descriptor of the awareness or 'inner awakening' that arises when sound evokes the deeper parts of human consciousness.



Figure-99. View of the building and Parliament Hill from Hull.



Figure-100. View of the building and Pont Du Portage Bridge from Parliament Hill.

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## Appendix A: Acoustics

Reflection patterns depend on a material's surface and shape. *Convex* surfaces diffuse wave fronts, creating a wide distribution pattern of the sound energy, and can often be used to acoustical advantage. Conversely, *Concave* surfaces focus wave fronts to one point, creating uneven reflection pattern. Other considerations in acoustic design give form to focal points, which, no matter their geometric form, should not be near the location of any receiver, as well as acknowledging corner reflections, which can be problematic because they reflect sound back in the direction of the incoming wave front. Flat surfaces, with dimensions sufficiently larger than the wavelength of a sound result in specular reflections, where the angle of reflection equals the angle of incidence. Diffusion occurs when a wave is reflected from a surface and the sound energy is redistributed diffusely back into the space. To diffuse a sound wave, the reflecting surface should generally have irregularities at approximately the scale of the wavelength of the sound.

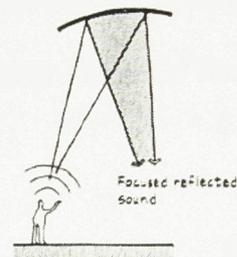
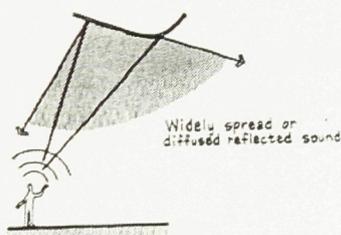
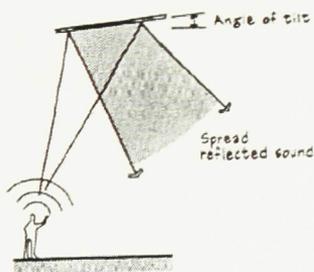


Fig A-a. Flat Reflector. Fig A-b. Convex reflector. Fig A-c. Concave Reflector.

Reflection ( $>4$ ) – return sound wave from a surface

Diffusion (=) – Random redistribution of sound wave from surface.

Diffraction ( $<$ ) – Bending of sound wave around an object (or through opening)

Given the above considerations, a design module develops through an understanding of sound waves, considered through the time- frame and notation of sound occurring in compression.

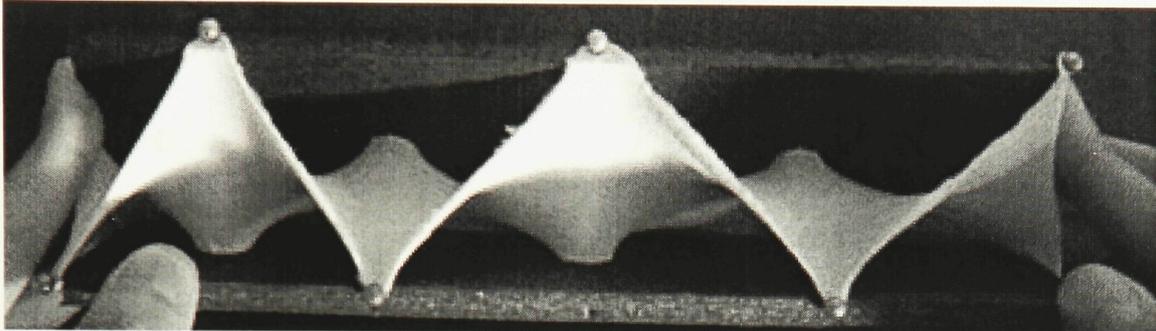


Figure A-d. Concave and convex shapes generated within the module define the space of sound reflection for sound control. The practical use of these principles allow for the diffraction of sound in public spaces.

Echo - Distinct echoes are generally undesirable in a space. Concave surfaces can create creep echoes or “whispering galleries”.

Flutter echoes can 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, zones completely free of first order reflections must be created.

## Appendix B: Soundwalking in Victoria Island

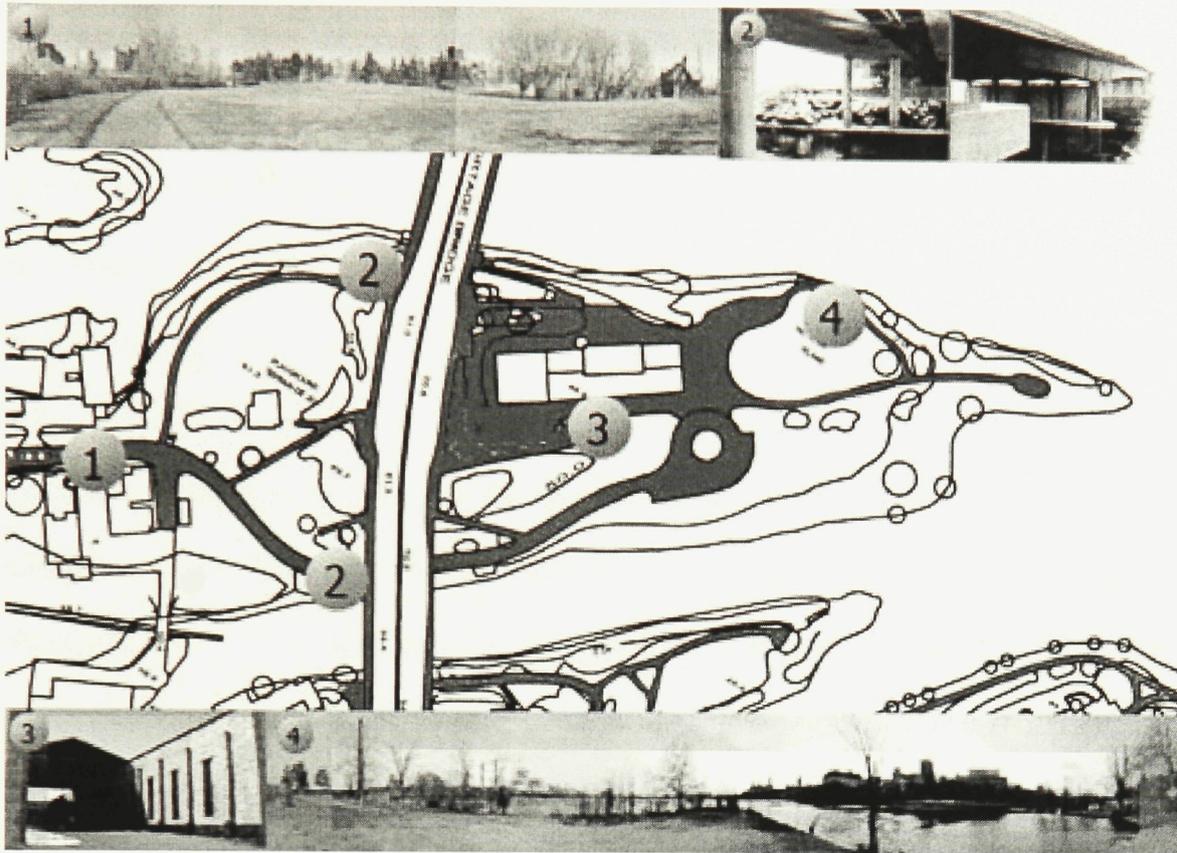


Figure B-a. Soundwalk map.

My summer daytime soundwalk started from the parking lot on Middle Street, proceeded across Parkway toward the bridge. The most obvious sound was that of water from Chaudiere Falls mixed with the mechanical sound from the generators. The sound become diffuse as one walks toward the East. Under the bridge, the sound of vibration from the expansion joints of the bridge is strong when the cars above pass by. The sound of metal is amplified as it is reflected off the water and bounced back to the listener's ear. These "vibrations" are indicative of the size and speed of the vehicles. Above, up on the bridge, there is a very different sonic experience, with the noise of traffic being clear and strong.

The path toward the end of the island leads to the historical Carbide Mill. The stone walls of this building are not enclosed; its ruinous state is evocative of architectural silence, disrupted only by the mixing of wind and birds' calls. At the East end of the island, one is caught between two cities; Hull to the North and the Parliament Buildings of Ottawa to the South. The sound of the water ascends to mix with monotonous rumblings of the industrial buildings in Hull. This soundscape is like a loop of music, a continuous tie weakened only by the clang of bells suddenly released from Parliament Hill's Peace Tower. The strong bell sound is monumental, piercing the air with clarity, in contrast to the steady and laborious drone from Hull.

Walking along the bike path at the south of the Native Zone during July 7<sup>th</sup>, 05, around 3:46pm: The aboriginal music from there can be heard from within the island, as well as from the bike paths on the opposite shore. The music is a traditional type of native music which mixes with biker sound. [Attached CD: soundwalk video] The music I heard from there allowed me to feel a part of it.

The night time sound walk on this site is even more interesting, in part due to the limited light. Being unable to see forced me to rely on my auditory faculties. The reduced evening traffic resulted in a more relaxed pace, and the sounds were more accessible and individualized. The sound of insects was a lot stronger resembling a group of singers in a chorus and the tree a concerto in response to the wind.

Footsteps in the snow are an additional layer of sound on a winter sound walk. Each step of sound simultaneously reflects the action of a walk, although this additional layer is amplified in comparison to the

summer soundwalk. With almost no insects nor leaves to make sound, the winter soundwalk is distinctly isolated like a solo.

The Soundwalk relies on the ambient sound while walking; the sense of hearing gives the additional layers of the objects seen during the walk. After performing the sound walk on Victoria Island, the vibration of the specific environment left a trace on later thoughts. Footsteps, the choice of the next direction, the duration, and the natural elements; animals, water and leaves have a direct impact on the experience and record of the soundwalk experience.

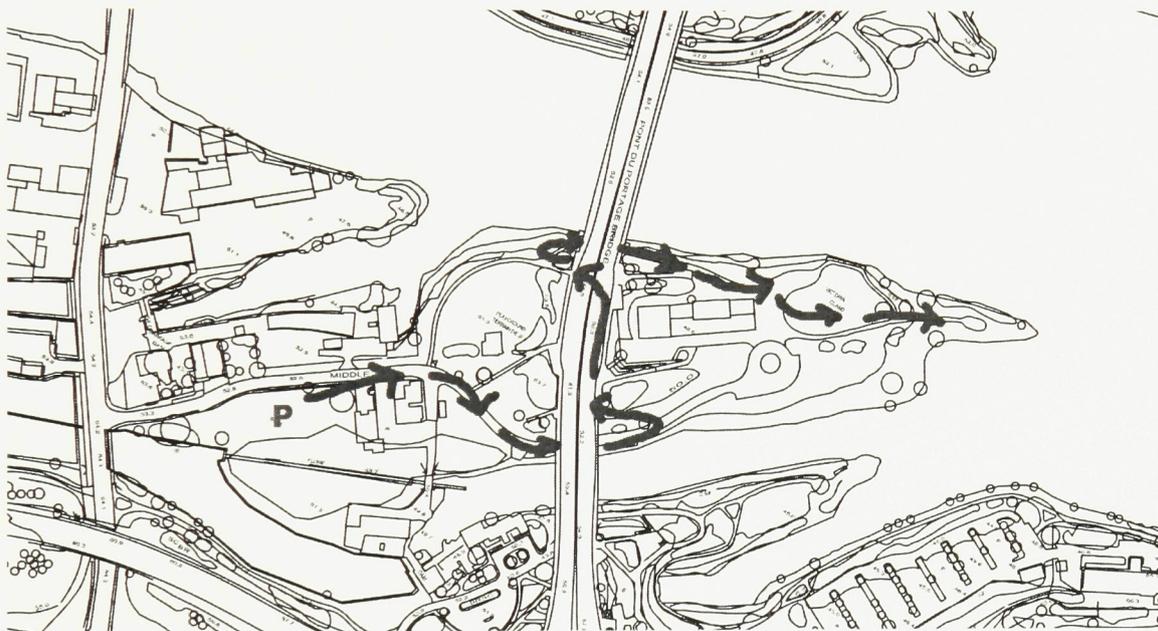
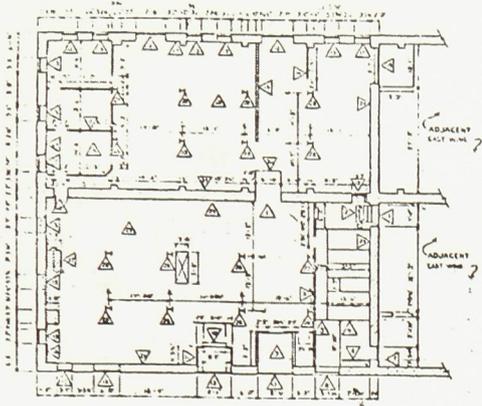
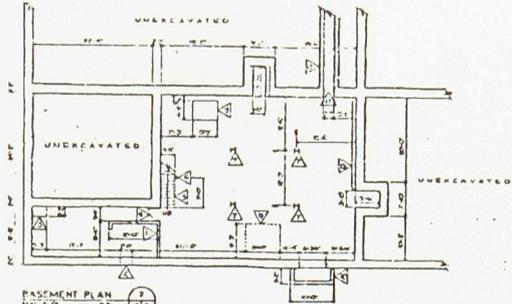


Figure B-b. Soundwalk Pathways.

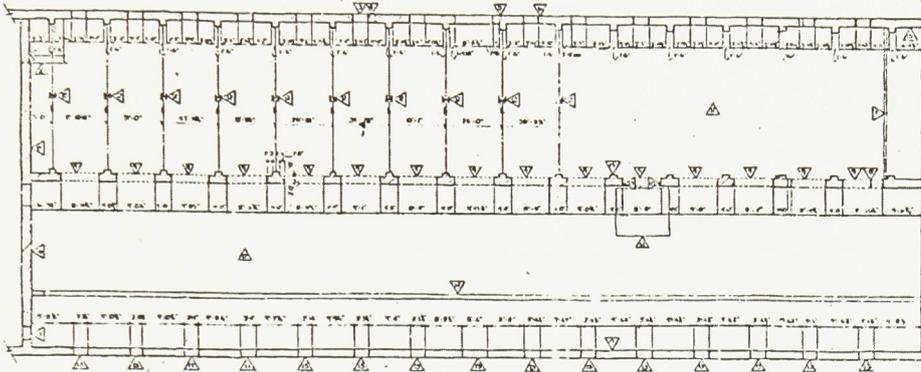
# Appendix C: Historical Carbide Mill Building Floor Plans



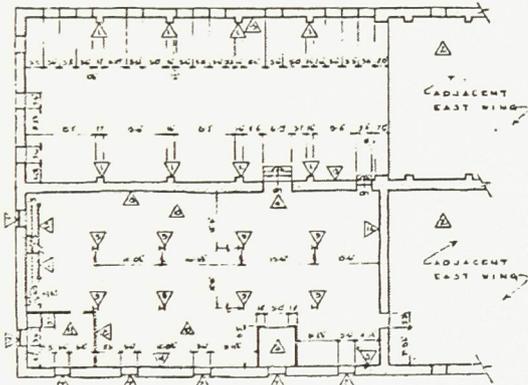
MAIN FLOOR PLAN  
 10-10 GC (1) 217  
 △ SPACED MULTI-GLENE WITH AREA  
 EXPOSED STEEL MEMBERS



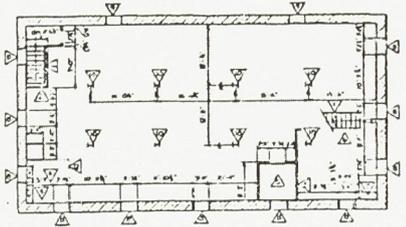
BASEMENT PLAN  
 10-10 DB (2) 217



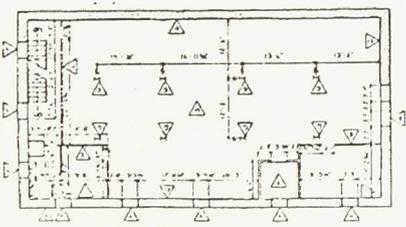
EAST WING - GROUND FLOOR PLAN  
 10-10 SB (3) 217



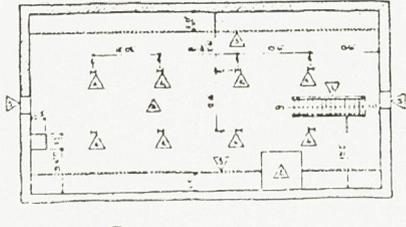
SECOND FLOOR PLAN  
 10-10 BM (4) 217  
 △ EXPOSED STEEL BEAM - GIRDER CORNER



FOURTH FLOOR PLAN  
 10-10 SB (5) 217



THIRD FLOOR PLAN  
 10-10 GC (6) 217  
 △ EXPOSED STEEL BEAM - GIRDER CORNER



ATTIC PLAN  
 10-10 BM (7) 217

## Appendix D: The Phenomena of Sound

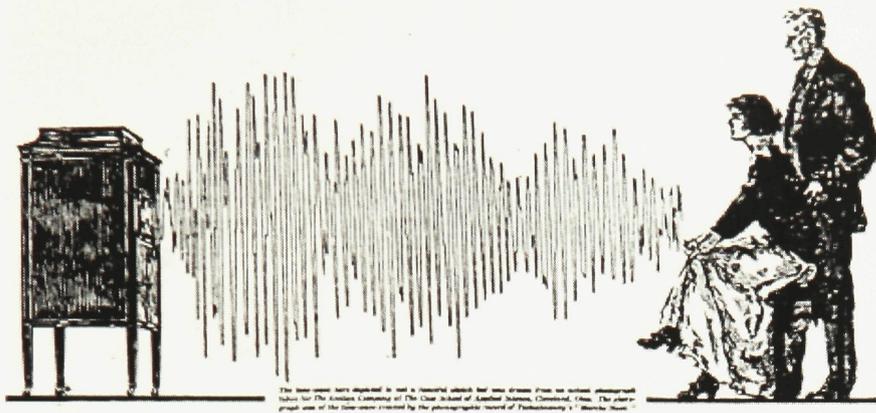


Figure D-a. Phonodeik image of a sound wave.

To 'see' sound in space, one must investigate the visual interpretation of sound wave phenomena, allowing for the discovery and integration of these observations into the realm of architectural space.

The following series of experiments explore the connection between sound and space. These experiments were performed by projecting sounds through a medium (intervening substance) whereby material transmits or carries sound. Example include: point and ambient light, white smoke, different size of space, liquid, pressure, air, pencil pen and paper etc. The impressions and expressions created from the vibrating elements produce a notation; a technical system of symbols used to represent sound's effect on matter, building materials, and spatial boundaries.

These sound experiments produced a series of results, as the sound was transformed by passing through various mediums with varying notational systems.

### **Appendix D.1:** *Sound pressure generate vibrations - Gas*

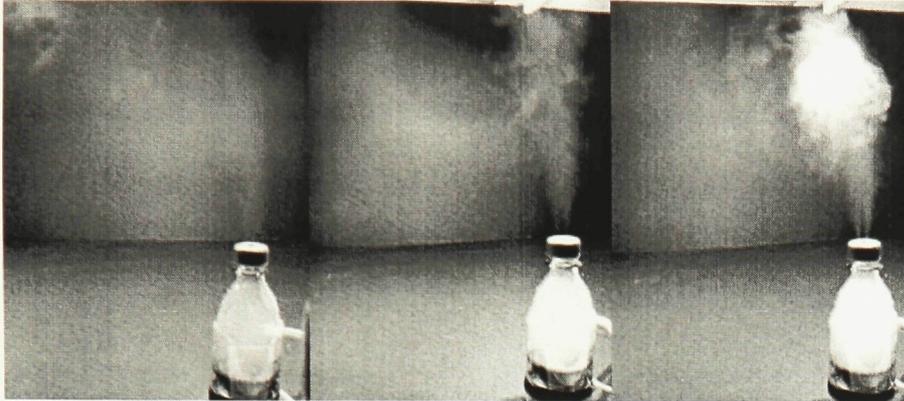


Figure D.1-b-d. Vibrations in gas bottle illustrated through white smoke.

**Setup:** A speaker is installed inside a bottle, and the opening is sealed. Two holes are drilled in the top. Smoke is inserted into the bottle. The speaker is connected to the audio system.

**Result:** The notation of sound is translated to air pressure. White smoke as a medium allow us to visualize the vibrations of sound, in a three-dimensional *container* producing a three-dimensional *expression*.

### **Appendix D.2:** *Frequency, time motions, wave length illustrated - Pen and Paper*

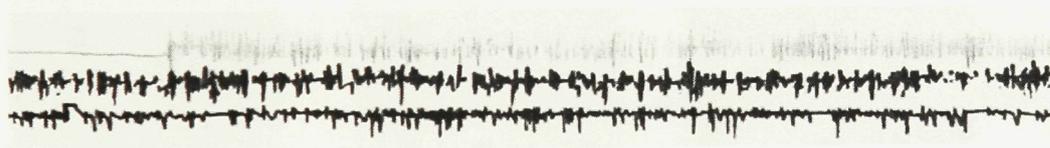


Figure D.2-e. Sound wave in pen and paper.

**Setup:** Pen and pencil attached to the sound source with moveable strip of paper.

**Result:** The resulting line-weight is descriptive of the characteristics of perceived sound. Depending on the speed at which the paper is moved, a 'written' two-dimensional notation of perceived sound is

created. A faster movement results in denser readings, whereas slower movements results in simpler graphic notations. The movement of sound waves is captured through the medium of pen and paper, resulting in an image of sound: a map of its chaotic physicality. This graphic represents 'visual aurally'.

**Appendix D.3:** *Notations, chaotic graphic produced - Point Light*

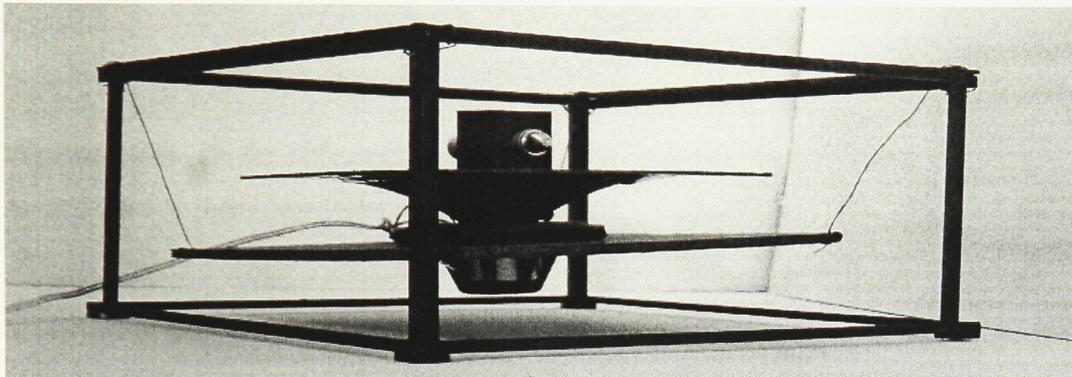


Figure D.3-a. Laser pointer installation.

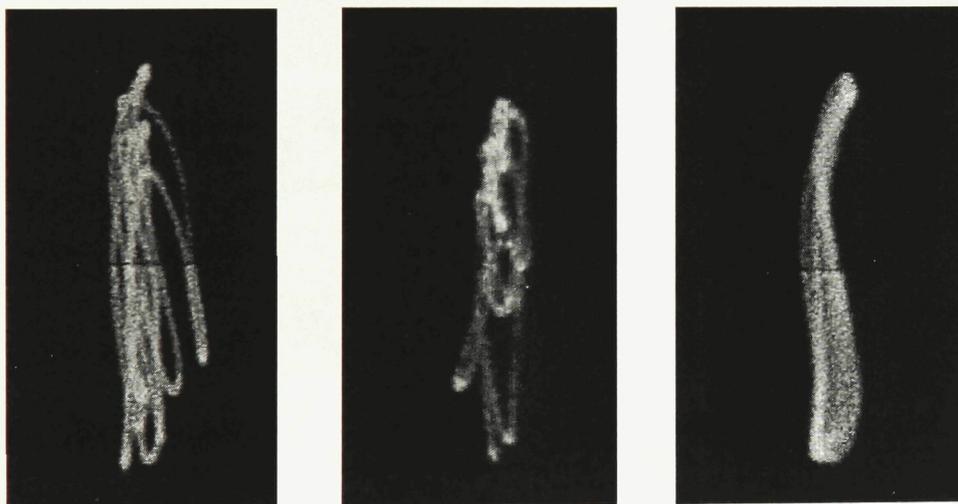


Figure D.3-g-i. Laser light illustrated in wall.

**Setup:** A laser pointer is installed on a loud speaker, which is then suspended to a frame by wire. The speaker is connected to the audio system; the laser pointer is directed at a projection screen.

**Result:** The light source directly projects the vibrations created by sound. The result is visible in different line conditions; elongated, dissecting, curved, dotted, or convergent.

The chaotic nature of the graphics produced is indicative of the ephemeral conditions of vibration. The differences amongst the notations, (the images produced by sound), suggests a translation between sound and space. This suggests an architecture changing over time through movement.

#### **Appendix D.4:** Oscillations – Liquid Ripple Pond

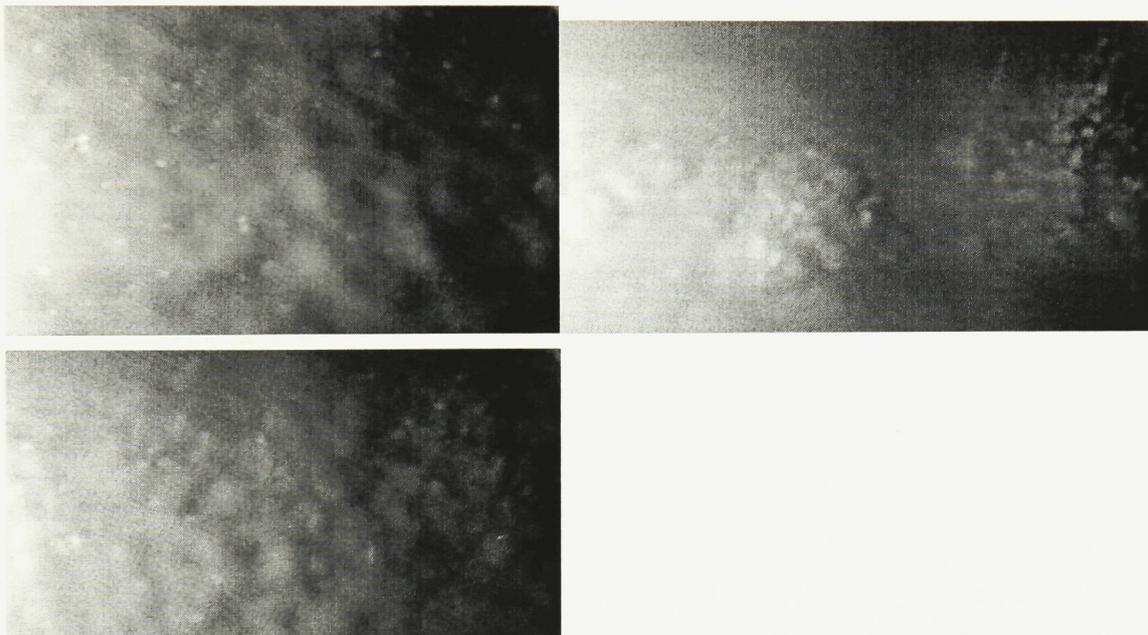


Figure D.4-j-l. Ripples in liquid pond.

**Setup:** Two speakers are installed under 1' X 2' sealed metal tank. A maximum amount of 1cm of colored water is poured into the metal tank and light, projected linearly at 45 degrees, is reflected on the water's surface.

## Appendix D.5: Particle movements – Dry Ripple Pond



Figure D.5-m. Ripples in sand pond.

**Setup:** Two speakers are installed under a 1' X 2' plastic tank filled with 300ml of white sand. Indirect lighting is reflected on the particles' surface.

**Result:** Sand particles are displaced vertically when sound is emitted, and re-organize into new forms upon their descent. Their new formations are descriptive of the nature of the sound emitted.

All the patterns are three-dimensional, though different patterns are created by sand particles even though the sound transmitted is the same. These rhythmic vibrations translate into a notation, a descriptive spatial pattern formed from a decidedly non-tangible source.

## Appendix D.6: Spatial Boundaries-Lamp-Zone

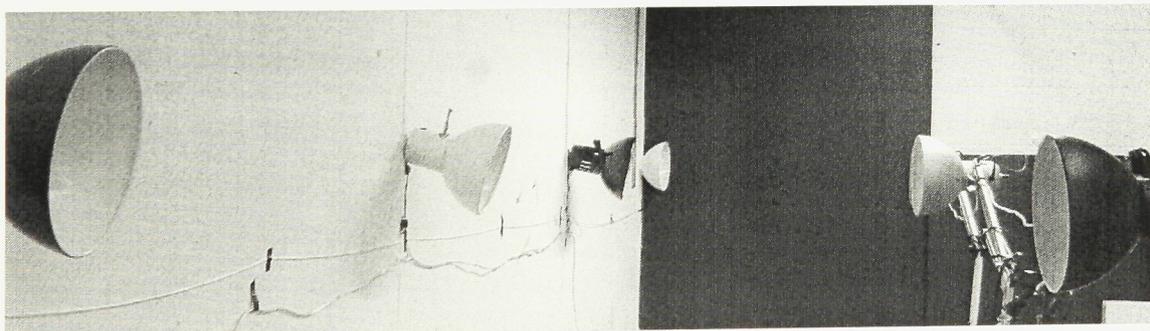
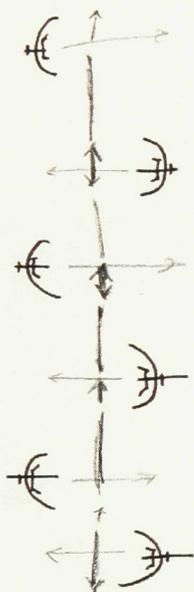


Figure D.6-n. Spatial boundaries experiment: Lamp-Zone.

**Setup:** Eight mini speakers are installed in the sockets of standard table lamps, which have been mounted on the wall at ear-level. The

spacing is four on the left side and four on the right side, with a two step' distance between each speaker. The speakers are connected and turned on with each speaker having a different audio source.

**Result:** The concave shape of the table lampshade reflects the sound in a specific direction. Speakers without the lampshade in this setting would result in sound mixing together. Because steps have been taken to overcome this, the sound changes with body movement, each lamp-zone focuses one specific sound/music perception to the ear.



From the experiments, it is apparent that sound has the potential to define boundaries in the same way that physical walls partition space. Sound can create a sort of 'barrier,' causing a division of space. In crossing through these divisions, one experiences a very different quality of space, in much the same way that entering into another room would engage the individual in a different set of spatial conditions.

Figure D.6-0. Spatial boundaries experiment: Lamp-Zone's plan.

This "walk-through" experiment suggests that sound, too, can play a role in shaping the physical boundaries of architectural space.

Body movement, creates the "virtual wall."

The space of sound is characterized by simultaneity and transformation through movement.

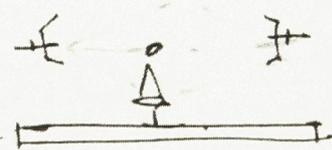


Figure D.6-p. Spatial boundaries experiment: Lamp-Zone's section.