To the Graduate Council:

I am submitting herewith a thesis written by Alyson Laun entitled "Intertwining." I have examined the final electronic copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Architecture with a major in Architecture.

Brian Ambroziak
Major Professor

We have read this thesis and recommend its acceptance:

Richard Kelso

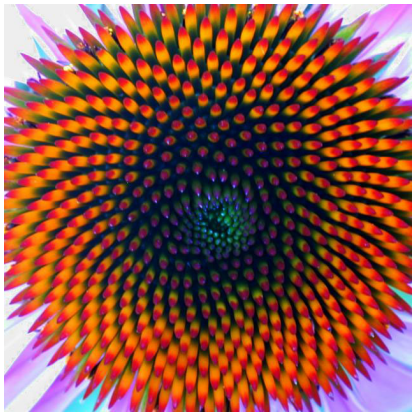
Scott Wall

Accepted for the Council:

Anne Mayhew
Vice Provost and Dean of Graduate Studies

(Original signatures are on file with official student records.)

Intertwining



A thesis

Presented for the

Master of Architecture

Degree

The University of Tennessee, Knoxville

Alyson Laun
August 2004

“Architecture and music have, side by side, always been part of the fabric of artistic evolution. However, whether (and how) these two threads intertwine or touch tangentially, has been a matter of lengthy debate”

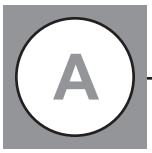
- Aaron Dai

Dedication

To my Creator, who has given me the talent to make it this far.

To my family, who has always encouraged me to shoot for the moon.

To my fiance Scott, who will never be a mathematical formula for me to uncover but who is an intricate piece of music with the notes arranged in a way that just seems right.



Acknowledgements

Thanks to my classmates who helped carry me through two weeks at a time, and thanks to the faculty for my most challenging experience yet!

Abstract

From Vitruvius' *Ten Books on Architecture* to Wagner's conception of the Gesamkunstwerk, many would agree that each area of art should influence the others. By narrowing my study to the relationship of architecture and music, I will explore in depth how music can directly influence the design, in form and experience, of architecture.

There are two ways to understand the interactions of music and architecture. The analogical is concerned with the artist's intention and technical procedure. Often, we think of the Pythagorean philosophy concerning the mathematical relationships that both music and architecture employ. These include, but are not limited to, harmony, rhythm and order. The Pythagoreans are credited for having brought measure to music through the study of the monochord, pipes, and bells. Pythagoras discovered through

plucking strings of different lengths, hitting bells, and blowing pipes of different lengths that musical harmony existed in multiples of the original note. Architectural form and structure follow many of the same rules in which music is composed. For example, single components of primary structure, such as rhythm, may include secondary structural components to create harmony. Also, Architecture can use musical iconography in the form of buildings. Frank Gehry uses several musical icons and distorts them in order to give shape to his Experience Music Project building. This is the most literal translation of musical influence on architecture. I am not suggesting this is the appropriate way in which these forces meet. However, a combination of the following two interactions will be further explored.

There also exists the metaphorical,

the poetic analogies that exist in both architecture and music. We use a different art to describe the impalpable effects that another art has on us in order to better identify that effect. Like built architecture, performed music can capture many emotions and feelings. Music is much like architecture in that it is written as well as experienced. “For Kahn, the work of the architect was closer to that of the musician than to that of the painter because the visual notations on paper which both musicians and architects make represent something outside the paper. A musical score represents sound, an architectural plan the three-dimensional experience of mass, space and light,” (Shaw-Miller, 34). Musicians continually write and rewrite pieces so that in the end, their audience will be able to fully engage in the experience of the music. In order for this to be a rich experience the music must be composed

in great detail through many layers. I would argue that music can be used as a precedent for technique and intention, and also for the metaphorical, to create an effect in architecture. In this thesis, I will explain how we, as architects, can learn from the creation and experience of music and translate this into architecture by designing through a deep layering of information in order to create a rich, inspirational experience.

Table of Contents

Chapter 1 - Musical Properties Influence Architectural Form **1**

Acoustics 1

Chapter 2 - Proportion **15**

Nature 16

Fibonacci 18

Golden Section 20

Human Body 22

Harmony 24

Harmonic Proportions 25

Value of Proportion 25

Chapter 3 - Iconographic Form **29**

Chapter 4 - The Gesamtkunswerk **31**

Chapter 5 - Program and Site **36**

Tempo 38

Rhythm 38

Repetition 39

Crescendo 39

Chapter 6 - Urban Design **41**

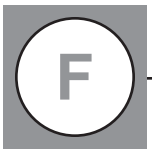
Chapter 7 - Sound Club **46**

Chapter 8 - Epilogue **52**

Bibliography **54**

Appendix **57**

Vita **65**



List of Figures

Figure

1.1	Fibonacci Numbers	19
1.2	Fibonacci Spiral	19
1.3	Harmonic Proportions	25
1.4	Guitar Inspiration	29
1.5	Use of Color	30
1.6	Site Analysis	36
1.7	Tempo Model	38
1.8	Tempo Model, Nashville	38
1.9	Rhythm Model, Nashville	38
1.10	Rhythm Model	38
1.11	Repetition Model	39
1.12	Repetition Model, Nashville	39
1.13	Crescendo Model, Nashville	39
1.14	Crescendo Model	39
1.15	Synthesis Model, Nashville	40
1.16	Appalachian Spring	40
1.17	Existing Figure/Ground	41
1.18	Proposed Figure/Ground	41
1.19	Existing Connections	42
1.20	Volume Cuts	43
1.21	Rhythm and Repetition	44
1.22	Jam Boxes	44

Figure

1.23	New Urban Design	45
1.24	Massing Diagram	46
1.25	Private/Public	46
1.26	Public Stair	46
1.27	Sun Diagrams	47
1.28	Diffuser	47
1.29	Diffusion of the West Facade	48
1.30	Pattern of the West Facade	48
1.31	Reflection of the Wall	48
1.32	Revealing Windows	49
1.33	North Facade Movement	49
1.34	Jam Box Continuation	49
1.35	Reflection of the Stage	50
1.36	Residential Twist	50
1.37	Layering of the Fourth Floor	50
1.38	Hallway Elevation	51
1.39	Diffusing Wall	51
1.40	Tower Vignettes	51

1 Musical Properties Influence Architectural Form

Acoustics

Since Vitruvius' *Ten Books on Architecture*, there has been a theoretical marriage between music and architecture. According to Vitruvius, an Architect was to embody several arts and other professions. "Let him be educated, skilful with the pencil, instructed in geometry, know much history, have followed the philosophers with attention, understand music, have some knowledge of medicine, know the opinions of the jurists, and be acquainted with astronomy and the theory of the heavens," (Vitruvius, 6).

The first way in which Vitruvius related architecture and music was through acoustics. He described the bronze vessels placed under seats in theaters that resonated at different frequencies. When an actor's voice was in accordance with any one of these vessels, the power was increased and harmonics of his voice

sounded in the theater. Architecture was used in accordance with music and the laws of sound. An understanding of the laws of sound is useful for an Architect to understand the form of a space. Sound interacts with the angle of the walls and the materials used to create either noise or beautiful music. So, the architectural form can be manipulated to achieve a certain sound condition for the program of the building.

For example, the Symphony Hall in Boston was designed for the best acoustics possible for the Boston Symphony Orchestra. Built in 1894, it was the first auditorium in the world to be built according to mathematical acoustical laws.

Henry Lee Higginson, owner and controller of the orchestra, was delighted to build a new home for his musicians.

He specifically asked for a hall that would “shelter” the audience from exterior sounds so that the hall would do justice to the great music of the past. As a result of this comment, there was much debate on the form of the structure. In order to create this fascinating acoustical space, music and architecture had to be molded together. Charles McKim, in the midst of building Boston’s new public library, was commissioned to design the theater. Three initial designs were submitted, one rectangular, one elliptical, and McKim’s favorite, semicircular. McKim went into great detail with the third proposal designing after a Greek theater. The board dismissed his favorite choice since the risk was too high to build a concert hall in a form that had never been built before. Unfortunately at this time, the only measure of acoustics was by trial and error. So, there was no other way to determine ahead of time how a form

would acoustically perform unless it had already been built. So, the board proposed a rectangle to replicate the form and hopefully the acoustical success of the New Gewandhaus in Leipzig.

It was at this time that Wallace Sabine, a young assistant professor of physics at Harvard, was introduced to the project. Sabine had been studying the reverberation and other acoustical properties of music, and also had recently worked on improving the acoustics of the university lecture hall. Up until this point, knowledge of acoustics was ambiguous. It was assumed that a shoe-box shaped room had better acoustics because of past experiences, but there was no concrete evidence to even tie acoustics to room shape. Since the turn of the century, many acoustical designers assumed that there was a direct relationship between room shape

and acoustics. For quite some time, halls built since 1905 could not achieve the same acoustical standards as the older halls. This suggested that construction methods and materials played a vital role in the acoustical performance along with the shape of the room. “It is likely that fortuitous circumstances engendered by the economy of construction with a rectangular plan and by the structural limitations inherent in traditional building led to such pleasing acoustical results,” (Edwards, 133).

“the lingering over time of residual sound in a space, had always been a direct result of the architecture that created it, a function of both the size of the room and the materials that constituted its surfaces,” (Thompson, 3).

Given the rectangular form, Sabine proposed using materials to improve the acoustical properties of the hall. “Sabine had meticulously investigated the reverberation of sound in rooms and discovered that reverberation is related to the cubic volume of the room and the total sound absorbing power of the room surfaces and contents,” (Edwards, 133).

Recent investigations have uncovered such objective characteristics, some of them strongly influenced by room shape," (Edwards,133).

In the age of modernity, improvements have been made in the search for acoustical properties. Since Sabine's findings that sound was directly related to the materials of the surfaces, new materials have been invented to improve the acoustics of a room. Perhaps this is partially responsible for the disjoining of music and space. Acoustics are no longer solely dependent on room shape as once thought. New materials can absorb or reflect sound waves masking the actual acoustics of a given room form. Baffles and bass traps can also be installed to tweak the sounds present.

In the midst of new materials and technology, architects are still relying on old principles. In the Disney Concert Hall in L.A., Frank Gehry paid great attention to the interior shape of the concert hall recognizing that the traditional shoe-box shaped concert halls possessed excellent

acoustical properties. New technology allowed him to analyze older architecture and provided for a groundbreaking vineyard shape while still retaining the superb acoustical characteristics of a traditional shoe-box shaped hall. Gehry also paid careful attention to the materials used in and outside of the concert hall. Douglas fir is used to enhance the acoustical properties in the auditorium and is carried through into the concrete foyer. Twists of wood are staggered throughout to improve the harsh acoustic qualities of concrete. This is the same wood that is used in the backs of cellos and violas.

In a concert hall, live music is enhanced by the acoustics of the space. However, in recorded music, sound and architecture have been separated. This started to take place in the 1940's when acoustic chambers became popular. Recording studios couldn't always record music in a

specific space to achieve desired sounds either due to logistics or finances. So, in order to get around this barrier, acoustic chambers were created. These were rooms located in the building that were used specifically to add reverberation, the sound of space, into the recording. The recorded music would be played back in an acoustic chamber and re-recorded to obtain the effects of the room. Even then, all desired qualities could not be achieved or manipulated, and the cost of building these spaces was great.

A cheaper method of reverb was invented in the form of a reverb unit. These units were placed in solitary rooms where the signal was then fed into the unit and the resulting reverberation would be recorded into the recording. These units could be adjusted to control the amount of reverb desired. Still, the cost was great to have a separate space to house the unit, and

also the technicalities of adjusting the reverb would interrupt recording sessions. Often the engineer would take so long to adjust the unit, that the musicians would lose any inspiration in playing their music. The magic of music would get lost in the technicalities.

The creation of digital music in 1979 completely revamped the recording industry, and changed the way in which music is presented to our culture. Digital music calls for a complete divorce of music and architecture. “When electroacoustic instruments like microphones and loudspeakers moved out of the laboratory and into the world, this new way of thinking migrated with them, and the result was that sounds were reconceived as signals,” (Thompson, 3). Despite the advantages of digital music, it has some pitfalls. The music tends to lack warmth because of the way

in which digital music approximates parts of the sound wave. When music leaves an instrument, it travels in the form of waves. In analog recording, such as tape cassettes, the wave is recorded. When music travels from the speaker to our ears, the music again travels in waves. In digital recording, music enters the computer as a wave and is translated into a series of points on that wave. When the digital points are then translated back into waves to be heard, the result is not the same as the original wave as in analog. The sound is approximated and tends to not have the same warmth as analog sound.

The digital trend in music continues because of the many benefits of digital music. “The desire for clear, controlled, signal-like sound became pervasive, and anything that interfered with this goal was now engineered out of existence,”

(Thompson, 3). Once music is in a digital format, the engineer can control many different aspects of the sound. This is beneficial in recording so that each instrument can be recorded separately and then the totality is configured in the computer. The acoustics of the room are not important and in most cases undesirable. In some instances, such as recording studios, it is now desirable to have an acoustically dead space in which all created sounds are electronically altered and “mastered.” Reverberation, delay and echo can now be digitally altered leaving no desire for a relationship between music and architecture.

The roots of sound are in architecture and cannot therefore escape. The principles of digital reverberation, for example, are reliant upon architectural concepts. Reverberation can be broken down into its components of reflection, time delay,

and quality of sound. The reflection of a sound is directly related to the type of material in which it is being reflected or absorbed, while time delay is based on the size of the space in which the sound is being played. The quality of sound differs with the different shape of each space. (A space with many angles will have a fuller sound because of the many reflected sound waves.) The purpose of using effects in digital music is then to recreate certain architectural spaces virtually. Perhaps the relationship between music and architecture is not entirely missing but is taking on a new character.

Modern music follows similar trends to modern architecture. With the introduction of digital sound, modern music became a commodity. It is now a product marketed to specific audiences. Engineers produce music in a specific way according to the environment in

which the target listener is most likely to listen. For example, pop music is often compressed into a smaller field of frequencies that sound good on smaller, cheaper speakers, usually in traditional home stereo systems and car stereos. So, the music sounds ideal in this setting. If it were to be played on a very expensive stereo, the music wouldn't sound full because it was targeted to a different audience. Digital media has enabled music to become very transportable and easily reproducible. In a materialistic culture infatuated with consumption, we are producing cheap music. "Finally it was modern because it was perceived to demonstrate man's technical mastery over his physical environment, and it did so in a way that transformed traditional relationships between sound, space, and time," (Thompson, 3).

This can be related to trends in modern

architecture. The desire for standardized, reproducible elements has resulted in cheap, non-specific architecture. Early architecture possesses such a rich aroma because it is intended for a specific place and function, and that information is layered throughout the structure.

2 Proportion

"Van der Laan encouraged me to see a proportion system not as a tool or a recipe that makes good design' easier', but as something vastly more important," (Padovan, 15).

"But for Pythagoras, what mattered was not so much the material of which the building blocks of the house were made, as their size and shape," (Padovan, 62).

From ancient times through the middle ages, architecture and music were inherently linked through the underlying harmony in the order of the universe. In addition to his objective findings in acoustical design Vitruvius states that there is also an underlying proportioning system that can be used in creating music as well as architecture. The relevance of this proportioning system has been a long debate throughout the history of architecture as well as other arts. Is there one universal proportioning system that should be used for creating architecture? This does not explain how the works of Palladio and Le Corbusier can be considered beautifully proportioned when two different proportioning systems were used. In fact there are several proportioning systems that architects have used in design. Before we can further explore the proportioning systems of architecture and music, it is vital to

understand that we will be looking at several elements of a composition. It should be agreed that nature can not be simplified into one proportioning system, neither can art. There are multiple layers and interactions between these layers that are responsible for art, architecture and nature. We will pick apart the elements to understand the parts and how they might fit together in a composition.

Nature

Architects have searched for a way in which their architecture could live in harmony with nature. “Mathematical law is, for him (Le Corbusier), not just a prescription for beauty, nor even a means by which human beings are somehow able to comprehend their world, but the axis or ruling principle of the universe itself, and the source of the unity and harmony of nature and of art,” (Padovan, 4). Proportioning began as a

way in which architecture could begin to imitate nature. The thought was that the underlying ordering system of nature is what makes it beautiful. “Mathematical systems of order in art have always been connected, of course, with visual beauty,” (Padovan, 3). Mathematical systems are one way in which we can comprehend art and even nature. We look for ways in which we can number or order so that we can better understand why and how things are created. It also creates a standard in which we can measure beauty.

Perhaps architects were trying to imitate the Creator by imposing an order to nature thereby allowing architects to create beauty. If nature has an order and nature is beautiful, then we must be able to create beauty by replicating that order. In order to understand the complexity of nature, it is important to understand that nature has order however it can not

be described by only that. Architects and artists tried desperately to impose an order to creation. The proportioning systems seemed to follow the scientific realm. With the ability to study nature and the processes of nature through science, architects were able to better understand and mimic the way in which it was created. This also opened the door to possibilities of multiple ordering systems in nature.

Fibonacci

The Fibonacci Numbers is one of these systems. It began when Fibonacci (1202A.D.) investigated how fast rabbits could breed in ideal circumstances. “Suppose a newly-born pair of rabbits, one male, one female, are put in a field. Rabbits are able to mate at the age of one month so that at the end of its second month a female can produce another pair of rabbits. Suppose that our rabbits

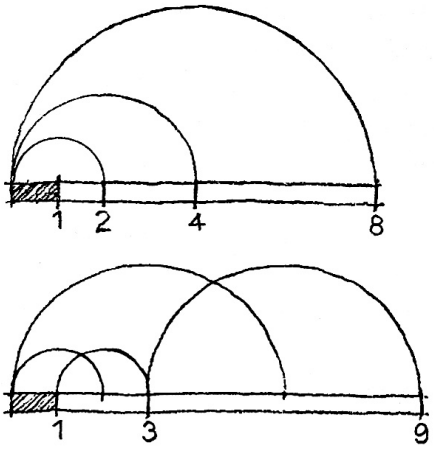


Figure 1.1 - Fibonacci Numbers

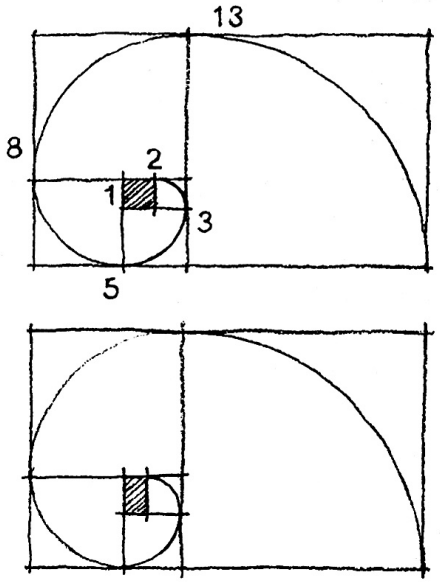


Figure 1.2 - Fibonacci Spiral

never die and that the female always produces one new pair (one male, one female) every month from the second month on. The puzzle that Fibonacci posed was... How many pairs will there be in one year?" (www.msc.surrey.ac.uk). This resulted in a system in which two sequential numbers are added to obtain the third and so on (Figure 1.1). The sequence starts 1, 1, 2, 3, 5, 8… There are many examples in nature that reflect these numbers. Here is a spiral drawn through the corners of squares sized using the Fibonacci numbers (Figure 1.2). The spiral is not a true mathematical spiral, but is a spiral that is reflected in nature, such as in the shape of snail's shells, sea shells, and the arrangement of seeds in some plants.

Fibonacci numbers are also used in pieces of art, architecture, musical instruments and music composition. In

music, “for example, an octave of the chromatic scale has 13 notes. On a piano, 8 of these keys are white and 5 are black. The black keys of the pentatonic scale are grouped into sets of 2 and 3 keys,” (www.geocites.com/cyd_conner/music.html). Fibonacci numbers are responsible for the form of a piano. In writing, “George Duckworth (1962) argues that Vergil consciously used Fibonacci numbers to structure this poetry in the *Aenid*,” (faculty.oxy.edu/jquinn/home/fibonacci/homecoming/art1.html). Here, in poetry, the Fibonacci numbers are used as an underlying structure.

Golden Section

A second similar system, the golden section is a proportion of 1:1.618 (which is the same as 0.618:1). Divide each number by the number before it to get the sequence: 1/1=1, 2/1=2, 3/2=1.5, 5/3=1.666..., 13/8 = 1.625, 21/13

=1.61538... The limit of this sequence is called the golden mean or golden section. A rectangle whose sides are in the golden proportion has been seen throughout ancient Greek architecture including in the Parthenon. In modern architecture, Le Corbusier incorporated some golden rectangles as the shapes of windows and also other parts of the design. This can be seen in the United Nations building in New York. In art, the golden section is seen in Modrian's paintings as well as in the Mona Lisa. Concerning music, "Mike Kay (1996, *American Scientist*) reports many of Mozart's Sonatas divide into 2 parts exactly at the golden section point in almost all cases. Apparently Stradivari was aware of the golden section and used it to place the f-holes in his famous violins," (faculty.oxy.edu/jquinn/home/fibonacci/homecoming/art1.html).

Human Body

Also, science in understanding the human body introduced another model for perfect form and proportion. "During the Renaissance and the centuries that followed it the human body was held up as the most perfect manifestation of natural form and proportion. Man was made in God's image; the proportions of his body manifested the divine harmony of His creation, and were the model for proportion in art and architecture," (Padovan, 24).

"I shall describe as 'empathy' the tendency to hold that, being ourselves part of nature, we have a natural affinity with it and an innate ability to know and understand it. Le Corbusier calls this affinity 'an indefinable trace of the Absolute which lies in the depths of our being'," (Padovan, 12).

If we step back a little further in time, we will see that the human body was proportioned, but possibly not for the sake of beauty as the Renaissance believed. "In origin, the principal aim of the 'canon' was 'to guarantee that the proportions of the various artistic representations conformed with the natural proportions of the human body, and the ratios of the

"The certainty of mathematics is due precisely to the fact that it is man-made, the uncertainty of nature to the fact that it is not," (Padovan, 11).

various units of the canon represented standardization of the natural relations of the corresponding parts of the body," (,39). The proportions were used as a standardization technique, not as a mark of beauty. Sculptors often went to the quarry to choose stone for a statue. They would divide the stone into fourths and allow for the removal of parts so that it would be lighter for shipping. A proportioning system was employed also so that two sculptors could work on opposite halves of a sculpture and it would still fit together perfectly. "It should be emphasized that there is no indication to any extant source that the purpose of the Egyptian and Archaic 'canons' of proportions was to secure the beauty of the finished product. Rather, the concerns seemed to have been practical," (44).

"The question whether mathematics is inherent in nature and distilled out of it by human reason, or is a construction of the human mind that we impose upon nature in order to measure it, has been debated by mathematicians and philosophers at least since Pythagoras (c.520 BC)," (Padovan, 11).

Harmony

Music has also been used as an inspiration for order. Pythagoras is responsible for finding the musical relationships between whole numbers. He experimented with a string with a moveable bridge. At first is was shortened to three quarters of its length to sound a fourth higher, then to two thirds to sound a fifth higher, and finally in half to sound an octave. These proportions, 4:3, 3:2, and 2:1 seemed to provide still more evidence of the underlying orders of nature and the harmony of all created things. There is a unity which spans all natural things. By studying music, we can discover more proportions which are natural and beautiful. "In the same way, through the measured relations between sounds, music gives measure to a portion of time – a kind of measure quite different, for instance, from that provided by a clock," (Padovan, 15).

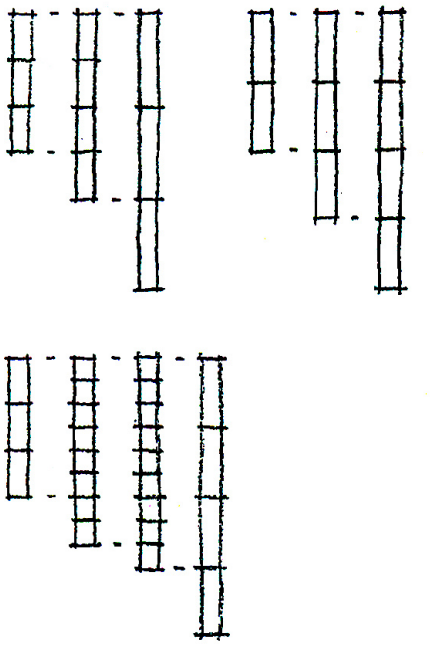


Figure 1.3 - Harmonic Proportions

Harmonic Proportions

Palladio, in his *Four Books on Architecture*, recommends using proportions in determining the height and size of rooms. Much like Alberti, he states the height of the rooms should be either the arithmetic, geometric, or harmonic means of the breadth and length. Palladio strays from Alberti's Pythagorean ratios by introducing ratios such as 5:4 and 5:3. Their introduction is linked to developments in northern Italian music theory according to Wittkower. The proportions resemble the harmonic proportions of the octave, fifth, fourth, etc. See Figure 1.3.

Value of Proportion

Unfortunately, the artists and architects who sought proportion as the final solution fell short. Proportion, a mathematical ordering system, is not the key to unlock the secret to the beauty of nature.

Proportioning systems are not a formula for beauty. Vitruvius discovered that an underlying proportioning system in music, as in architecture, can result in ‘subjective pleasure’. “In his consideration about music and architecture, Vitruvius claimed that the musicality of architecture stemmed from the belief of subjective pleasure on objective mathematics with the exact application of numerical proportioning of music to architecture resulting in the experience of pleasure,” - Scott H. Neish. The mathematical ways in which music is written can be directly applied to the process of architecture resulting in the experience of pleasure that Vitruvius describes. Music must be reintroduced as an integral influence in the process of designing architecture, but not the sole influence in designing architecture.

It is important to remember that one

proportioning system is not responsible for all beautiful architecture. I would argue that there needs to be a layering of systems in order to create beauty. If we are looking at nature as a precedent for beauty, it cannot be pigeon-holed into one mathematical equation. There is a complexity and mystery that begins to unfold as we study other types of art and other ways of creating this beauty of which proportion is one.

Palladio's predecessors, including Alberti, had only described proportions in individual rooms. Palladio's architecture was the first to interweave proportions throughout the composition combining harmonic proportions with the Vitruvian concept of symmetry. The Villa Rotonda, Palladio's best known work, embodies the key ratios of 15:11 and 26:15 which are thought to be whole-number approximations for irrational proportions

based on square roots. “Certainly as in music, simple numbers are the grounds and generators for this kind of harmony, be they the numbers 1, 2, 3, 4…” (Padovan, 235). In taking a closer look at the Villa Rotonda, we can see that Palladio used a layering of mathematical proportions. There is a direct relation in the shapes of the smaller rooms (15:11 or√3+1:2) to the shape of the larger ones (26:15 or √3:2). This is further integrated into the central rotunda. One side of an equilateral triangle inscribed into the circle measures almost exactly 26 feet, and the rectangle defined by the radius of the circle and the side of the inscribed triangle, 26x15, the exact size of the main rooms. The diameter of the circle equals the diagonal of the room plan. You can see how such complexity and deep order has resulted in a much-admired work of architecture.

3 Iconographic Form

Frank O. Gehry responds to the program of the Experience Music Project to intertwine art and architecture. Gehry combines his style with the inspiration of music to create a piece of architecture specific for housing a collection of Jimi Hendrix memorabilia.

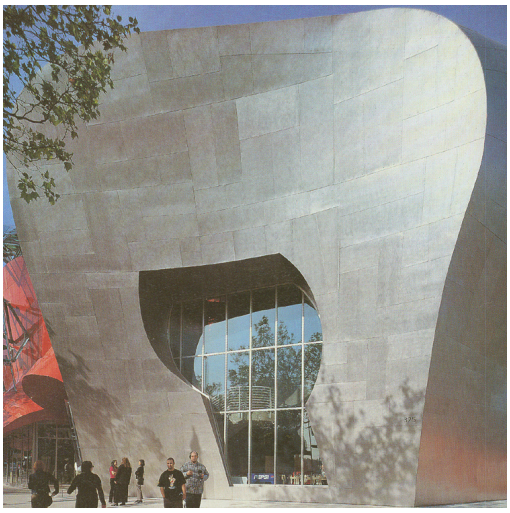


Figure 1.4 - Guitar Inspiration

Gehry used the inspiration of a shattered 1960's Fender Stratocaster guitar (figure 1.4) to derive the form for this building. Gehry fed images into his computer program which continued to distort and derive new forms from the original guitar shape. At some moments the building reflects the guitar shapes, but mostly the building is an abstraction of that form. Gehry continues to use sculptural abstraction to link art and architecture. "Though obviously not contradictory with the ebb and flow of rock and roll, Gehry's architecture again underlines his position as a sculptural master, redefining

architecture at a level that brings it closer to art," (Taschen, 202).

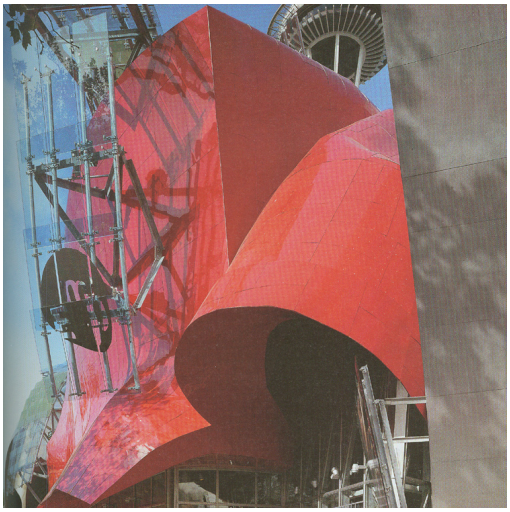


Figure 1.5 - Use of Color

The most unusual feature of the building is Gehry's use of color (figure 1.5) which is not typical of his style. The colors are inspired by rock and roll: blue for the Fender guitar, gold for Les Paul and purple for Jimi Hendrix. Gehry colored the passages red as a tribute to the faded old trucks the stars used to drive.

Gehry sculpts imaginative interior spaces within the exterior form. The use of lighting and color introduce an atmosphere that is similar to a rock and roll performer's stage. "The powerful sculptural volumes of Frank Gehry take on a life of their own in the interior, just like the music they are intended to celebrate," (Taschen, 207).

4 The Gesamtkunstwerk

The final way in which music can influence architecture is best described through Wagner's Gesamtkunstwerk. Until now, "music becomes a model as a method, rather than as a kind of effect, at which point 'the avant-garde [found] what it was looking for'," (Shaw-Miller, 30). The idea behind the Gesamtkunstwerk is that all art is intertwined into an Art. Each method of creating art is not independent of the others. Wagner's idea of the Gesamtkunstwerk holds the key to the poetic analogies between architecture and music.

Up to the eighteenth century, it was likely that one would converse about painting, dance and music, but the term 'art' had not yet come into play. The word 'art' was not widely used until the nineteenth century with the distinction of artisan and craftsman. Until then, all art was seen as a combination of the arts. In

fact, music was rarely referred to as the music we think of. It encompassed words and dance. The Greek word “mousike” described the complex form of music and poetry.

The difference between art and craft was the layering of meaning and principles in art vs. the skill of craft. Therefore, the purpose of studying all forms of art is to learn the layering of meaning and principles behind the art of which are not dependent on the media. “Comparing the resources of totally different arts, on art learning from another, can only be successful and victorious if not merely the externals, but also the principles are learned.” - Wassily Kandinsky.

This comparison is not entirely dependent on the media of the art. Many analogies can be drawn between the different forms of art. A painter might imitate the color

of nature whereas the musician imitates the sounds. However, there arises a difficulty when the presentation of the two compared arts is different. The way in which music is experienced involves the ear while the way in which a painting is experienced is through the eyes. Another distinction between architecture and music is the way in which space is experienced as opposed to the way in which time is experienced. While there are noticeable differences in the forms, much of the mystery remains the same. Music in written form can produce such emotion in played form. The same is true for architecture.

Music and architecture are placed in a separate category from the other arts because they by nature embody several arts. From the history of music we know that it has crossed the sensual boundaries. For example, sung drama

combines music, the ear, and drama, the eyes, to form the opera. Architecture has also crossed these boundaries. A piece of architecture is very complex in that it engages almost all of the senses. When architecture is drawn, it is experienced visually. Then, as it is built, it engages touch, sight, smell, and sound. The way in which a piece is effective, then, is how it engages each of these senses and it's ability to disappear so that the subject is lost in the form of art. "'Therefore, each art has its incommunicable element… its unique mode of reaching the 'imaginative reason'," (Shaw-Miller, 31). By studying the laws and mathematics of music which are responsible for creating imaginative music, perhaps we can use similar laws to result in experiential architecture.

"Form is linked to sensation and subject to intelligence. The mission of art lies in finding a balance between these binary

poles: ‘Art, then, is thus always striving to be independent of the mere intelligence, to become a matter of pure perception, to get rid of its responsibilities to its subject or material;… that the material or subject no longer strikes the intellect only; nor the form, the eye or ear only; but form and matter in their union or identity, present one single effect to the ‘imaginative reason,’ (Shaw-Miller, 31).

When we refer to a piece of sculpture as a poem in stone or the architecture of the symphony, we are speaking in metaphor. These metaphors enable us to better describe the effect of the work of art. It is not that the sculpture resembles a poem in the way it was created or intended, but that it evokes the same emotions that we have felt from a poem.

5 Program and Site

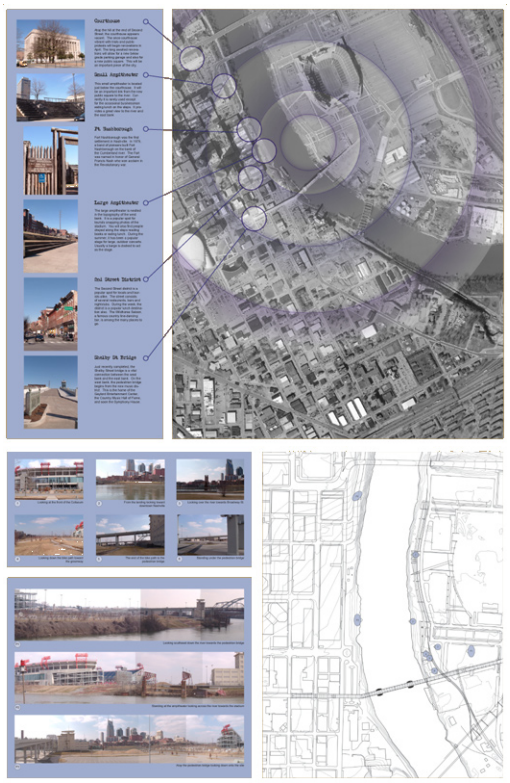


Figure 1.6 - Site Analysis

In the large scale, I chose Nashville, TN as the site for my thesis project. Since Nashville is known as the Music City, it is appropriate to use the influence of music in designing architecture.

The original site analysis (figure 1.6) began on the West Bank of the Cumberland river which flows through Nashville. Downtown Nashville is located on the West Bank of the river. It includes important sites such as the Courthouse, a small ampitheater, Ft. Nashborough, a large amphitheater, the Second Street district, and the Shelby Street Pedestrian Bridge.

With nearly all commercial development on the west bank, the river acts as a boundary to downtown development. In 1999, the Titans' football stadium was built as an attempt to bring activity to the East Bank. More recently a pedestrian bridge

has been completed which links the east and west bank.

Instead of seeing the river as a boundary which divides the city, I chose to look at it as the melody of Nashville which binds everything together. My analysis began by looking at Nashville as a piece of music. In each of the first four models, I investigated a different aspect of music and how it relates to Nashville. Each model builds on the idea of the one prior. The fifth model is a collection of all of the ideas of the first four models. Each model documents the idea in the city and then responds to this idea by adding a new piece of program to the river edge. The pieces along the river edge represent small recording studios which always link back to a major hub. The hub would include recording studio offices, reception area, a live stage and short term living facilities.



Figure 1.7 - Tempo Model

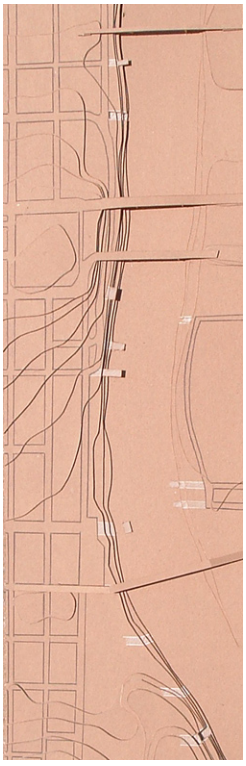


Figure 1.8
Tempo Model,
Nashville

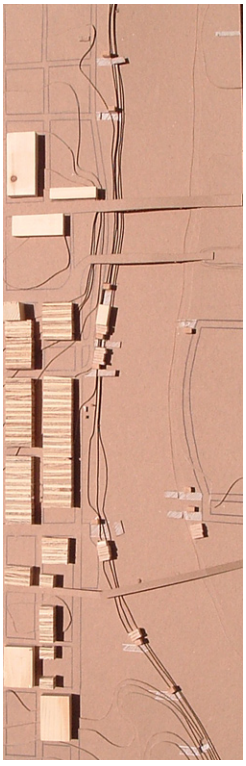


Figure 1.9
Rhythm Model,
Nashville

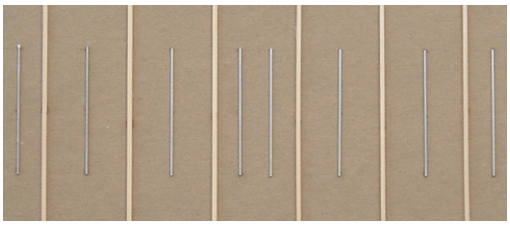


Figure 1.10 - Rhythm Model

Tempo

In building the models, I first identified the tempo of the city (figure 1.8). Tempo (figure 1.7) is the speed at which music is or ought to be played. Typically, the tempo is constant throughout a song. The tempo of Nashville is defined by the street grid. This provides the basic framework within which buildings can be built. It sets up the boundaries which rhythm can infill.

Rhythm

Rhythm (figure 1.10) is defined as a pattern of musical movement through time. Rhythm is played according to the tempo, but can set the speed according to the frequency of beats played. Within the street grid, the buildings introduce rhythm in their frequency (figure 1.9). In the Second Street District, the buildings are very thin and occur very frequently creating a fast rhythm vs. the outlying buildings which are very large and less

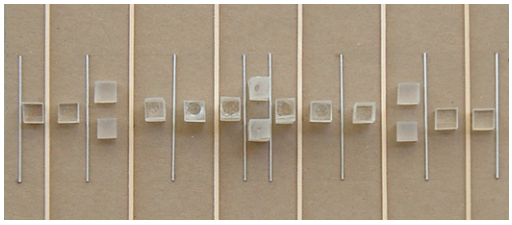


Figure 1.11 - Repetition Model

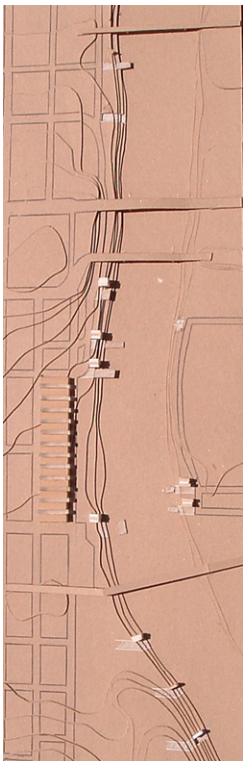


Figure 1.12
Repetition Model,
Nashville

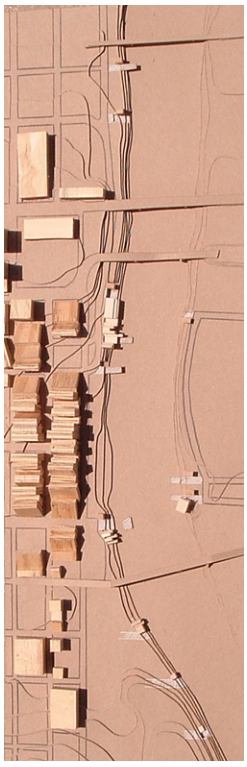


Figure 1.13
Crescendo
Model, Nashville

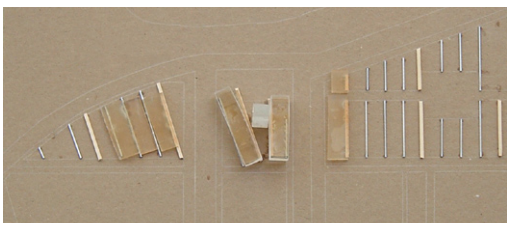


Figure 1.14 - Crescendo Model

frequent.

Repetition

Repetition (figure 1.11) can also be used to describe music. In the city, repetition is achieved by, among other things, building type (figure 1.12). The tall, narrow buildings of the Second Street District create a rhythm that carries throughout the buildings as in the placement of windows.

Crescendo

Finally, the idea of a crescendo is played out in the city (figure 1.13). In music, a crescendo is the gradual increase in the volume or intensity (figure 1.14). In Nashville, this is displayed on Second Street. The increasing rhythm provides opportunities for more activity to take place. The street front is activated by the many different store fronts which attract many people to this area. All

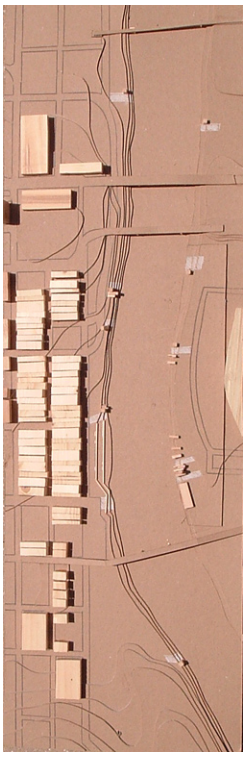


Figure 1.15
Synthesis Model,
Nashville

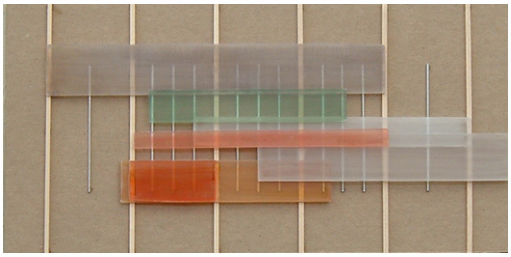


Figure 1.16 - Appalachian Spring
Model

of this activity results in a high energy place which represents this idea of the crescendo.

After looking at the music that was played on the west bank of the river, it was determined that music needed to be created on the east bank (figure 1.15). The lack of context and history proved to be a difficult hurdle in the introduction of music to the east bank. I used Aaron Copland's Appalachian Spring as an inspiration in the development of the East Bank (figure 1.16).

Urban Design

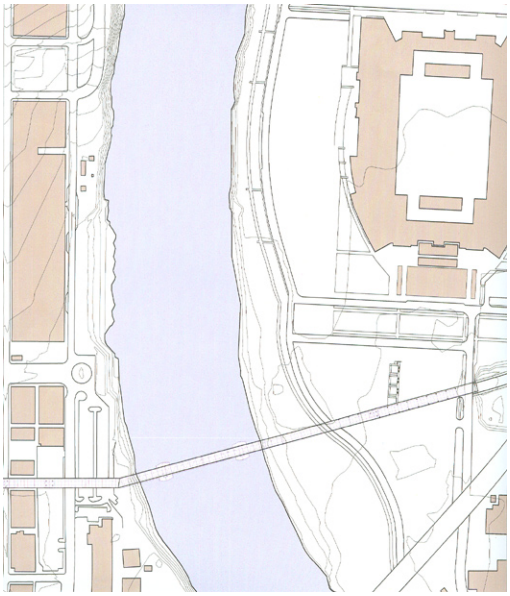


Figure 1.17 - Existing Figure/ Ground

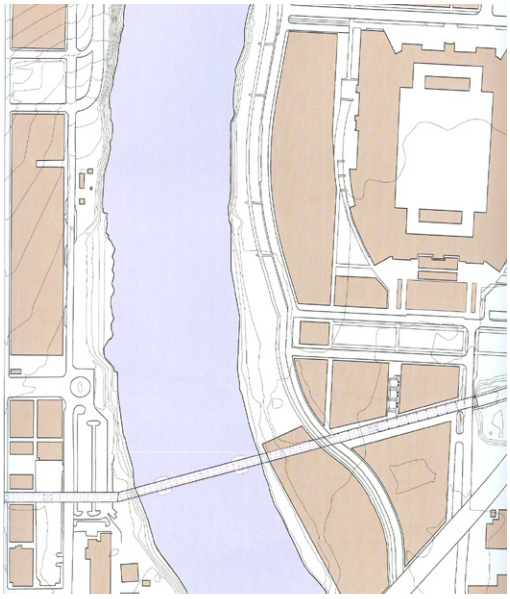


Figure 1.18 - Proposed Figure/ Ground

I began the process with a mixture of logical and instinctive moves that used a combination of the existing clues with a bit of the west bank music to create a new urban design for the east bank.

I examined the existing figure/ground of the site (figure 1.17) and proposed a new infill plan (figure 1.18). I wanted to activate the river edge by replacing the existing parking lots with buildings. This will define a strong edge for the existing greenway and will also allow for an uninterrupted view of the river. The river will remain a public place for all people to enjoy.

There are many existing connections between the west and east sides of the river (figure 1.19). The northernmost connection is created by an axis that starts on the east bank and it carried through to the other side until it ends on

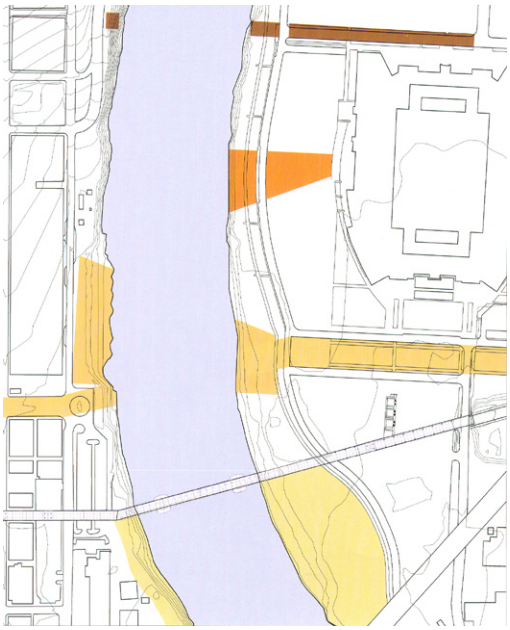


Figure 1.19 - Existing Connections

the west bank. Next, there is an existing volume that is created at the main entrance to the stadium. It is currently created by pavement, and is used as a funnel out of the stadium and a place for people to congregate before and after the game. Since the stadium is only used a few days out of the year, it is necessary to program this space so that it can be used at times other than on game days.

The next connection is created at the level of the water. A large ampitheater on the west bank dialogues with a low area on the east bank. The topography of these sites combined with the reflective qualities of the water sets up an interesting acoustic which defines this space as an outdoor room. It will be important to maintain this connection and to strengthen it on the east bank.

At the level of Broadway, there exists

another strong volume. The axis of Broadway is picked up on the east side of the river by another large tree-lined boulevard. Finally, the pedestrian bridge and another bridge close off a portion of land creating another volume.

I overlapped these existing volumes with the proposed figure/ground in order to emphasize the connections across the river (figure 1.20). The resulting outdoor spaces are used as places for live performances. The harbor was introduced in order to strengthen the lower level relationship to the large ampitheater. The harbor provides a larger space at the sunken level which encourages people to inhabit the space, further strengthen the acoustic room connection.

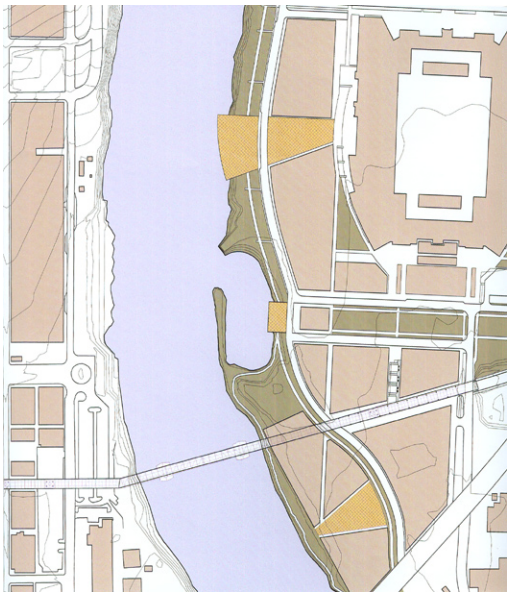


Figure 1.20 - Volume Cuts

Next, I introduced a strict rhythm of buildings which reflected the existing conditions of Second Street. Within

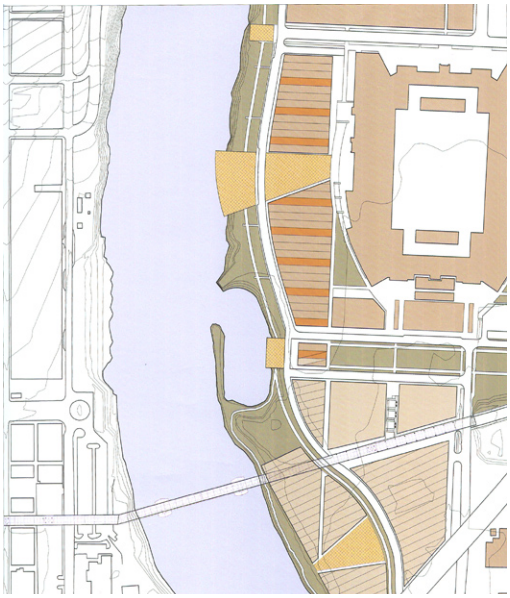


Figure 1.21 - Rhythm and Repetition

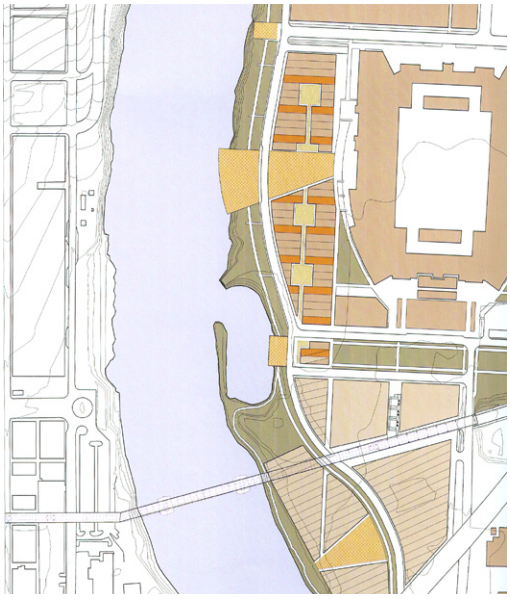


Figure 1.22 - Jam Boxes

this rhythm I introduced a repetition of recording studios (figure 1.21). This followed the original idea of recording studios along the river, but allowed for them to be in closer proximity to the main hub. I also identified part of the urban design as a residential area and part as commercial. It is a prime place to live with a close proximity to downtown and a growing greenway along the river. The residential neighborhoods will help to support the commercial area while the stadium is not in use.

In the residential area, the buildings are re-oriented to face the waterfront. This sets up an interesting design problem where the two orientations meet which This will be discussed later.

Finally, within the block of commercial buildings, I created small outdoor courts (figure 1.22). These courts will be used

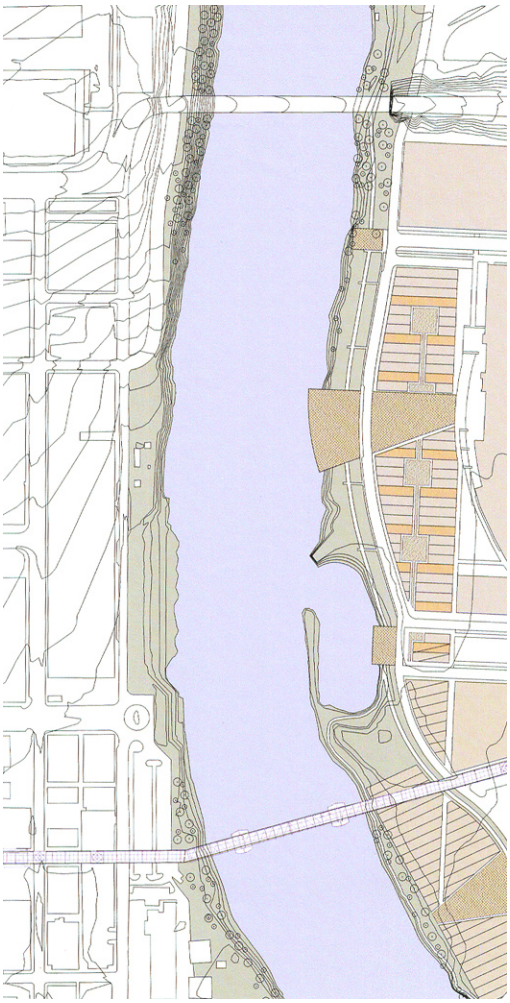


Figure 1.23 - New Urban Design

for intimate interaction between musicians and the public. They provide an informal stage for musicians to create and play music. Each “jam box” is located next to a studio in order to allow for more public interaction with recording. This will be a place for the public to learn more about the process of creating music.

All music is created using the same basic principles such as tempo and rhythm. It is the configuration of these principles and the variations within the rigid guidelines that make music special. In this urban design, many of the moves are structured and seem to make sense, but it is in the disintegration of this logical order that the true music is played and experienced (figure 1.23). The jam boxes and stages become the heart of the music.

Sound Club

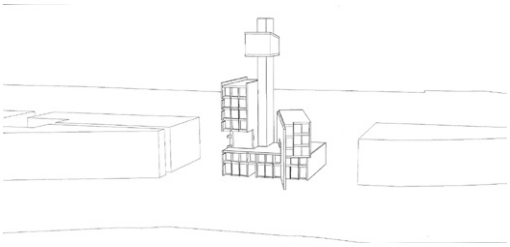


Figure 1.24 - Massing Diagram

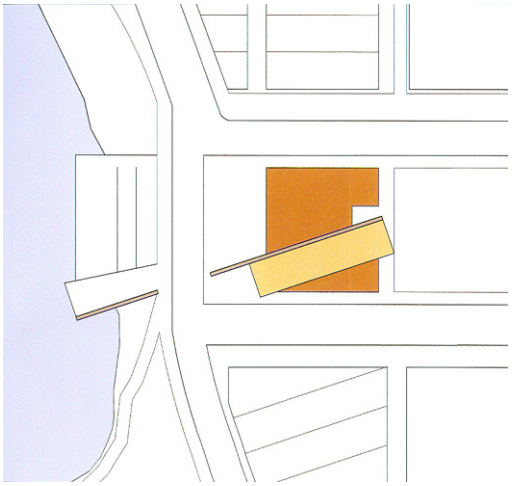


Figure 1.25 - Private/Public



Figure 1.26 - Public Stair

After I completed the urban design, I chose one building to design. This building, located at the intersecting point of the two grids, is a crucial piece of the urban design. This building will react to and inform the urban design. It sets the patterns that will be carried throughout the building of the rest of the urban design.

The building continues the rhythm of the commercial buildings through the load-bearing concrete walls. It begins to set up the twist of the residential orientation in the diagonal wall that runs throughout the project (figure 1.24). This wall responds to music in several ways which will be revealed throughout the entire project. At the ground level, it acts as a buffer between the public commercial space and the private residential space (figure 1.25). A public stair is punched through the wall which leads to another public space on the third level (figure 1.26).

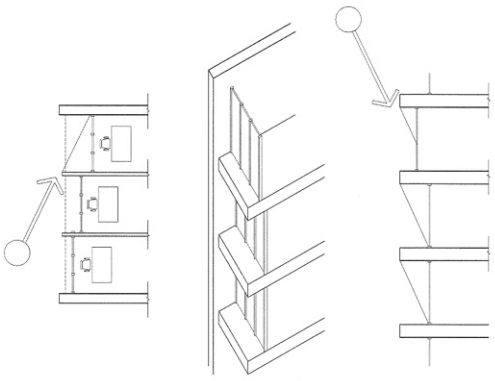


Figure 1.27 - Sun Diagrams

The building also relates to the geographical climate in its response to sun and wind (figure 1.27). The glass of the west facade is set back so that it is shaded during the summer seasons. The eastern sun responds to the lower, rising sun with vertical members that help to shade the glass. The wind typically moves in a southwest to northeast manner. So, the previously mentioned wall allows for the wind to penetrate into the building.

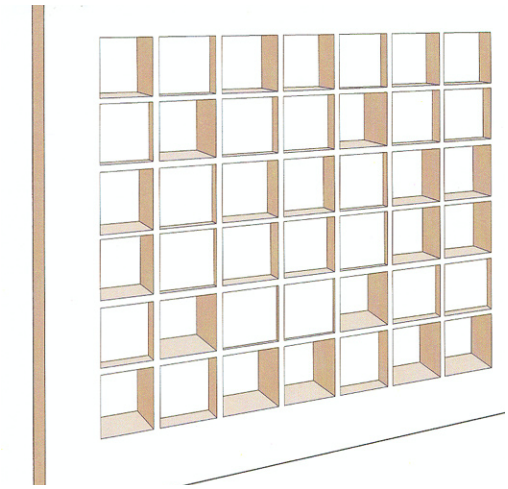


Figure 1.28 - Diffuser

The rhythm of the urban design is also carried out through the facade by extruding load bearing elements and filling in with secondary structure. The western facade also responds to the nearby sound stage. It is modeled after a recording studio diffuser (figure 1.28). These diffusers are located on the rear walls of recording studios. When the sound hits

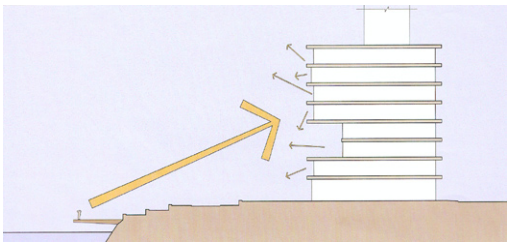


Figure 1.29 - Diffusion of the West Facade

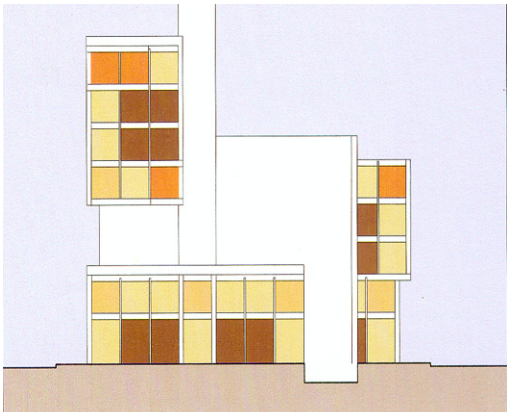


Figure 1.30 - Pattern of the West Facade

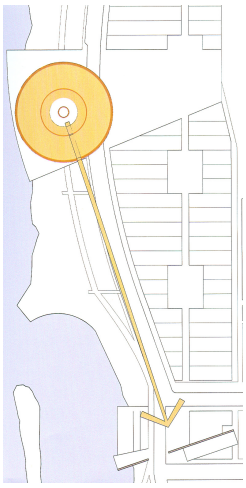


Figure 1.31 - Reflection of the Wall

the rear wall straight on, the diffuser acts as an explosive device sending the sound waves in all directions (figure 1.29). The sound is muffled rather than reflected eliminating an echo. In the same way, the western facade is stepped in and out so that the music from the sound stage is diffused rather than reflected.

Within this function, an orderly system is set up so that the facade has many readings (figure 1.30). It can be interpreted as many single boxes or as groups of boxes. This pattern that is set up allows for special moments in which these boxes actually protrude from the facade. These moments are reserved for special offices and conference rooms.

The diagonal wall also responds to the sound stage at the entrance of the stadium (figure 1.31). It is located in such a way that music traveling from the

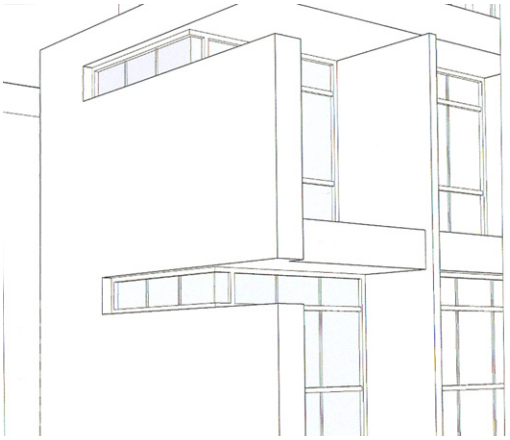


Figure 1.32 - Revealing Windows



Figure 1.33 - Northern Facade Movement

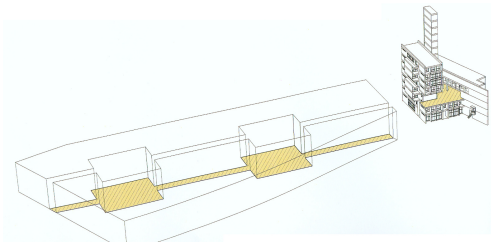


Figure 1.34 - Jam Box Continuation

sound stage is reflected off the wall. This enforces the buffer between the public and private, but also is one of many ways sound is experienced through this wall.

The western facade is carried around the corner to the northern facade by revealing clerestory windows (figure 1.32). The northern facade appears to be cut away to show the undulation of the western glass.

The northern facade starts to push out in certain places (figure 1.33) which sets up the activity that is occurring in the court of the third floor. The cut away on the third and fourth floors is a continuation of the pattern that the jam boxes established. This cutout leads to an elevated jam box on the third floor of the building (figure 1.34). This jam box is used for showcasing bands. The recording studio offices, located in the northern part of the building, can use this outdoor stage area

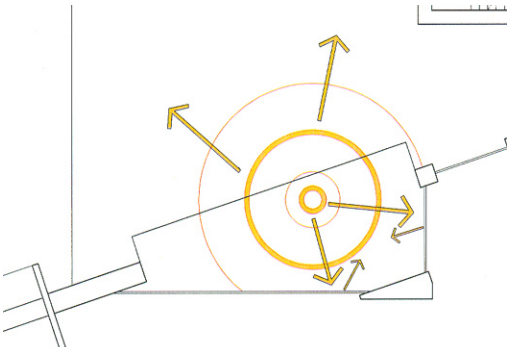


Figure 1.35 - Reflection of the Stage

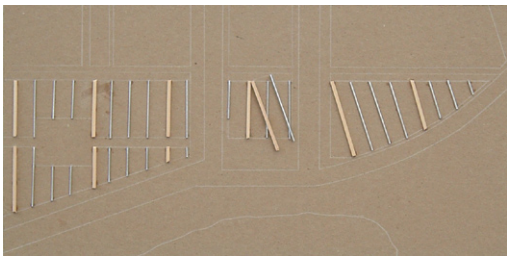


Figure 1.36 - Residential Twist

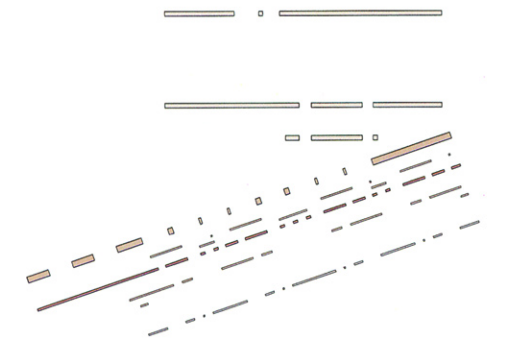


Figure 1.37 - Layering of the Fourth Floor

to showcase the up and coming bands. The stage is located in a cutout of the wall which is another way in which the wall engages music. The cutout is lined with metal and glass materials which provide a very reflective sound (figure 1.35). This loudness is needed in an outdoor space such as this so that a small band can be heard.

Behind the stage is an indoor banquet room that can be used in conjunction with the showcase. This part of the building is twisted to match the diagonal wall. This begins to set the pattern for the residential part of the urban design (figure 1.36).

The wall begins to open up on the fourth floor (figure 1.37). There is a rhythm carried out through the wall as defined by the structure, but in places it is opened up to reveal a complexity of layers beyond. It is similar to the jam boxes in that it

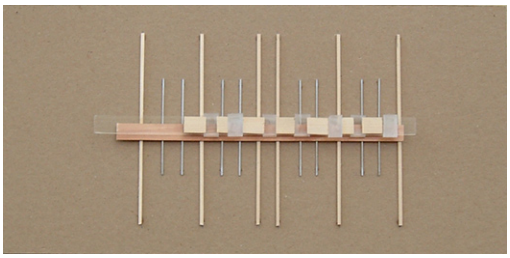


Figure 1.38 - Hallway Elevation

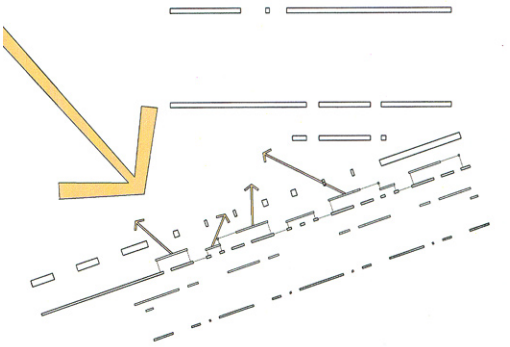


Figure 1.39 - Diffusing Wall

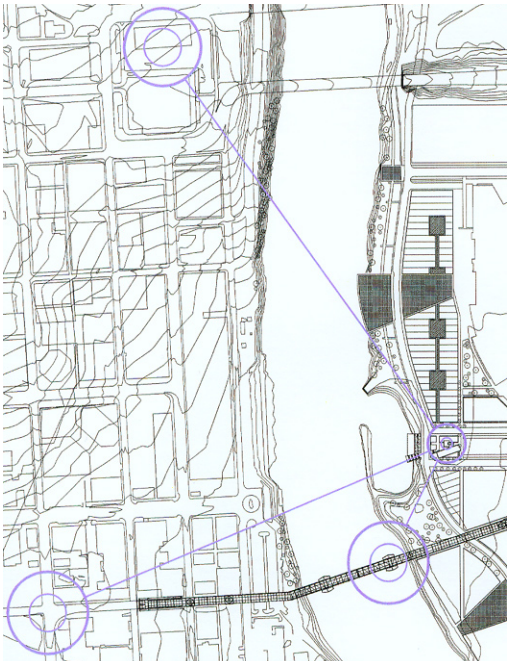


Figure 1.40 - Tower Vignettes

starts to reveal what is at the heart of this building. The layers show through the wall in their different materials of wood, glass and concrete (figure 1.38). The overlapping of layers and ordering systems start to create music by allowing certain layers to pop to the foreground while other layers slide to the back. The thick and jagged layers also create another form of a diffuser and muffle the noise of the bands below (figure 1.39).

Finally the crescendo is reached in the tower. The tower houses a recording studio to complete the repetition throughout the urban design. Small vignettes of the city are framed by the windows in the stair tower (figure 1.40). Once the top is reached, there are amazing views of Nashville and back to the urban design.

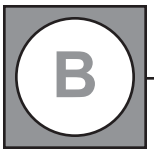
8 Epilogue

Throughout this process I struggled to quantify music. I saw it as a code that could be defined as an equation. Once that was done, it would be simple to apply this equation to architecture. Music is much more complex than that. Although all songs use similar ordering systems, special moments are created in each song. A certain arrangement of notes at a certain rhythm can create emotions welling up inside. But, that is not something that works every time like a mathematical equation. Sometimes notes just sound right, and sometimes the best songs are discovered by accident.

The same is true for architecture. There are many different factors that flow into the generation of form. There are site conditions, contextual issues, and programming concerns to name a few. In using music as an ordering system and a formula, I found that there are times when

it is necessary to break the rules, and sometimes design happens by accident.

Music can be a generator and an influence on design, but it is not an answer to all of the questions. I have gained a great respect for musicians that can reach those emotions deep within us, and an even greater respect for architects that can do the same.



Bibliography

Architectural Acoustics

Egan, M. David. Architectural acoustics. New York : McGraw-Hill, c1988.

Forsyth, Michael. Auditoria : designing for the performing arts. New York : Van Nostrand Reinhold, 1987.

Forsyth, Michael. Buildings for music : the architect, the musician, and the listener from the seventeenth century to the present day. Cambridge, Mass. : MIT Press, 1985.

Lawrence, Anita. Acoustics and the built environment. London ; New York : Elsevier Science Pub. Co, 1989.

Leitner, Bernhard. Sound, Space. Ostfildern : Cantz, c1998.

Musical Acoustics

Acoustics : architecture, engineering, the environment. San Francisco: William Stout Publishers, 1998.

Culver. Musical Acoustics. McGraw-Hill, 1956.

Nisbett, Alec. The technique of the sound studio : for radio, recording studio, television and film. London : Focal Press ; New York : Focal/Hastings House, 1979.

Porges, G. Applied acoustics. New York : Wiley, 1977.

Riedel, Scott R., Acoustics in the worship space. St. Louis : Concordia Pub. House, 1986.

Rossing. The Science of Sound. Addison-Wesley, 1982.

Architecture

Alberti, Leon Battista, 1404-1472. Ten books on architecture. New York, Transatlantic arts, 1966.

Nietzsche, Friedrich Wilhelm, 1844-1900. The birth of tragedy, and The case of Wagner. New York, Vintage Books, 1967.

Padovan, Richard. Proportion. London: E&FN Spon, 1999.

Vitruvius Pollio. Vitruvius : ten books of architecture. New York: Cambridge University Press, 1999.

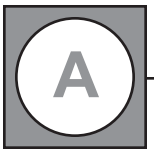
Wittkower, Rudolf. Architectural Principles in the Age of Humanism. London: Academy Additions, 1988.

Music

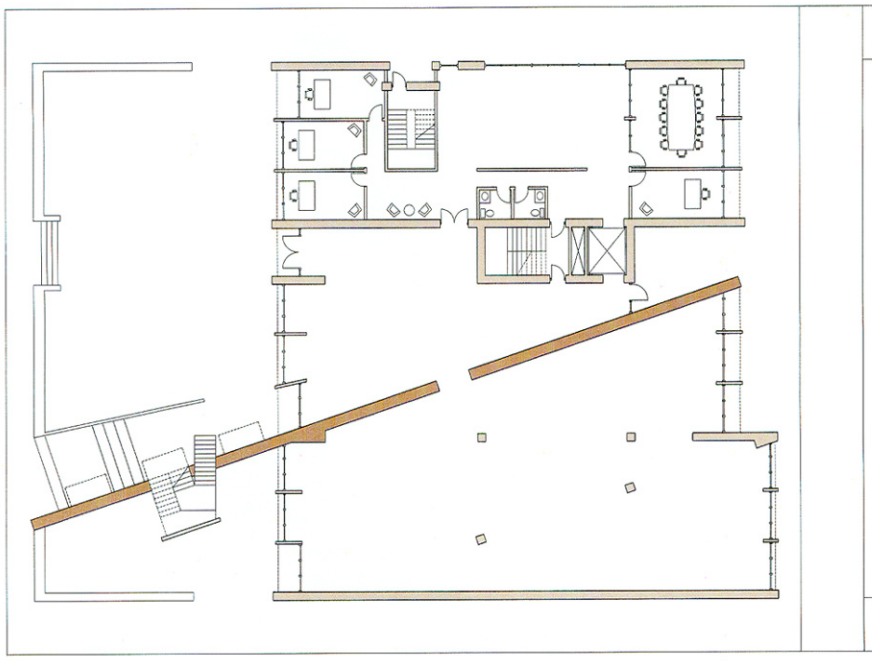
Scruton, Roger. The Aesthetics of Music. Oxford: Clarendon Press, 1997.

Shaw-Miller, Simon. Visible Deeds of Music – Art and Music from Wagner to Cage. New Haven: Yale University, 2002.

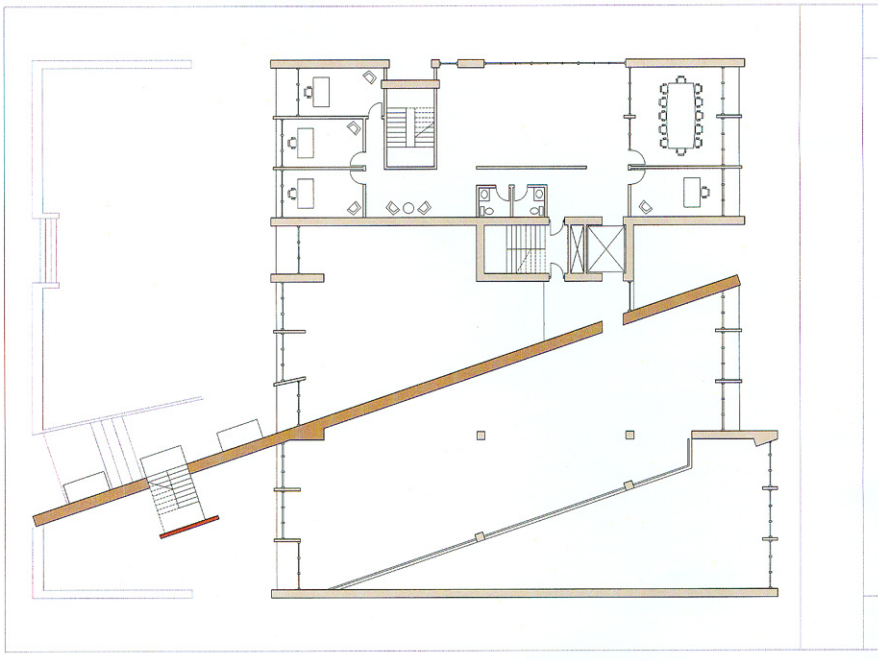
Thompson, Emily. The Soundscape of Modernity. Cambridge, Massachusetts: The MIT Press, 2002.



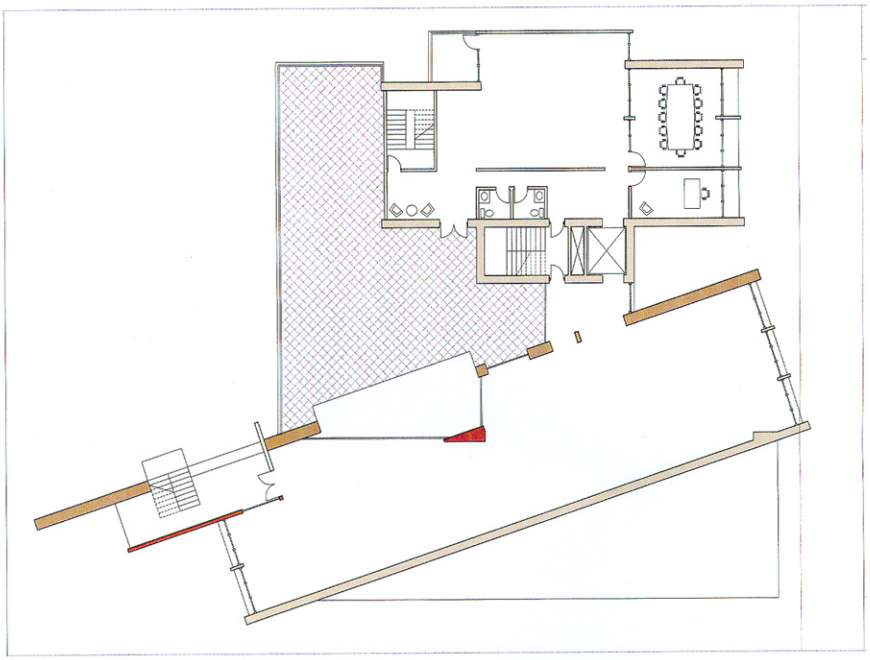
Appendix



First Floor Plan



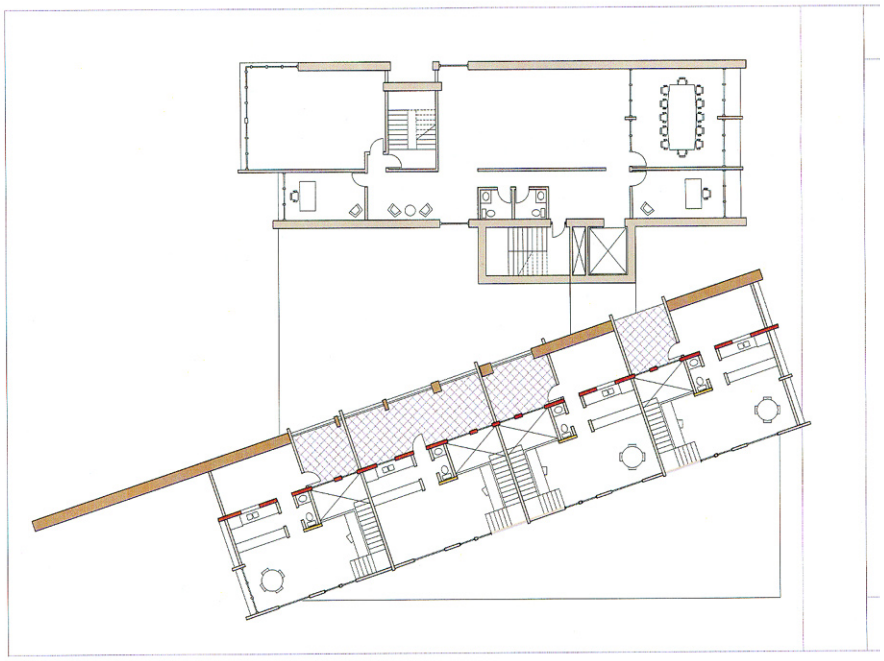
Second Floor Plan



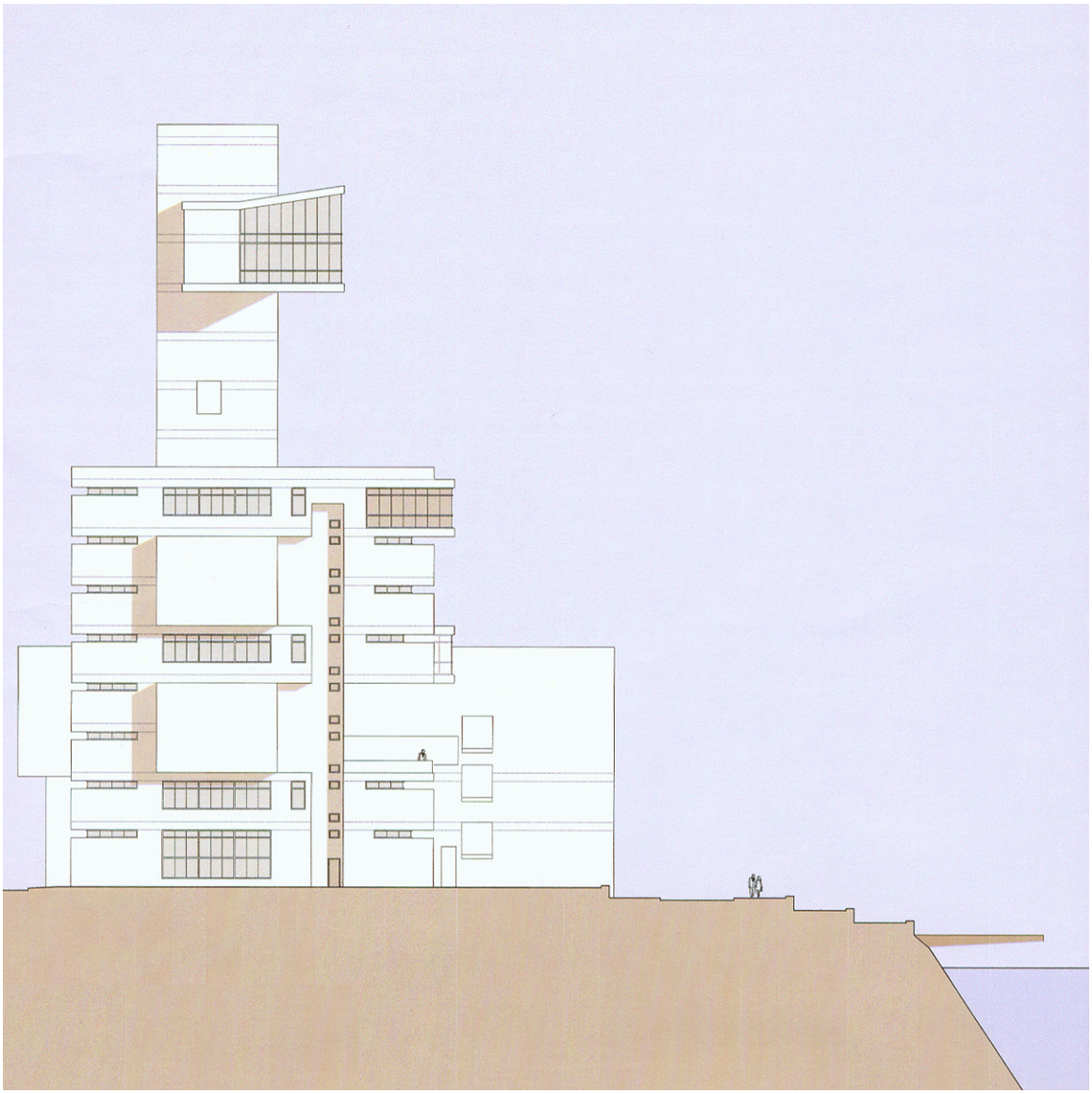
Third Floor Plan



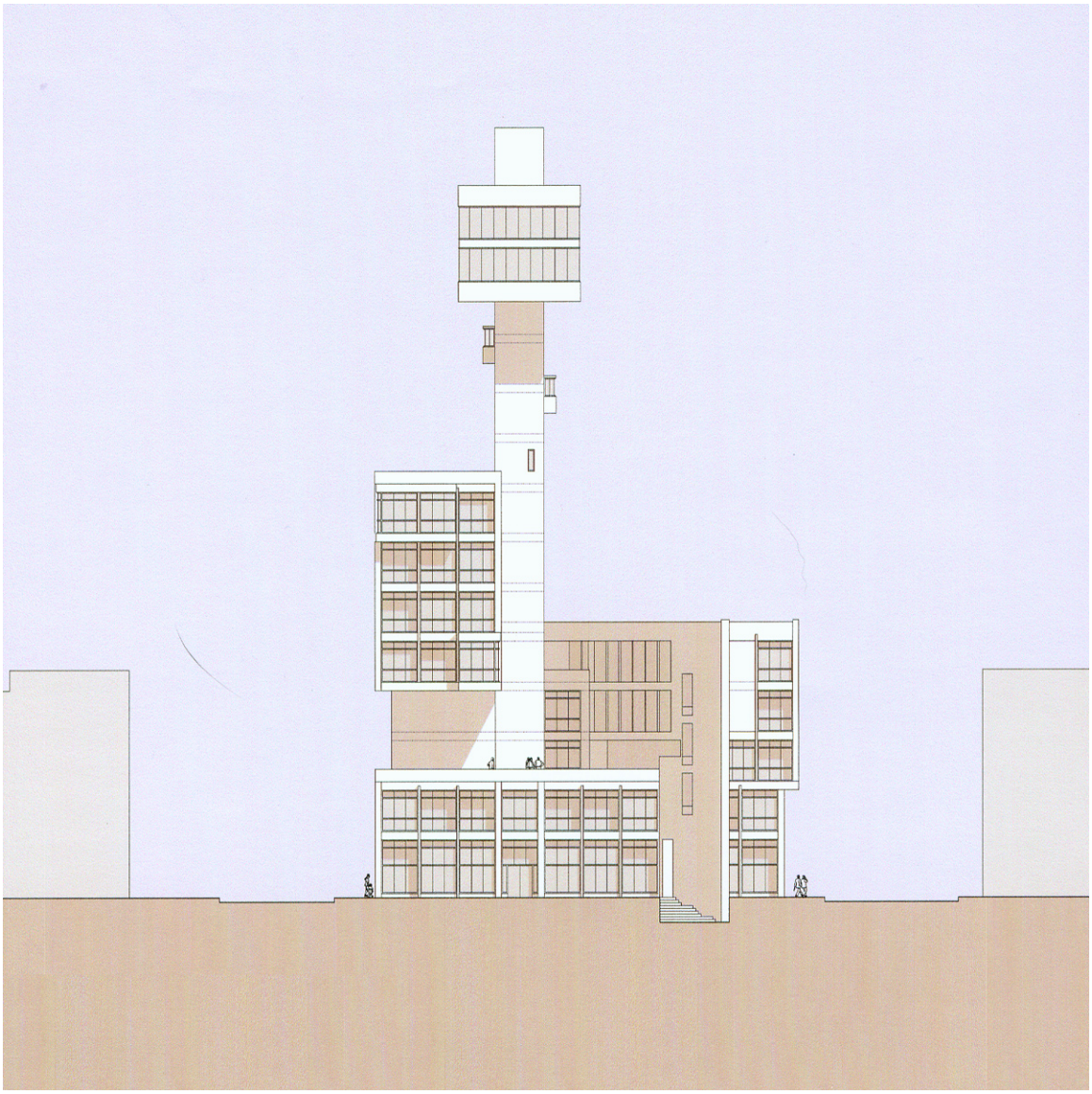
Fourth Floor Plan



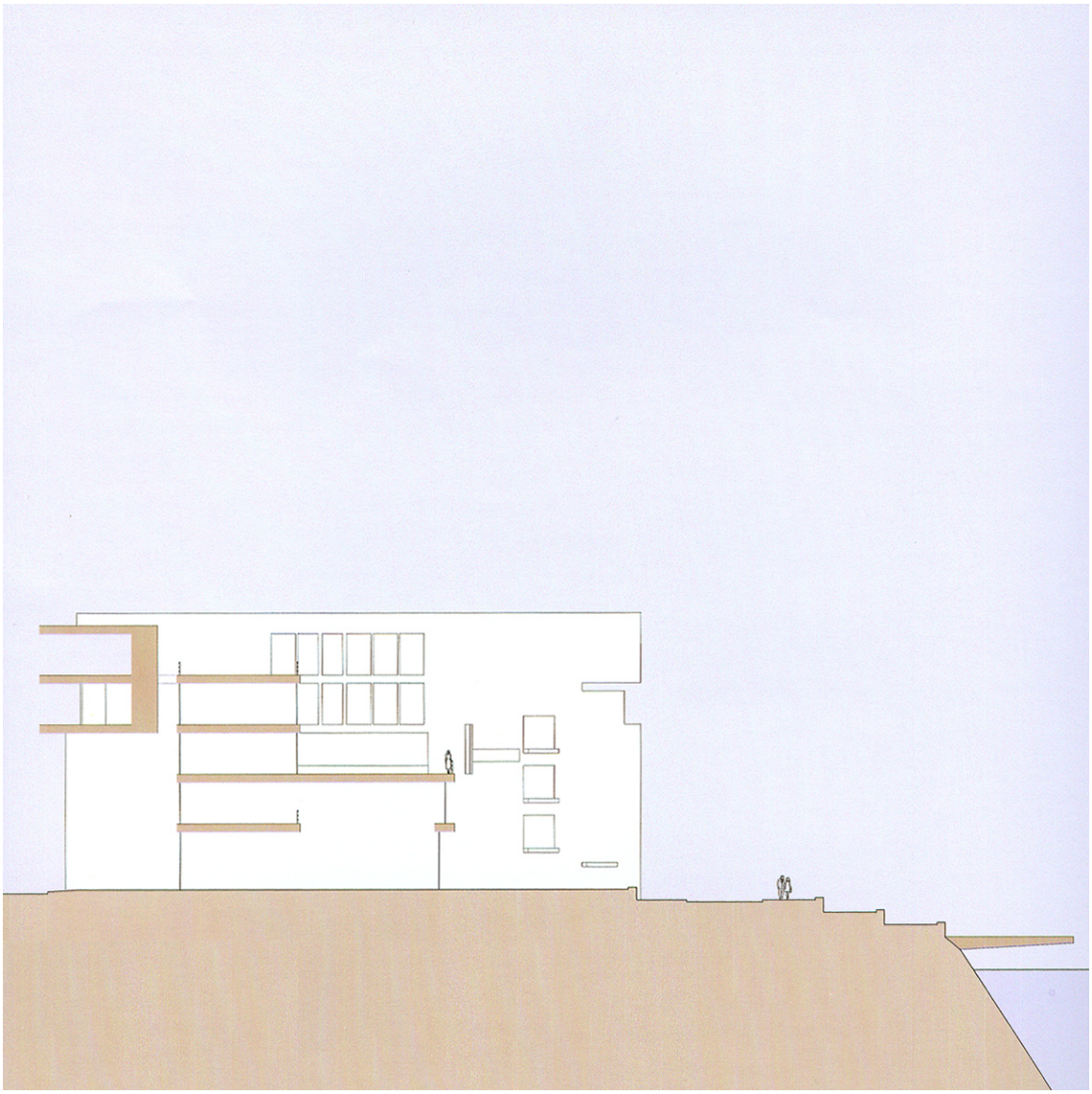
Fifth Floor Plan



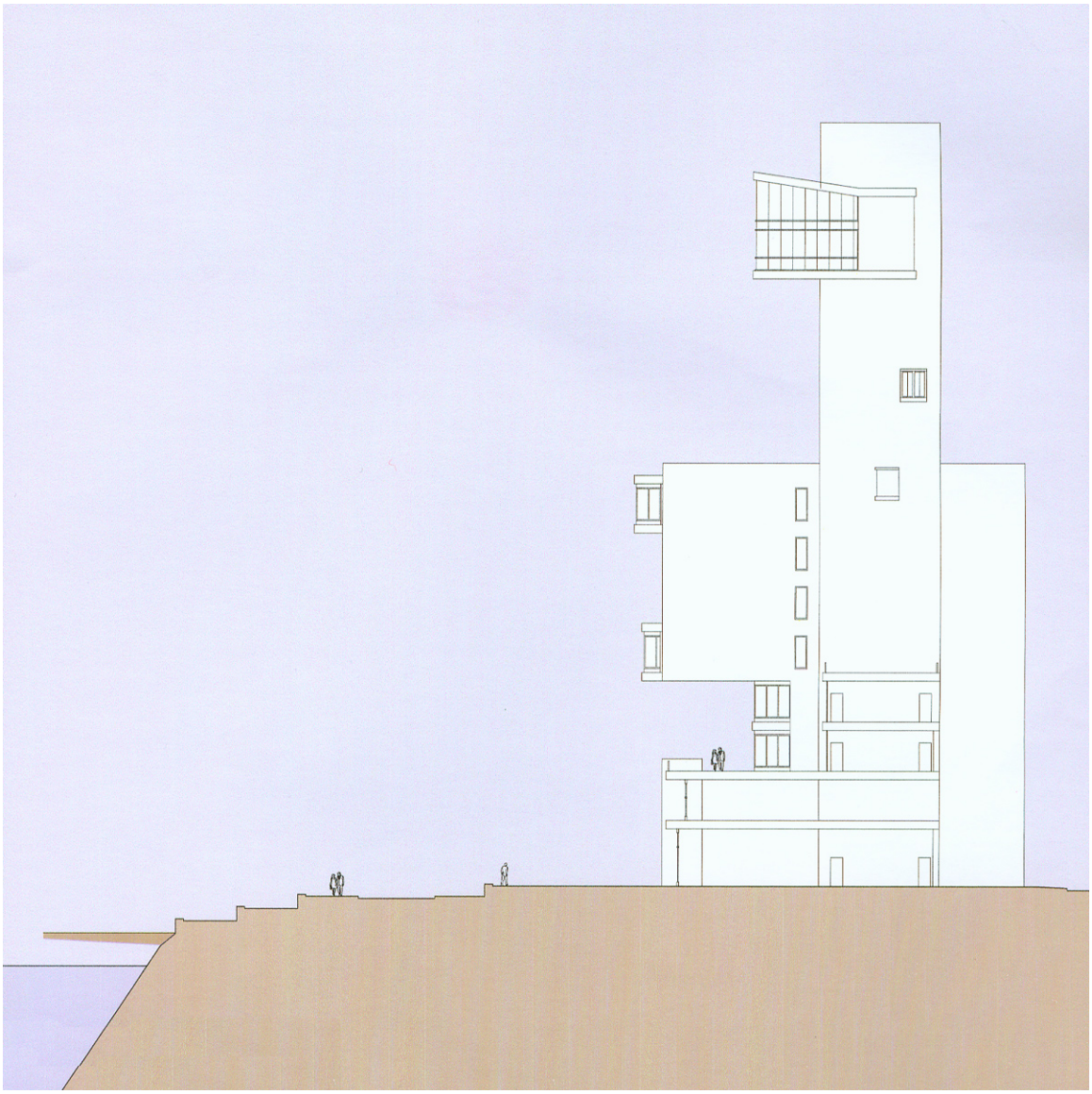
North Elevation



West Elevation



Interior North Elevation



Interior South Elevation

Vita

Alyson was born in Akron, Ohio on July 17,1978. She found her love for architecture in the 8th grade while touring open houses on Sunday afternoons with her family. She attended Revere High School and began to pursue her architectural education through a series of architectural courses. She graduated from high school in 1996 and attended Miami University in Oxford, Ohio. She received a Bachelor of Arts in Architecture degree in May 2000. She pursued her professional career for two years before returning to school at the University of Tennessee. From this program, she received a Master of Architecture degree in August 2004.