

# **A Quest on the Relationships between Music and Architecture**

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## ABSTRACT

Our environment is formed with the effects of physical, social and cultural factors. One of the manifestations about this formation is our architectural setting at the cross section of art, science and technology. Scientific and technological developments are resulted with the advanced construction techniques, improved design strategies and representation methods. On the other hand, these changes, which are under the impacts of modern movement, also raised the triumph of eye over ear. Visibility and visual perception become the first and utmost concern for the contemporary architects, though sound and its effects fade in the realm of architecture. However, perception and sense of space and understanding of architecture cannot be restricted merely with the features of visual perception. The trace of sound, and especially music, can feed into visual and physical aspects of architecture. In this regard, the present study aims to focus on the interrelations between music and architecture.

The study puts forward an overview about interaction between music and architecture. Music and architecture are considered as art as well as being certain art fields closely related with science and technology. Music and architecture are concerned with their common communication, expression, and interaction tools and mediums through history. In a narrower scrutiny, the study reviews general similarities and differences between music and architecture to provide the needed background to the study. At last but not least, the study presents certain architectural examples to illustrate different modes of using musical images, principles and concepts in architectural design. In this respect, the study is considered as an endeavor indicating potentials of music caused new ways of understanding and approaches in the field of architecture.

**Keywords:** Architecture, Music, Art, Creativity, Organization, Communication

## ÖZ

Çevremiz fiziksel, sosyal ve kültürel faktörlerin etkisi ile oluşur. Bu faktörlerin manifestolarından biri olan mimari, sanat, bilim ve teknolojinin kesişiminde yer alır. Bilimsel ve teknolojik gelişmeler, yapım tekniklerinin gelişmesine neden olurken bir yandan da farklı tasarım stratejileri ve sunum metotlarının geliştirilmiş olmasına neden olmuştur. Öte yandan, modernleşme sürecinin etkisinde ortaya çıkan bu değişiklikler görseli algılayan gözün işitseli algılayan kulağa karşı zaferine neden olmuştur. Görünürlüğün ve görsel algının önem kazandığı ve yüceltildiği dönemde, işitsellik ve ses ile ilgili etkiler, çağdaş mimarlar için çok geri planda kalmıştır. Halbuki, mekan hissi ve algısı ve mimari anlayış sadece görsel algılama ile sınırlandırılmaz. Ses, özellikle müzik, mimariyi, görsel ve fiziksel özelliklerinin zenginleştirilmesinde besleyebilmelidir. Bu bağlamda, söz konusu tez çalışması bu durum üzerinde durur ve mimari ile müzik arasındaki etkileşimi inceler.

Tez, mimari ile müzik arasındaki ilişkiyi genel bir bakış ile gözden geçirir. Müzik ve mimarinin, birer sanat dalı olduklarını kabul ederken, aynı zamanda, bilim ve teknoloji ile güçlü ilişkileri üzerinde durur. Tarihsel süreç içerisinde, mimari ve müzik, ortak iletişim, anlatım ve etkileşim araç ve ortamlarını ele alır ve örneklerle anlatır. Daha daraltılmış bir bakış açısı ile, mimari ve müzik arasındaki genel benzerlik ve farklılıkları, çalışma için gerekli arka plan bilgisini sağlamak için değerlendirir. Çalışmanın son bölümünde de, müziksel imgeler, ilkeler ve kavramlar göz önünde tutularak geliştirilmiş olan mimari tasarım ve anlayışları üzerinde durur. Seçilmiş olan mimari projeler ile, müziğin mimari tasarım üzerindeki etkileri örneklenip tartışılır.

**Anahtar Kelimeler:** Mimarlık, Müzik, Sanat, Yaratıcılık, Organizasyon, İletişim

The thesis is honorably dedicated to my lovely family.

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# LIST OF CONTENTS

|   |     |
|---|-----|
| ABSTRACT.....   | iii |
| ÖZ .....  | iv  |
| ACKNOWLEDGMENTS .....   | vi  |
| LIST OF CONTENTS .....  | vii |
| LIST OF TABLES.....   | ix  |
| LIST OF FIGURES.....  | x   |
| 1 INTRODUCTION .....  | 1   |
| 1.1    Background of the Study .....                                | 2   |
| 1.2    Research Problem .....                                       | 6   |
| 1.3    Aim of the Study.....  | 7   |
| 1.4    Methodology.....   | 8   |
| 2 A THEORETICAL OVERVIEW ON MUSIC AND ARCHITECTURE.....             | 9   |
| 2.1    Architecture and Music as Art .....                          | 10  |
| 2.2    Music and Architecture as Tools of Communication.....        | 14  |
| 2.2.1    Sacred and Monumentality.....                              | 17  |
| 2.2.2    Folk and Vernacular.....                                   | 19  |
| 2.2.3    Religion and Belief System.....                            | 21  |
| 2.2.4    Function and Theme .....                                   | 22  |
| 2.3    Intersection of Music and Architecture through History ..... | 23  |
| 2.3.1    Sound Nature and Theater in Ancient Times.....             | 24  |
| 2.3.2    Chores and Churches in Middle Ages .....                   | 25  |
| 2.3.3    Harmonic Proportion in Renaissance Times .....             | 27  |
| 2.3.4    Tonality Range and Ornament in Baroque Times .....         | 28  |
| 2.3.5    Technological Production Tools in Modern Times.....        | 29  |

|  |    |
|--|----|
| 3 THE COMMONALITIES AND DIFFERENCES BETWEEN MUSIC AND ARCHITECTURE ..... | 33 |
| 3.1 Architecture as Frozen Music .....                                   | 34 |
| 3.1.1 Space and Time .....   | 35 |
| 3.1.2 Visual and Aural World .....                                       | 38 |
| 3.1.3 Shape and Form.....  | 41 |
| 3.2 Audible and Visible Wave.....  | 43 |
| 3.2.1 Sound and Light as Two Waves.....                                  | 43 |
| 3.2.2 Sound Wave & Environment.....                                      | 47 |
| 3.3 Effects of Mathematics on Music and Architecture.....                | 51 |
| 3.3.1 Numeric Orders .....   | 51 |
| 3.3.2 Proportion and Interval.....                                       | 54 |
| 3.3.3 Rhythm and Sequence .....  | 61 |
| 4 ARCHITECTURE BASED ON MUSIC .....                                      | 65 |
| 4.1 Architecture based on Musical Image .....                            | 66 |
| 4.1.1 Musical Image in Urban Scale .....                                 | 67 |
| 4.1.2 Musical Image in Building Scale .....                              | 70 |
| 4.1.3 Musical Image in Components of Space .....                         | 72 |
| 4.2 Architecture Based on Musical Principle .....                        | 74 |
| 4.2.1 Sound Orders in Architecture .....                                 | 75 |
| 4.2.2 Noise Disorders in Architecture .....                              | 79 |
| 4.3 Architecture based on Musical Concept .....                          | 81 |
| 4.3.1 Indirect Use of Musical Concept.....                               | 81 |
| 4.3.2 Direct use of Musical Concept .....                                | 84 |
| 5 CONCLUSION .....   | 89 |
| REFERENCES.....  | 94 |



## LIST OF TABLES

|   |    |
|---|----|
| Table 1: Interrelation of Music and Architecture in Different Eras .....    | 32 |
| Table 2: Commonalities and Differences in Mutual Theoretical Concepts ..... | 64 |
| Table 3: Criteria of each Architecture Designed based on Music .....        | 88 |
| Table 4: Theoretical Overview .....   | 90 |
| Table 5: Commonalities and Differences .....                                | 91 |
| Table 6: Architecture based on Music .....                                  | 92 |

## LIST OF FIGURES

|  |    |
|--|----|
| Figure 1: Architectural Totality .....                                     | 2  |
| Figure 2: Three Marys .....  | 4  |
| Figure 3: Milan Cathedral, Italy.....                                      | 4  |
| Figure 4: Piet Mondrian, Composition with Red, Yellow and Blue .....       | 4  |
| Figure 5: Schroder House, Gerrit Thomas Rietveld 1924 .....                | 4  |
| Figure 6: German Pavilion, Barcelona Exposition of 1929 .....              | 4  |
| Figure 7: Music and Architecture as Two Arts .....                         | 5  |
| Figure 8: Imitation .....  | 13 |
| Figure 9: Egyptian Pyramids as Monumental Structure .....                  | 18 |
| Figure 10: Epidaurus Theater in Greece (Stone Theater) .....               | 25 |
| Figure 11: Milan Cathedral, Italy .....                                    | 26 |
| Figure 12: Santa Maria Novella Church, Alberti, 1456, Florence, Italy..... | 28 |
| Figure 13: Pannini, Giovanni Paolo .....                                   | 29 |
| Figure 14: Wave Perception Requirements.....                               | 44 |
| Figure 15: Different Sound Timber .....                                    | 45 |
| Figure 16: Music Studio.....   | 46 |
| Figure 17: Signal of Sound and Its Envelope Marked with Red.....           | 48 |
| Figure 18: Interpretation of a Mountain as a Musical Notes .....           | 48 |
| Figure 19: New York City and its Silhouette .....                          | 49 |
| Figure 20: Toronto and its Silhouette.....                                 | 50 |
| Figure 21: The Cologne Cathedral, Koln, Germany and its Musical Line ..... | 50 |
| Figure 22: The Three Sequence System .....                                 | 53 |
| Figure 23: The Music of the Night Notes .....                              | 53 |

|   |    |
|---|----|
| Figure 24: Arithmetic Sequence in Architecture .....                            | 53 |
| Figure 25: Note Graph of Opening Two Measures of “The Music of the Night” ..... | 53 |
| Figure 26: Blondel’s Scheme of Eight Consonant Musical Interval.....            | 55 |
| Figure 27: Musical Ratio Overlaid on Bernini’s Design .....                     | 55 |
| Figure 28: A Room with Musical Ratios.....                                      | 55 |
| Figure 29: Musical Dissonance! .....  | 56 |
| Figure 30: Breaking Dissonance in Architecture .....                            | 56 |
| Figure 31: Golden Section Ratio in Line .....                                   | 57 |
| Figure 32: Golden Section Ratio in Rectangle .....                              | 57 |
| Figure 33: Doryphorus by Polyclitus .....                                       | 58 |
| Figure 34: Venus the Milo .....   | 58 |
| Figure 35: St. Peter Building .....   | 59 |
| Figure 36: Egyptian Pyramid .....   | 59 |
| Figure 37: The Parthenon .....  | 59 |
| Figure 38: Fibonacci Sequence in Architecture .....                             | 59 |
| Figure 39: Marseille Housing Project .....                                      | 60 |
| Figure 40: Le Corbusier, the Modular Man, 1946 .....                            | 60 |
| Figure 41: Rhythm in the Façade of Buildings .....                              | 62 |
| Figure 42: Richard Meier 1995 .....   | 66 |
| Figure 43: Grand Piano, Daniel Libeskind, 2003 .....                            | 66 |
| Figure 44: Bloch City, Cook, 1983, Master Plan .....                            | 67 |
| Figure 45: Jerusalem Chords Bridge in city of Petach-Tikva, Israel .....        | 68 |
| Figure 46: Alamillo Bridge in Seville, Andalusia, Spain, 1992.....              | 69 |
| Figure 47: Egyptian Wall Painting, Harp, 15 BC .....                            | 69 |
| Figure 48: “The Lute” Bridge Santiago Calatrava, Northernland .....             | 69 |

|   |    |
|---|----|
| Figure 49: Piano House .....  | 70 |
| Figure 50: Walt Disney, Gehry, Model.....                             | 70 |
| Figure 51: Walt Disney, Gehry .....                                   | 70 |
| Figure 52: Kilden Performing Arts Center by ALA Architects.....       | 71 |
| Figure 53: Swimming Pool .....  | 72 |
| Figure 54: Piano Stairs before and after Changes.....                 | 73 |
| Figure 55: The Secret ‘Contrabajo Mueble Bar’ .....                   | 74 |
| Figure 56: Furniture with Figures of Musical Instrument.....          | 74 |
| Figure 57: Freeway, Sculpture .....                                   | 75 |
| Figure 58: La Tourette, Proposal Concept .....                        | 76 |
| Figure 59: Two Distinctive Parts of Building .....                    | 76 |
| Figure 60: La Tourette Building.....                                  | 76 |
| Figure 61: Façade Drawing & Interior Illumination.....                | 76 |
| Figure 62: Chandigarh Undulating Glass .....                          | 77 |
| Figure 63: Marseille Housing Project .....                            | 78 |
| Figure 64: Chamber Works, Daniel Libeskind, 1983 .....                | 79 |
| Figure 65: The Jewish Museum Windows .....                            | 80 |
| Figure 66: Drawing of Museum as a Chamber Work .....                  | 80 |
| Figure 67: Stretto house, Steven Holl, 1989-1991.....                 | 81 |
| Figure 68: Stretto House Site plan .....                              | 82 |
| Figure 69: Spatial Dam, Aqueous Space .....                           | 82 |
| Figure 70: Stretto House Timpani Interpretation (Spatial Dam).....    | 82 |
| Figure 71: Stretto house Timpani Interpretation (Aqueous Space) ..... | 82 |
| Figure 72: Spaces with Golden Section Ratio .....                     | 83 |
| Figure 73: Golden Section in Organization .....                       | 83 |

|   |    |
|---|----|
| Figure 74: Performance of Polytope de Cluny .....                     | 85 |
| Figure 75: Xenakis Diatope, 1978, Sound and Light .....               | 85 |
| Figure 76: Xenakis Laser in Polytope de Cluny .....                   | 85 |
| Figure 77: Metastaseis (Glissandi) in Combining Wall and Ceiling..... | 87 |
| Figure 78: The Philips Pavilion, Le Corbusier/Xenakis .....           | 87 |
| Figure 79: Diatope Structure & Building .....                         | 87 |
| Figure 80: Sample of Diatope Performance .....                        | 87 |
| Figure 81: Light Flashes on Suspended Cables .....                    | 87 |

# **Chapter 1**

## **INTRODUCTION**

Architecture having complicated characteristics can be said to have roots in various concepts while always being mentioned as a field of art. Hence architects via creativity are able to have more productive forms by utilizing different facilities. This is the reason why architecture and several types of art are interrelated completely. Accordingly, music as a field of art is one of those types having certain impacts on architecture. In this respect, after a brief look on the relation of arts and architecture, the discussion in this chapter focused on the importance of musical perception of architecture, following by the aim and structure of the whole investigation.

## 1.1 Background of the Study

As Vitruvius, the first architectural theoretician, says in his books: “Architects should serve people”. Throughout the centuries, architecture, as one of the oldest professions, has provided the needs of human beings with the act of space creation (Vitruvius, 1999). Therefore, architecture that usually was called as the ‘art of creating space’ became a solution for people’s need of spaces with various concerns; including aesthetic, static, financial, function, climatic issues. Over the time, advanced building materials techniques and design, living conditions, and several other socio-economic parameters that an architect ought to be responsible for, have been changed and improved, causing architecture to become more complex and complicated than ever. However, the three everlasting factors which were pointed out firstly by Vitruvius, and followed by subsequent theoreticians, are still valid and define the nature of design in the field of architecture (Schulz, 2000). The first constituent of architectural totality proposed by Vitruvius, in his ‘Ten Books on Architecture’ is that *utilitas* focuses on function and purpose that a building is erecting for, while *firmitas* concerns about material and execution, and *venustas* deals with the aesthetic task of creation through order, proportion, ornament and etc. (Schulz, 1965). These three concepts, like every other term, are enhanced, complicated and also been renamed as functional, technical, and aesthetic aspects. Apart from the function concerned with the purpose of any buildings constructed for, improvement of science resulted in technology in the realm of architecture, therefore the three important factors can also be regarded as art, science and technology (Fig. 1).

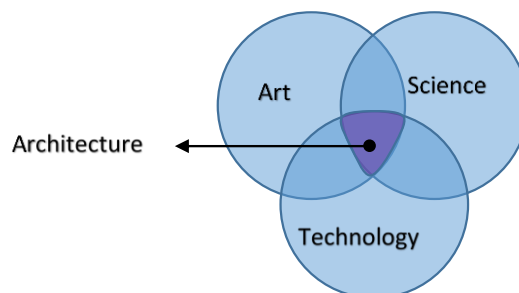


Figure 1: Architectural Totality (Author)

With this nature, architecture is closely related to art, science and technology, and is considered as the intersection point of these concepts. Science, as a comprehensive and influential term, is mostly related to the engineering part in contemporary architecture. Technology, which can be considered as the child of science, brings new materials, architectural elements, and also design and production processing equipment to the architecture. And lastly, art, as another influential and significant constitution of architecture, concerns about aesthetic and formal pleasantness rooted in proportion, formal composition, shapes, geometry and etcetera. Architecture then is carrying the characteristics belonging to three overlapped, influential and interrelated concepts of art, science, and technology.

In addition to the inseparable significant concepts in the realm of architecture, architects use artistic strategies even in technical and scientific issues. From this point of view, artistic actions in architecture play a crucial role in architectural products. Accordingly, although there can be different inspiration sources for artists, the same root of artistic inhale and inspiration such as philosophy and theory can be seen in different branches of art. And with a glimpse over the history the consequences of the interrelation between arts becomes clear. As an instance, in the Middle Ages, people rejected Greek naturalism and lost their believe in the nature and God's creatures; everything should be begged from God. This social belief is manifested by spiritual tendency of sculpture (Fig. 2) and resulted in having upward, vertical trend in geometrical forms of buildings in the architectural realm such as the Milan Cathedral (Fig. 3) (Gelernter, 1995).





Figure 2: Three Marys  
(URL 1)



Figure 3: Milan Cathedral, Italy  
(URL 2)

Not only the trace of interrelation between arts is vividly visible through the old history, it can be noticed that in Modern time, purifying the artistic product into fundamental elements interrelated to both painting and architecture has resulted in International Style. Piet Mondrian and a Dutch architect, Gerrit Thomas Rietveld, used pure form, color, geometry, and shape in their artistic production. This trend could be achieved by a new look through architecture and breaking the composition of the box into panels, drawing a code for modern architecture (Zevi, 1994 p.31). Mies van der Rohe perhaps is the most outstanding exponent of this approach, especially with his design of German Pavilion at the Barcelona Exposition (Zevi, 1994 p.35).

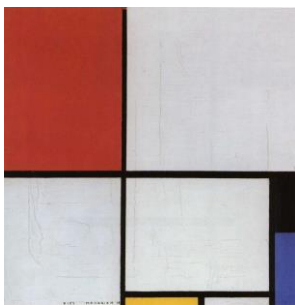


Figure 4: Piet Mondrian,  
Composition with Red,  
Yellow and Blue (URL 3)



Figure 5: Schroder House,  
Gerrit Thomas Rietveld 1924  
(URL 4)



Figure 6: German Pavilion,  
Barcelona Exposition of 1929  
(URL 5)

Music is one of the significant types of art. Arthur Schopenhauer, a German philosopher, believes that the highest level of art belongs to music since every art goes through the abstract that music has a good place in. Apart from Schopenhauer, Walter Pater has stated: "All art constantly aspires towards the condition of music". He reasoned his statement with the absolute unifying of subject and form in music: something that all arts seek to unify, but music is the only one in which subject and form are seemingly one (Lütke-meier, 2001, p.170).

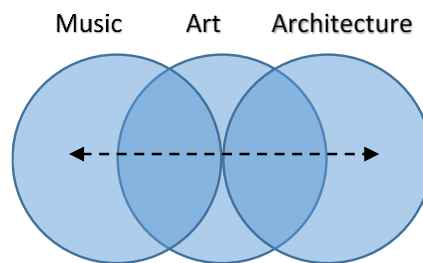


Figure 2: Music and Architecture as Two Arts (Author)

Music has always been considered as the highest level of art and the most influential one on architecture. Based on Arthur Schopenhauer's idea, "*All the arts in common are inspiring toward the principle of music*", music possesses a significant place in the quality of art (Lütke-meier, 2001, p.170). Thus assumption of an interrelation between architecture and music is expectable. Interestingly, Johann Wolfgang von Goethe has also mentioned that: "*I call architecture frozen music*"; in spite of different interpretations for the above statement, the quotation shows that the interrelation between music and architecture is beyond the simple terms, especially when Iannis Xenakis, composer, also vividly expressed the great linkage and so much shared terms between music and architecture (Xenakis, 2008). Consequently, there was a great curiosity for knowing more about the interrelation between these two types of art in contemporary era when the professions are getting more and more interrelated, and interdisciplinary researches are getting progressively important.

## 1.2 Research Problem

Humans understand the world around them by means of their senses among which audioception is a critical one that is sometimes being ignored. Schafer, in his book, by declaring that “We are condemned to listen” (Schafer, 1993, p.163) shows, whether or not, we unconsciously perceive our neighbors and are influenced by the sound of the place even at the times we are asleep. Regarding architecture, Kourosh Mahvash mentions that “Without sound, space feels lifeless” (Muecke & Zach, 2011, p.60). Sacred or profane, our ancestors were more in touch with all our senses that can be seen and learnt in vernacular architecture. They adapted sound, light, material and so on in their buildings artistically. In modern times, eye prevail ear, and visual perception has been replaced by all our senses. Even Murray Schafer points out that modern architecture is for dumb (Muecke & Zach, 2011, p.62).

Effects of sound in architecture, as an important factor, need to be seen so to have more enriched designs. It is also worth mentioning that sound and music cannot be comprehended just by ear; our mind unconsciously understands music of a place by the visual perception. For evidence, it is enough to consider Beethoven, an important composer around the world, who had audition difficulties. Rhythm of a series of columns is also simulated in our mind as musical rhythmic beats. Thus, architecture can get use of audible or visible sound effects. Consequently, being informed about the relation between music and architecture in our era, if the effect of sound in architecture not be ignored, it can result in more qualified and well-designed architecture.

### **1.3 Aim of the Study**

Creation of musical patterns and shapes are sometimes drawn from visual memories which are usually within the architectural settings. Vice versa, it may also be seen that architects are using musical terms in design process such as rhythm and beat. In addition, imagination of a sonic world possesses some characteristics like balance, height and weight that also conceived within the visual world of architecture. Eventually, music and architecture have shared and borrowed certain terminologies, concepts and approaches from each other. In comparison to the other fields, these two fields are more interrelated to each other with the present of a common lexicon. In this regards, rhythm, balance, value, and tone are remarkably being known as some of the common principles of the visual and aural world.

From this point, there was a great curiosity to know more about the common issues in the fields of music and architecture. With this purpose, the study will proceed from the shared theoretical issues to more tangible and feasible examples in both fields. However, audible part of music that comes as acoustic science into architecture will not be focused and the study in commonly concerns with main visible similarities and interrelations. In this respect, the study rather concentrates on the effects of music on architectural product. To achieve this goal, similarities and differences of mutual theoretical issues including space, time, world, materials and other fundamental origins is dealt with. Moreover, certain architectural cases, designed based on music, whether directly or indirectly, will be discussed, illustrating the different manners and levels of interaction between music and architecture in practical realm.

## **1.4 Methodology**

This investigation as interpretative research is comprised by basing on collecting, analysis, and categorization of knowledge in the fields of music and architecture. In order to achieve the main aim of the study that is to find out the interrelationship between music and architecture, (i) the raw data, in both fields, are collected by library research and literature survey. Subsequently, (ii) analyzing and categorization of collected raw data comprised the main theoretical framework of the whole structure of thesis. Lastly, (iii) some architectural examples are investigated to illustrate the impact of music in the field of architecture.

To have a more profound perception toward the study and a deeper understanding of the thesis, the investigation is categorized in three chapters. Not surprisingly, the first chapter has an overview of both fields and includes locating both in the realm of art, being tools of communication resulted in similar classification terms, and possessing some interrelation through history as a result of being cultural heritage and under the influence of social behaviors. The second chapter, by a narrower scrutiny, pivots on similarities and differences of main characteristics and theoretical concepts both in music and architecture. The last chapter focuses on more tangible interrelations between music and architecture and shows how architecture is influenced by music. Accordingly, certain architectural cases are considered in different categories at different complexity levels which are defined as: (i) musical image in architecture, (ii) musical principle in architecture, and (iii) musical concept in architecture.

## **Chapter 2**

# **A THEORETICAL OVERVIEW ON MUSIC AND ARCHITECTURE**

The trace of some similarities in root and trait is visible in different types of art like music and architecture. Arts as tools of communication can result in some interrelation between arts through history. In this respect, this chapter overviews the relationships between music and architecture theoretically and it is organized in three parts. In the first section, music and architecture are considered as two related art. Secondly, music and architecture is considered through the window of communication capabilities giving service for non-linguistic transfer of messages. And in the last part, interrelation between architecture and music throughout history is discussed as cultural issue rooted social structure of a society.

## 2.1 Architecture and Music as Art

Different definition for the term 'art' can be found. Some people believe that art is the way of doing something, but others accept the result of a process as an art. However, art finds its full definition when it is accepted as a quality of performance or a method of doing something (Waterhouse, 1921). Hubbard believes "Art is not a thing - it is a way." (Hubbard, 2009) and also Charles Eames defines it as "Art resides in the quality of doing; process is not magic (Eames, 2007). On the other hand, some people argue about the definition of art as a communication between the artist and observer but others believe that sign system is the real art. Victor Hugo believes (1802-1885), with art, a communication happens that cannot be explained easily. By understanding certain 'forms' can indicate to perceive certain 'content', Langer defines all works of art as "purely perceptible forms that seem to embody some sorts of feeling." (Langer, 1955). In contrast, Schulz believes that it would be misconception to say that the purpose of art is to 'express feeling' especially when we are engaged emotionally by the work of art (Schulz, 1965, p.68). He also mentions that art can result in our emotional reaction and affecting on people, but in fact "Art is a symbol system." (Schulz, 1965, p.58). Schulz's idea provoked Charles Morris to develop 'Theory of signs' (semiotics). Whether art be a way of communication or a system of signs, communication is an action that takes place by the use of art. Things that art express is value on the contrary to science that express facts. Art is a means communicating values and making them common (Schulz, 1965. P. 68, band 75). Heidegger argues that art is not only a way of expressing the element of truth in a culture, but the means of creating it. He mentions that "Works of art are not merely representations of the way things are, but actually produce a community's shared understanding" (Heidegger, 1950).

Art has certain fields and branches in which music and architecture take place. Grillo grouped and compared arts by basing on 6 categories which are Music, Architecture, Painting, Sculpture, Poem and Dance (Grillo, 1987). Paul Waterhouse also classifies art in 5 categories which are Music, Architecture, Literature, in his idea poem is a sort of literature, Sculpture Painting (Waterhouse, 1921). From another outlook, some professions propose different classification for art based on the limitations and characteristics. Leonardo da Vinci points out light and shade as the common issue for both sculpture and painting in spite of differences in limitations that sculpture is a three dimension object that must be simplified within a two-dimensional image in a painting. Vinci also vividly expresses painting as a poetry which is seen and not heard. They can be in the same classification, though, some theoretician bring them as different categories. Consequently, apart from different classification both music and architecture are always take place in the realm of art, though music and architecture are concerned with some limitations. Music has a limitation of time and production material that is absolutely different from another tangible substances of many other arts. While architecture is focusing on design of space for a specific function, different factors are needed to be considered. (Waterhouse, 1921).

Different views about definition of architecture is coexisted within the realm of theory. Any human product is a 'tool' servicing the purpose of bringing order into our environment. The purpose of architecture is to give order by means of organized mass to certain aspect of our environment. Thus, we may say that Architecture is a human product which brings order and improves our relation with the environment (Schulz, 1965, p.22). On the other hand, Zevi takes into account architecture as interior space. Beautiful or an ugly architecture is an architecture in which the interior space attracts, elevates, and dominates us spiritually or disgusts and repels us respectively. (Zevi,



1993, p.28). Based on his idea, interior space is regarded as architecture and external or urban space defined by that building; thus bridges, obelisks, fountains are not a true architecture (Zevi, 1993). Consequently, since the social works do not take place in voids, it makes a good sense to define the architecture as the “art of place”. (Schulz, 2000. p.11)

There is no single universal concept and definition for interpretation of art of music. As the same as architecture that is an “organized mass”, music is also defined as "organized sound" or “organized notes” with the combination of silence (Nattiez, 1990). That is to say, music is an art form whose medium is sound and silence (Liddell, Scott, 2010). On the other hand, John Cage a composer of 20th-century thinks that any sound can be music. He mentions that "There is no noise, only sound” (Wilkinson, 2008) if the sounds are not organized appropriately we may perceive it as a noise. Consequently, music is also understood as an artistic organization of sound and silence.

Apart from being music and architecture in the realm of art, understanding the main characteristic of art in these two categories can result in deeper perception. Nature of art are rooted in creativity and representation. Although creativity and imitation seems two opposite direction, they always mentioned as two feature of art. Creative activity plays a fundamental role in changing society. By giving new intermediary objects public status, it enriches our world (Schulz, 1965, P.79). But perhaps the most important function of art is to create new things, like new buildings, spaces, places, formal combination in architectural realm, new combination of notes, rhythm of sound and silence in musical realm. Finally, ‘art teaches us to see the things in a new way’. Based on Aristol view, art as creativity is something beyond utility by means of new creations (Schulz, 1965). Creativity in architecture can be seen in different issues.

Since music and architecture as two arts have different criteria to be concerned, the reality of work of art, however, is in the sum of all these factors within a creative method (Zevi, 1993. p.30). For example a beautiful room ruined by unsuitable furniture or poor lighting cannot be as architecture, and a great combination of notes with an unpleasant clapping sound is not in the realm of music.

All arts are mainly involved in representation, called mimesis (imitation) by Aristotle, in different levels. The imitations or representations cover tangible and visible parts of the artist's world. Imitation can be seen in most of the art cases like literature drama, poetry, painting and sculpture. Leonardo da Vinci graded the arts based on different levels of mimesis. He states: "The poet ranks far below the painter in the representation of visible things, and far below the musician in that of invisible things." (Waterhouse, 1921). Mimesis in architecture is also represent and concern with tangible material like the illustrated building interior has the imitation of outside (Fig. 8).



Figure 3: Imitation (Schulz, 2000, P.64)

Imitation as a characteristic of art, has different level in architecture and music. Mimesis is related to material and that comes to architecture as form of a building. In addition, since imitation is related to structure and tactile material comprising form, music has no direct clear imitation within. Thus, music has higher level in the imitation complexity and art level in comparison with architecture that can have a clear, direct imitation as a result of tangible construction material. (Waterhouse, 1921)

In brief, music and architecture are always mentioned and truly insisted as two main categories of art that has profound effects on our life. Music is expressing the feeling by means of sound in time and architecture with substances in designing a space. Based on Langer's idea, music was concerned with time, architecture and sculpture with space (Langer, 1955). It might be significant to say each art has certain impact on different matters of life and architecture is mirror of the whole of presence experience. This is why architecture is called "Mother of all arts" (Schulz, 1965, p.126). In addition, Blanchard states that "Music can change the world because it can change people." (Blanchard, 2009, p.7). Eventually, music and architecture are the two main branches of art that can affect our life and each other.

## **2.2 Music and Architecture as Tools of Communication**

We understand the world and act on the basis of our spontaneous perception. To serve our behaviors and live as a member of social system, we need to communicate via our senses as the perception means. Schulz mentions that "Communication renders true social life practicable" (Schulz, 1965, p.60). Thus, people found some methods to transfer the information within our common and recognizable signs via our senses. They, by means of certain tools on the basis of understandable actions, try to

communicate each other that results with an art. For example, body via movement is resulted with dance and theater, hand by means of carving creates sculpture and mouth by using words is resulted with poem, text and dialog. Music and architecture are also not exceptional and retina and eardrum are the two tools of perception and communication.

Architecture as an art is communication. Communication affects our feelings and we cannot restrict it just with verbal messages like speaking. For instance, a caricature can speak and transmit information to the extent of a book via an abstract, compacted and meaningful image. Architecture also speaks via images, forms, places, and the spirit of places. Architectural member can be take into account as constituent of a sentence, windows are like words in a sentence, as they may be in any geometric shapes and forms, for each eras. For example, symmetry is one of the invariable of classicism while asymmetry is an invariable of the modern language. Although thousands of architects and students of architecture designing without knowing the vocabulary, the grammar, and the syntax of the contemporary language in design, we cannot conclude there is no shared and understandable rules for communication in architecture (Zevi, 1994).

Music is also a tool of communication despite of different interpretation and ideas. Victor Hugo believes “music as an art expresses that which cannot be said and on which it is impossible to be silent” (Goldman, Hain and Liben, 2012, p.101). Music is defined as "The art of combining sounds of voices or instruments to achieve beauty of form and expression of emotion" (Cross, 2001). Langer says music is neither the cause nor the cure of feeling, but a form of logical expression or language of emotions which could enable listeners to experience moods and passions they had never known before

(Langer, 1955). In ceremony with music, wine, and dance, people feel the music in their muscles and joints, they connect to the music, the “dance” being a bodily engagement with, and an understanding of, the structured tonal sequences that constitute the music to which they attend (Winters, 2001). Eventually, communication with an unconscious or conscious method needs to be understood for both the speaker and hearers. In this matter, Langer expresses "not his own actual feeling, but what he knows about human feeling." (Langer, 1955) Consequently, both architecture and music as tools of communication are required to be perceived correctly.

In a broader point of view, since art is sort of communication therefore not only the artist but also others must be capable to perceive the messages of art by means of their senses at different levels. It is necessary to be conscious of the rules to be able to use a symbol-system. However, the rules represent the form we have to employ to express ourselves in a meaningful way (Schulz, 1965). Non-verbal communication is just as dependent upon a structured symbol system as verbal communication. Charles Morris wrote a book on ‘Theory of Signs’ and speaks about a ‘language to talk about sign’. Whether we employ gestures, other kinds of actions, image sound, these have to be ordered and connected with a system of expectation to be meaningful. Cherry thus considers “form as the main common denominator of science of art” (Schulz, 1965. p61). Consequently, art as means of communication is based upon common symbol-systems which are attached to common behavioral patterns or ‘forms of life’. (Cherry, 1980, p.13) The rules for the use of signs are in daily life rarely formulated in an exact way, rather they have the character of habits or tradition. (Schulz, 1965).

We cannot communicate or even think without a code. Whereas language is a symbol-system, art can be taken into account as a language. It is language that “speak us” in the sense that it provides the instruments of communication without which it would be impossible even to work out our thoughts (Zevi, 1994). In music, the utter inarticulate meaningless sound that carry no message. They do not know how to speak; they say nothing and have nothing to say. In architecture also the signs needs to be codified to enhance to a language carry a message, as an instance, the Beaux-Arts system actually codified the previous system of sign classified as Gothic, Romanesque, Baroque, and Egyptian (Zevi, 1994). Consequently, a symbol-system as a language has to be constructed in such a way that easily adapts itself to region, people, and society characteristics (Schulz, 1965). In this respect, there are such situations, terms, values which uses music and architecture to express themselves like monumentality, folk, religion and function. Although these terms do not indicate to an especial style or a restricted period of time, they indicate some similar concepts and themes in both languages.

### **2.2.1 Sacred and Monumentality**

Monumentality is a mutual term for both languages of architecture and music. Musical and architecture as communication tools carry a message with the aim of “*to mean*”. Indeed, the monuments are intended to be as a remembrance of an event, a pioneer or even a provocative sign for a special theme. That is to say, monuments are human landmarks created as symbols for their ideal aims and for their actions both in music and architecture. Though the use of monumental architecture tends to be the most prominent during the formative stages of a state or society, monumental architecture is mostly designed to show the political power of the rulers and governments (Rehding,

2009, p.26) or express elite identities or power relations (Trigger, 1993 p.74-81). Therefore these products by their intrinsic and hidden messages constitute a heritage for future generations and form a link between the past and the future. (Harrison-Moore & Rowe, 2006)

Monuments are not limited in a special style, theme, or instrument neither in music nor in architecture though some are fit better for the purpose. There is no limitation for using different types of music and musical instruments to have monumental sign but some instrument are more adapted like a lime trumpet, timpani produce bass sound, since produce a powerful sound that hacks in the mind better and more adapted by monumentality. In architecture also any structures like palaces, temples, elite residences, and political and ceremonial centers can be a monument structures but monuments are mostly seen in political edifice and tomb constructions (Fig. 9) (Knapp, 2009). It is also worth mentioning that higher structures can also symbolize and cover broader different cultural aspects (Schulz, 1965). For instance, group of musicians cooperating to come a great monumental true to have richer cultural product, and in architecture mostly massive building with collaboration of different architect, painter, sculptor, and landscapist produce a great monumental product (Harrison-Moore & Rowe, 2006).



Figure 4: Egyptian Pyramids as Monumental Structure (URL 6)

In brief, musical and architectural monuments are not absolute music and architecture respectively. Monumental music should rather be understood as non-purposive with a purpose, remembrance of an issue. Therefore, musicians are using familiar national melodies to have a trace of local and nationality event and convey a better remembrance while architects mostly use familiar national and local symbols to be understandable and a better transmitter of the codified data. Apart from the differences between music and architecture and the same purpose of the monumentality that is invoking memories, these two fields use the same terms and concepts.

### **2.2.2 Folk and Vernacular**

Folk is the other concept conveying both in music and architecture. The term folk was coined in 1846 by the English antiquarian William Thomas to describe "the traditions, customs, and superstitions of the uncultured classes." (Scholes, 1970). This term both in music and architecture are developed by basing on culture and local circumstances and they represent the culture and the way of life in particular regions. In this respect, both folk music and folk architecture are social representations and coherent cultural system of values (Asquith, 2006). Accordingly, artists arise from the heart of society and mostly are not academically educated create folk architecture and folk music by using of local material and instruments (Scholes, 1970).

Folk is entitled in music as folklore. Ronald also defined clearly folk music as "old songs, with no known composers" (Cohen, 2006, pp.1-2). Folk music indicates to simple uneducated local music that may be as simple as a minimal music (extreme reduction of musical means). Eventually, minimal music is not with local equipment but folk music is. (Martin, 1994) The number of styles of folk music is not countable



since each location can have more than one. The types are mostly categorized based on ethnic, racial, religious, tribal, political or geographic boundaries.

Folk in architecture is a concept that concerns with local technology, material, culture and society characteristics. In fact, folk architecture is also called vernacular architecture. Generally, it is determined with the characteristic of environmental contexts and available resources by utilizing traditional construction technologies by the designers who are not professionally trained. Vernacular architecture makes a building belong to a place and identifies it with particular local features. That is to say, those buildings and settlements that express the local or regional dialect, are often called vernacular. Finally, this type of architecture as a text consequently reflect the environmental, cultural, technological, and historical context in which it exists (Asquith, 2006).

In brief, folk architecture and folk music are localized artistic productions communicate and convey local messages that cannot be easily understandable by foreigners. Thus both folk (vernacular) architecture and folklore music by their nature like a local language belong to their regions and therefore “immobile”. It may be significant to mention that folk can be interpreted as opposite direction of style that is a formal probability structure of a mobile symbol system understandable for people living in different part of the world (Schulz, 1965). Consequently, Folk as a localized code of sign is a shared concept both in music and architecture (Schulz, 2000).

### **2.2.3 Religion and Belief System**

Religion has an immeasurable effects on people, behaviors, cultures, societies. Undoubtedly, architecture and music has remained under the impact of religion and belief systems throughout the ages. Even they become strong communication tool of religion, they convey beliefs, ideologies, concretize value-objects thus affected artistic codes. Ancient, Medieval, Gothic, Baroque are the very concrete era of reflections of beliefs and their effects on their architecture and music. (Schulz, 1965).

Religious music and religious architecture are the two realms that reflect codes of belief system of societies. Religious architecture which is also known as sacred architecture, concern with sacred or intentional spaces, such as churches, mosques, stupas, synagogues, and temples. Many cultures have significant consideration to their sacred architecture and places of worship based on their beliefs. Like religious architecture concern with religious places, religious music, in contrast with secular music, is generally composing for performance as part of religious ceremonies and for worship. (Howard, 2004, pp. 10-11). This theme for architectural design is not limited to a certain style of architecture or to a specific era, similarly, these concept in music has also many subcategories and classifications that may reach to more than 12 genres and the main distinguishable feature of this type of music is mostly based on lyrics (Leaver, 1998, p.215). Consequently, religious as a shared term both in music and architecture focuses on the sacred places to convey and communicate religious and spiritual beliefs.

#### **2.2.4 Function and Theme**

Music and architecture are the two fields which usually aim to express and communicate its own purpose, theme or uses. Function is a vast term in architecture that can be mentioned also as the base of modern architecture, though, the place of functionalism in architecture can be traced back to ancient times, when 'utilitas' mentioned as a factor comprising architectural totality. Function in architecture is defined as correspondence between the current way of life and the existing “architectural frame” (Schulz, 1965). Thus the significant function of architecture is to adapt way of life with the architecture. In contrast to architecture that function has a long background, function is an unclear term in music. Since music does not have a physical tangible material, it acts as a background supporting physical action. Function or theme in music becomes more meaningful when a special piece of sound is explicitly composed for a particular occasions like advertisement or amusing event. In this respect, function in music mostly concerns with the purpose of creating music. For example, an advertisement music is composed in order to enhance the success of a product thus function of music is mediating between disjoint images (Huron, 1989). In this case continuity is an important factor to make an especial product interesting. Finally the main function of this type of music can be summarized in the statement of music tends to linger in the listeners mind” (Huron, 1989).

As the same as function in architecture that aims to connect life and architectural form, functional aspect in music also intend to make a bridge between composer and listener. It aims to make a better and more meaningful communication and accordingly more profound effects. Consequently, function as another mutual concept in both architectural and musical realm is an effective and influential term that make the product more understandable and perceivable by the users.

In brief, music and architecture as system of signs and influential arts can be regarded as communication tools. In particular, music and architecture can affect and influence people and accordingly change the psyche of user and hearer. These effects are sort of evidences of the conscious or unconscious communication between the architects and users in architecture and composer and audience in music. Setting the shared mutual communicative expression of the fields aside, the mutual concept of sign like monumentality, folk, religion, and function can be considered as interrelation between music and architecture and their similar development. Apart from the same classifications, both of them are always mentioned as cultural heritage comprises our environment; therefore, it is a great curiosity to know more about interrelation in different environmental situation like different historical eras.

### **2.3 Intersection of Music and Architecture through History**

We live in the world that is surrounded by different objects. Our environment comprised by physical', 'social', and 'cultural' objects (Parson, 1951, p.4). It is not always easy to divide our environment objects into different classification whereas there are some interrelation between objects. Cultural objects are known through their social or physical manifestation; social and physical objects are known through behavior and observation respectively. Physical objects are serving social life and can be a cultural object as well. And, these three types of objects classes are overlapped and not easily separable. (Schulz, 1965)

Both music and architecture are cultural objects. "The purpose of architecture not only consists in giving physical protection, but also in giving a frame for action and social structure" (Schulz, 1965, p.105). Architecture is a human product serving common

human activities. Not only architecture is a cultural object, but music is also closely related to culture. Music rather than having a physical product, represents the culture and social life. It may be concluded that both music and architecture are cultural issues that represent society.

Architecture and music has the same inspiration source like same general trait of culture. Architecture is not merely a reflection of conceptions of life or a portrait of systems of living, it unfolds culture and dominated social characteristics (Zevi, 1993). On the other hand, music also under the influence one dominant culture, and social feature. (Schulz, 1965). Finally, since both music and architecture are the manifestation of same dominant feature of society, with a decent perception, some similarity, interrelation and reciprocal effects between music and architecture can be seen through the ages.

### **2.3.1 Sound Nature and Theater in Ancient Times**

In the ancient times, the first theoretician initiated the basics of architecture and its relevance with music. Based on Vitruvius theoretical book about architecture, the four main majors of science were introduced as arithmetic, music, geometry and astronomy, named "Quadrivium". Vitruvius, in the first book, writes about the importance for an architect of being knowledgeable in a variety of disciplines. He especially mentions about music that: "the architect should know music in order to have a grasp of canonical and mathematical relations." In addition to math, Pythagoras' ideas on harmony and proportion impressed the process of music and architecture formation. Geometry gives the role of formulization between architecture and music. (Leopold, 2005)

The trace of this four major prevailed science in architecture can be seen in different aspect of architecture. For example parallelism of volume banned on symmetry (Zevi, 1994). Not only ancient professionals persisted on theoretical aspect, they also emphasized on practical side, as architecture really is. Vitruvius also uses musical principles in design process of stone theaters with improved acoustics by means of using the principles of Nature. As the same as the musical instrument, the design of musical performance space should have been made to echo the sound like a lute. Vitruvius believes any theaters as places of performance should have resonate like a musical instrument. Vitruvius uses directly Greek source for using the theoretical issue in practical matter, especially in stone theaters (Fig. 10). Elsewhere, Aristoxenus, in ancient times, vividly expressed “Anyone who truly pays attention to his reasoning will be most easily capable of using the principles of nature to design theaters that enhance the voice for the pleasure of the audience.” In this era, theaters as the main professional architectural design composes wonderful proportion of physical space for improving visual and auditory experiences (URL 7).



Figure 5: Epidaurus Theater in Greece (Stone Theater) (URL 7)

### 2.3.2 Chores and Churches in Middle Ages

Despite complete differences in environmental situation, in medieval period also the traces of society and privilege of cultural issues dominated in both architecture and music. In Middle Ages, named also as dark-aged, people rejected Greek naturalism and lose their belief of nature and God’s creatures. In contrast, God was the only who

knows everything and just a few special people can interpret his messages. People should beg everything from God; therefore, no personal viewpoint could be seen in artistic product and the profession of architecture turned from theater to churches as the place of worship. (Gelernter, 1995)

In this era, Vitruvius' theory throughout his descriptions of temple and theater design are applied to the churches. The harmonic distance of columns and the principles were based on acoustic science. As he expressed, in second book of his series, columns should be spaced in temples according to the same intervals as tones in music, the principles were being used both in external and interior architecture (Vitruvius, 1999). In addition, the acoustic science is utilized in the elliptical roof of musician space in a church. On the other hand, based on the idea and privilege spirit of the age, the church is tented to show it's glorious. The churches are beyond human scale with glorious monumental scales (Zevi, 1993) (Fig. 11). This trend in music is revealed by chore music in churches. A group of singers performing together as a group substitute with a singer performances. Therefore huge scale and a number of singers with assist of acoustic science are the main manifestation of privilege cultural issues and interaction of music and architecture (Walden, 2012).



Figure 6: Milan Cathedral, Italy (URL 8)

### **2.3.3 Harmonic Proportion in Renaissance Times**

Another era that the changes in society affected architecture and music is Renaissance when is called the time of reborn as a result of returning to ancient Greek rationalism and naturalism (Jerome, 1971). After the Middle Ages when the society has a one-sided tendency toward churches, the privilege society behavior was moderated in different aspects and the more focused on secular themes was being observed. Not only the relationship between God and people is simplified, but the science is also developed (Schulz, 1965).

In this era, moderation in society affected on both music and architecture. From musical point of view, Giovanni Pierluigi da Palestrina who was the pioneer best-known 16th-century musician changed the complicated church music to a moderated organized and more pleasant and close to people behavior (Jerome, 1971). In architecture, the huge scale of middle-aged changed into more pleasant proportion. According to Pythagoras, principles of being can be defined by integers; especially, he expressed all harmonic proportions are express-able by the numbers of "Tetraktys", the integers 1, 2, 3 and 4. It is also significant that Pythagoras harmonic proportion, related with music, by means of his "monochord", a simple instrument with one string tightened over a resonance box. In this era the four discovered harmonic proportion are developed to seven pleasant harmonic proportions (Leopold, 2005). Apart from Pythagoras' idea about harmonic proportion, Alberti also expressed the importance of borrowing rules of harmonic proportions from musicians for applying in architecture. He reasoned his statement that because the musicians were working with numbers. (Alberti, 1992). Despite more secular idea of the society, the churches remained as the most important buildings since public spaces are concerning as the generalization of individual and accordingly geometrical perfection should be reflected the musical



harmony in the church buildings (Schulz, 1965). Finally, a comparative brief look through the churches of Gothic (Fig. 11) and Renaissance (Fig. 12) shows not only vertical, unpleasant, terrified proportion of churches turned into more pleasant, welcome horizontal proportionated form, but the harmonic proportion of music also developed both for musical and architectural usage.



Figure 7: Santa Maria Novella Church, Alberti, 1456, Florence, Italy  
(Left: URL 9, Right: URL 10)

#### 2.3.4 Tonality Range and Ornament in Baroque Times

Baroque was the time of supreme development in music and architecture and accordingly cultural enhancement especially in detail and ornamentation. From musical point of view, generally in this era, a major proportion of Classical Music is enhanced and performed. It was the time of creation and development of tonality in various complicated rhythms enriched by excessive decorations with their long and fluent melody by means of new playing techniques and new types of music (Hare & Işık, 2012). In a narrower view, range of musical tone, size and complexity of combination of notes is expanded in this time when opera, oratorio, concerto, and sonata as instrumental performance is initiated additionally. George Frideric Handel (1685-1759) and Johann Sebastian Bach (1685-1750) were the two pioneer influential composer of the time who come different tonality range in music true with their fabulous music (Neuman, 1983).

Apart from enhancement in musical realm in both structures and details, architecture is influenced by the trace of ornamentation especially in theaters as artistic place of art performances. (Fig. 13). Harmony in detail of music interpreted in architecture, and accordingly harmonic decoration always mention as distinguishable character of this era in architecture. Utilizing curved lines and surfaces illustrating motion that is enriched by rhythm of light is the dominate characteristic of Baroque period architecture not just the in facades but the floor plans as well (Hare & Işık, 2012). Finally, under the influence of cultural advancement Extravagant decorations that are

based on mathematical and geometric proportions are mentioned as the main feature of interrelation between music and architecture in this era that some of them are still in use today.



Figure 8: Pannini, Giovanni Paolo (URL 11)

### 2.3.5 Technological Production Tools in Modern Times

Many cultural and social factors are under the influence of technology radically changed specially in Modern time. It was the time of blossoming science and accordingly new construction materials and computers as technological electronic movement. In this era, the codification of the modern language of architecture and music changed as a result of fundamental improve of sciences (Zevi, 1994). These advancements cause unmeasurable changes not only on our environment but also on music and architecture as two tools of manifestation of cultural issues.

New introduced production tools changed both architectural and musical realm. Steel as inseparable construction material initiated in this period and the Eiffel Tower as a symbol shows a starting point of steel in construction and tower buildings. Reinforced concrete called “artificial stone”, as another revolutionary material changed the bases of construction radically. Accordingly, the forms of buildings is influenced with radical developments in erecting. On the other hand, the new musical instrument like electronic music influenced on music. The electronically generated sounds are more controllable to achieve the best pleasure beat in music whether in composing time or performance environments. Many factor of music can be adjusted at the time of performance to have the best result like intensity, decay, sharp-edged/ blurred points, smooth/ rough music, heavy/ light sound, hard/soft perception, spherical/ angular music, warm/cold understanding, etc. (Hofmann, 2002). "The Room Containing Sounding Objects" also can be mentioned as a combination of architecture and musical instrument. Tudor, the designer of this architectural instrument, spread out different sounding objects in the room, where the listener was able to walk around in between them, creating his own piece of music driven by the attraction of the sound he was led by (Hofmann, 2002).

Lots of enhancement in music and architecture are rooted in electronic advancement. In regard to same root of music and architecture, that is math, computers as tools of calculation influenced on both fields (Xenakis, 2008). By means of the calculation machines mathematical-scientific structures are transferred into the field of artistic production (Sikiaridi, 2004). In musical realm and based on Xenakis idea, evaluating his/her own music that is a dialogue with oneself is the most difficult part of analyzing any music. Musicians often used to rely on an instrument, in general piano, for scoring their music. But the piano cannot be fitted for new form of music; the new generation

of music is mostly evaluated by computers that, finally, put an end to these ever-insurmountable limits. In architectural realm, computers make it possible to simulate reality, not in the unilateral way perspective drawing does, but in all its visual and behavioral aspects. With simulation programs, we will “see” and “live” in a building before it is built (Zevi, 1994). Finally, various changes are partly supported by the universal computer instrument that cannot be mentioned within concise review on modern movement.

In spite of a lot of great developments in both music and architecture, there are lots of critical issues within. In regard to the aim of the thesis focusing onto music and architecture, it was the time of preference of eye over ear, though, eye and ear are both cooperate for space understanding. It is declared that “We are usually more touched by what we hear than we see” and exemplified by the sound of rain when we are inside a room (Tuan, 1974, p.8) elsewhere the vast extent of audible perception containing behind the head is mentioned. However, we live in a culture that readily and pervasively privileges the eye over the ear. (Martin, 1994) Walter J. Ong in his book *Orality & Literacy* points out that “the shift from oral to written speech was essentially a shift from sound to visual space,” (Ong, 1985, pp. 24-25). This changes and unpleasant movement can result in more profound problem like the separation of art, especially sound, from life, said by Graham (Winters, 2001). Without sound, space is felt lifeless that could be as traumatic as the loss of sight. With deafness, life seems frozen and time lacks progression (Muecke, 2011). In architecture, also Murray Schafer clearly said “the modern architect is designing for deaf,” and “the study of sound enters modern architecture schools only as sound reduction, isolation and absorption.” (Heschong, 1979, p. 25). Finally, Graham emphasis on modernist building rejection in favor of a more poetic view (Winters, 2001).

The overview through history reveals music and architecture comprising environment are under the influence of cultural and social matters. In this respect, the trace of interrelation in different environmental situation such as different epochs easily can be seen. As the table below summarizes the main feature of interrelation, different level of complexity in interaction between music and architecture from simple harmonic resonance to the highest tonality and complexity level in Baroque and Modern Times is clearly manifested (Table 1).

Table 1: Interrelation of Music and Architecture in Different Eras (Author)

|                   | Architecture                           | Music  |
|-------------------|--|--|
| Ancient Times     | Geometry & Resonance                   | Simple Harmonic Resonance                          |
| Middle Ages       | Monumental Scale                       | Chores Music                                       |
| Renaissance Times | Pleasant Proportion                    | Harmonic Proportion                                |
| Baroque Times     | Curvilinear Ornaments                  | Tonality in Music                                  |
| Modern Times      | New Material and Electronic Simulation | New Musical Instrument and Electronic Performances |

In conclusion, the glimpse overview of music and architecture shows not only they are always relate with the general concept of art but also concern with creativity and imitation as two main characteristics of art. In addition, non-verbal communication as a result of having meaningful signs in both music and architecture result in non-verbal transferring messages and influencing people feeling with similar classifications. Lastly, since both music and architecture comprising environment are under the influence of social behavior and cultural background, different complexity level of interrelations are found in dissimilar environmental situation like different epochs.

## **Chapter 3**

### **THE COMMONALITIES AND DIFFERENCES BETWEEN MUSIC AND ARCHITECTURE**

This chapter is pivoted in a narrower point of view on both fields' interrelation. Existing so many similarities between audible and visible world make some artists keen to combine or convey one art into another. For instance, Matthew said "Can I play my painting next week?" (Martin, 1994), and from another point of view, St. James' Hall also wanted to play a music via color (Waterhouse, 1921). Unfortunately, both projects was unsuccessful. The main obstacle and reason based on the study are referred to insufficient awareness about the differences between the characteristic of painting and music (Waterhouse, 1921, p.326). In this respect, this chapter deals with commonalities and differences between the main characteristics of music and architecture. Accordingly, their main traits and fundamental theoretical aspect of both fields, characteristics of audible and visible waves in music and architecture respectively, and the effects of math as root of both fields is explained.

### 3.1 Architecture as Frozen Music

Architecture in many reputed statements mentioned as frozen music. Perspective, distance, height, balance, proportion, weight and many others are being mentioned as the terms within the both music and architecture. But, there are other more fundamental shared terms between music and architecture like time and space, mutual world, shape and form. Under this scope, after a look through “frozen music”, this chapter focuses on more fundamental reputed terms in three subheadings: Space and Time as two main theoretical issue in architecture, Architectural and Aural World as the most comprehensive and influential concept, and Shape and Form as comprising factor in both music and architecture.

This part entitled “Architecture as Frozen music” based on a simple and meaningful statement of Johann Wolfgang von Goethe (1749-1832). In his book *Maxims and Reflections* he vividly said, “I call architecture frozen music” (Goethe, 1998). Although there is not one clear explanation and people based on different experience and background have interpreted this statement in different ways, this short term initiated a new way of looking through architecture as a musical piece.

Friedrich Von Schelling also says:” Architecture in general is frozen music.” Edward Lifson answered this statement with a think-needed question “if architecture is frozen music, what does it sound like?” In fact, this question tended to clarify the probability of reciprocal relation between them. Another related statement is belong to Frederich Wilhelm Joseph von Schelling; he mentions:” Architecture is music in space, as it was a frozen music” (Winters, 2001). Architecture, just like music that can be heard and comprehended in different levels, is experienced with different senses.

For a better understanding of the statements, it may be observed from a composer's point of view. We may reverse the proposition by saying "music is architecture in movement." This statement mostly focus on musical imaginary sculpture simulated in the hearers' mind. Both statement may be beautiful and accurate, but the problem is that no one truly entered to the intimate structures of the two arts (Xenakis, 2008). Since the music is playing in present time, from the moment being performed, the sounds are as well fixed, recorded in time. This is also can assist the statement that the played music is fixed and can be a resemblance of a sculpture, or an architectural form. (Hofmann, 2002).

These statements, in both point of views, architects' or composers', show the unmeasurable interrelation between them in spite of different worlds. Finally, Architectural works in quiescent mass and exists in external space. On the other hand, musical works with tone and effect on our feeling within internal space and time movements (Waterhouse, 1921). Consequently, Iannis Xenakis, architect and composer, by his statement depict a clearer relation between music and architecture "Architecture can be regarded as a transposition in space of what occurs in his music in time and pitch". (Xenakis, 2008). That is to say, architecture can come into existence when physical boundaries of space defined. However, Music can come into existence only by defining time experience. Ultimately, time and space are two important factors that the two arts attached in.

### **3.1.1 Space and Time**

There is an inseparable relationship between time and space. Without time and space, world is inconceivable; everything is dead. "Space gives form and proportion; time supplies it with life and measure". (Martin, 1994). Zevi defines architecture as "the art



of space' and shows the importance of space in architecture. (Schulz, 1965) From theoretical point of view, Giedion pursued to construct the architectural theory based on time and space in his book 'Space, Time and Architecture' (Giedion, 1941). From physical point of view, Einstein links space and time through the finite velocity of light. Einstein's theory defines space-time as 4th component of coordinate system that needs to be added to 3-D reference frames in Galilean relativity. Thus Einstein put an end into separation between time and space. Although some writers believe that our world has four dimension, Schulz claims architectural totality possesses an infinite number of dimension (Schulz, 1965). Overall, from any point of view, we live in a world that time and space are connected from any perspectives (Waterhouse, 1921). Finally, whether physically or theoretically, time and space are entities criteria in the environment.

Despite the term "time" seems a simple and clear term, perception of time has certain difficulties in both music and architecture. Time can be considered as a real or virtual criteria of environment. From a physical point of view, real time is based on science especially physics. Einstein surprisingly declared the importance of time as "everything doesn't happen at once". On the contrary, Kant by his assert declared the time an intuition and virtual event. Kant by his meta-physical views divided the time by the events ordered in mind. In fact, recognition of the beginning and end of an event can make signposts for inner sense of time. For instance, inner sense of tempo and the orders within a piece of music can comprise a virtual time in mind (Martin, 1994). Music by ordering some notes in time can make the time audible. In fact, music can be regarded as a semblance of time. Time in musical realm is in virtual theme whereas the order of harmonic musical notes make a virtual order of time in mind. Thus, our mind by a visualization of the musical components can define aural intuitive dimension

(Langer, 1950). Although Langer divides time as two great realms of past and future (Langer, 1955), In this study, time which is considered as real, mostly related to the field of architecture and the one which is virtual belongs to music.

Space is a fundamental term in architecture though does not have my definite interpretation. Different theoretician and architects define space dissimilar. One of the most prominent architectural theoretician, Sigfried Giedion, defined space as three different issues, two regarded to physical aspects and one more intuitional. The first definition considers space as “interplay between volumes” and the second equaled it with “interior space” (Giedion, 1941). In the first definition, space can be either inside or outside of a building. Bruno Zevi also asserted that space is the protagonist of the architectural and urban design. (Schulz, 2000). In contrast to the second definition, space must be an internal place. Therefore, in both definition, as Weber clearly mentions, corporeality of architecture shapes the voids. He mentions that architecture is the display of space (Weber, 1995, p.131).

The third definition of space based on Giedion theory, founded in twentieth century, defines space as “fundamental consequence for man’s conception of architecture and urban scene” (Giedion, 1941). This description totally believes space as an intuition concept. Bruno Zevi does not only consider the space-form when he defines architecture as ‘the art of space’. He rather has the total ‘spatial effect’ in mind (Schulz, 1965). Kant also declared space exists in the mind a priori as a pure intuition (Kant, 1987). Heidegger’s opinion about space was that space is neither a part of the apparatus by which the mind makes the world intelligible nor does it exist previous to one’s being in the world. In brief, there is no space independently of one’s being in it (Forty, 2000). From musically viewpoint, since there is no tangible material in music, the musical

space can be adapted with these theoretical definition. This space is something that build up in our mind, thus can be the same in both music and architecture.

In conclusion, both time and space are existed in both music and architecture as two significant concept. Although, Immanuel Kant asserted “Both space and time are not in themselves general concepts, but rather intuitions” (Kant, 1987), space in architecture is defined as corporeal and intuition, but in music it is just related to intuitional perception. Time is also can be seen from two views, physically and virtually in architecture, in contrast to music that possesses just virtual time. Finally, both of the field closely related to time and space; as a convincing instance, Le Corbusier in his book the modular said “Music, like architecture, is time and space. Music and architecture alike are a matter of measure.” (Le Corbusier, 1954, p.29). Consequently, in spite of difference of time in music and architecture that is virtual and real respectively, architecture concerns about understanding the space within time and music involves comprehending the order of sound in mind and virtual time (Langer, 1950).

### **3.1.2 Visual and Aural World**

World, as the most important realm for any arts, is a vast-extent influential term. Auditory/sonic and visual worlds have certain basic differences. In contrast to our ear, we are biologically able to close our eyes, thus the perception of visual world can be interrupted intentionally. On the other hand, the solid material and distance can be an obstacle to disturb our visual perception and accordingly the visual world. On the contrary, when we are awake, we are connected unintentionally to the aural world. R. Murray Schafer clearly declares “We are condemned to listen.” (Schafer, 1993, p.163). Moreover, the sound can penetrate to and cross solids thus a rich and powerful sonic

world is created. Walter Ong vividly declares “Sight isolates, sound incorporates” (Ong, 1985, p.32). Sound, whether in a visible or unseen part of the real world, can be heard and perceived by hearers. It can be seen as a powerful, rich and unifying sense.

When we are awake, whether or not, we hear the sounds surrounded us. As it has been declared “We are always at the edge of visual space, looking in with the eyes. But we are always at the center of auditory space, listening out with ears” (Schafer, 1993, p.164) Thus in contrast to visual world that faces forward and the perceiver can be in the edge of a visual space, we as hearers are always at the center of aural world and everything is happening all around us. However, architects want to design all surrounded objects to achieve better and more complete sense of perception, though it is impossible to be perceived instantly, like something happens in aural world (Hofmann, 2002).

The sonic world via simulation of sound within our mind and internal processes is realizing. Visual memories is the source of the visualization of musical patterns drawn in our imagination. This internal imaginary takes place by using musical materials during the gestation process. It is an important process for composer since they tend to compose a music and accordingly create a sonic world in our imagination. Just like architects designing with architectural elements, composers make a virtual and pleasant composition in the hearers’ mind that is called ‘sculpture of sound’ by the Italian composer, Fausto Romitelli (Hofmann, 2002, P.7).

As the same as parameter of "time" in architecture that is often neglected, the parameter "position" in sonic world is also ignored. Technological achievements have

affected everything around us by eliminating the limitations like privileged direction and movement in 3D world. Listener is used to be in front of music stage and face towards the performance to have an appropriate sound quality. By focusing on nature of sonic world that people are surrounded by sound, new concept of music founded. Sonic world is hugely influenced by the 3D stimulation. Sounds are all around the listener therefore there is no privileged direction to have perfect imagined 3D world. In addition, when people move in a different space or room of a building, the sound around them is changed and our imaginary understanding of environment is accordingly influenced. 3D sounds make an opportunity for composers to evoke our senses and stimulate the moving listener in the hidden realm of perception. The sound can move completely independently of the speakers and a precise position to the sound is also achievable (Hofmann, 2002, P.4).

It might be significant to know the difference of moving in architecture and in music. It is needed to be aware about the difference of move and change; change may be assigned to the quality of an object whereas movement regards the position relative to the perceiver. By means of 3D position in music can be assigned by composer's idea. By means of technology, and sound changes virtual world of music perception of hearer may move constantly from one position to another with different details, slow or fast, gradually or abruptly, vanish or fading progressively. Architecture, like new 3D music, has both move and change, however. Change in architecture is not as easily perceivable as in music. Characteristic of movement in architecture also has a radical movement in music. All objects of a building exist at the same time and there is no pre-determined perceiving way and order in understanding the architecture in both real world and 3D simulated world by computers (Zevi, 1994). In conclusion, world in music and architecture have some similarity and its characteristic like position,

location, move, change can affect on each other that may result in some creativity for both music and architecture.

### **3.1.3 Shape and Form**

Shape and form are two important terms both in music and architecture. Shape is defined as the simple meaningful and understandable part of form both in music and architecture. Shape in imaginary world of music designates to motif that is the simplest, understandable and meaningful melody in music. Like in architecture that comprehension of any shapes are being achieved and meant by geometry, the shape of a motif also reveals via notes. On the other hand, form is a simplified virtual image of a real or virtual event. As repeatedly introduced by composers “form covers the shape or structure of the whole work.” (Anzaldo, 2009, p.93). Like in architecture that any building has a form, every piece of music has an overall plan or structure or a "big picture". In contrast with form of architecture that can be shown within different utility like speculative drawing film, collage, text, computer imagery, and model (Winters, 2001), form of music cannot be understandable as easy as the architectural one by non-professional people except playing the piece.

Form in architecture may be derived and initiated by different factors like function that the building is designed for. Schulz mentions form is abstract of cultural meaning and architectural totality (Schulz, 1965, P. 131). Although in architecture different source for the forms can be mentioned, there is not a clear source for form of a music since there is a not a clear function for music. Generally, there is not a crucial physical function or specific source for music, but there are some meaningful cultural factors to attribute in musical forms (Xenakis, 2008). Wassily Kandinsky declares form should be adapted with its inner meaning. Since music is evocative of feeling and works on

our inner senses, catalyzing the sublimation through the all mean of expression is defined as the function and source of the musical form.

In spite of lacking physical circumstances in form of a music, there are some shared sub factors and components both for musical and architectural form. Both architectural and musical forms are comprised by elements and relations. Element donates a character to a form and relation donates a lawful way of distributing elements. Obviously, all elements of a form need to be organized in a manner considering the whole and its parts (Schulz, 1965, P.133-140). Additionally, material should be considered also as the constituent of form. In contrast to musical material that are audible sound, architectural material are tangible like stone, steel, metals, and compositions (Walden, 2012).

The whole perception is needed to have the best comprehension at any different level of formal complexity. Although there are different style and traditional types for architecture and music, but in all cases the natural organization structures must be understandable. Understanding and perceiving any forms are taken place by some terms such as 'order', 'balance', 'harmony' and 'scale' though complicated structure may not be quickly realized even for professionals (Weber, 1995). Form 'directly given to the senses' thus the subjective perception of a form cannot be ignored in both musical and architectural form. (Weber, 1995, p. iii). Apart from different level of perception, understanding the whole form called "the big picture" is fundamental for complete recognizing and more profound feeling effects.

Finally, both artistic forms are designed by artists and other professional people build them up. Musicians are playing the composer's form and the labors are erecting the

architects' design. Thus both of the artists need a language to transfer the form to executant that is musical phonetics and technical drawing in music and architecture respectively, though, a conductor may be needed in both categories for better arrangement and cooperation quality (Waterhouse, 1921). Consequently, designing a higher structures in art that are more valuable like a Gothic cathedral in architecture and a symphony by Mozart needs awareness in general fundamental issues, like space, time, movement, world and etcetera. In this respect, shared concepts employed both in music and architecture might be considered as some evidences pointing out architecture as frozen music.

## **3.2 Audible and Visible Wave**

Music, as a complement of silence, is art of combination the sounds to evoke senses and feeling. Whereas more than one note, as raw materials, may be sounded simultaneously, music regards as polyphonic (Hofmann, 2002). Consequently, understanding the sound criteria as fundamental component of music and its peers in architecture can make a deeper sense in interrelation discovery. Eventually, in this part, main medium of sound and light as waves and possibility of musical interpretation of architecture is explained respectively.

### **3.2.1 Sound and Light as Two Waves**

Sound and light are two physical waves having special role in music and architecture. Audible sound waves are component of music and visible light waves are disclosure of architecture. Light and sound, unlike noise which is the perception of sound, is high pressure wave produced by vibration. Both observing an architecture and listening to a music have the same general process. Musical wave move through the air and reach



our ear and visible wave similarly via a transparent medium reach to our ear (Fig. 14). The perception process in both issues need three main utilities: a producer like an instrument or a light source, an elastic medium like air and water and a receiver like human's eye, ear or even a microphone (Johnson, 2001). Indeed, comparison between these three main mutual issues in music and architecture that result in deeper sense will be explained in this part.

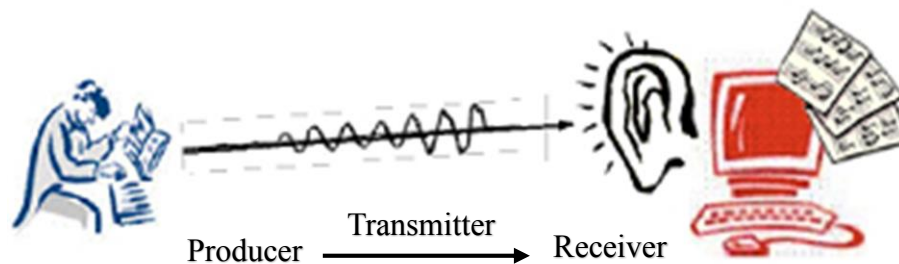


Figure 9: Wave Perception Requirements  
(Cont, 2010, Edited by Author)

The sound producer can be any materials, for example, in clapping, hands produce sound even can be recognized in a music or even as a music. There are different type of vibrant in instruments. Some instruments produce sound when blown into like flute. String is also another vibrant that is obviously used in violin, guitar, and piano and lastly a flexible membrane like drum curtain can make musical notes (URL 12). On the other hand, visible waves are producing by a light sources whether natural like sun and moon, or artificial light like florescent or halogen. Importantly, the differentiation of both sound and light producer must be taken into account by composers and architects respectively.

The different vibrated substances can have different wave form whether pleasant or nuisance that is a physiologically interpretation in our mind. Each instrument has its unique waveform called timber and results in recognizing a special musical instrument

notes and have an especial feeling evocation (Fig. 15). For example trumpet can evoke our military and hero's sensation via its special and unique timber. This factor in architecture are interpretable with color and texture of a materials that for instance concrete and wood can evoke violence senses and friendship and intimacy feeling respectively (URL 13). Color is another evocative factor like special instrument waves; orange and red our dynamic senses and mild color can be relaxation and solace senses. Wassily Kandinsky (1866-1944) was an influential theoretician about color and music; cited "A parallel between color and music can only be relative – just as a violin can give warm shades of tone, so yellow has shades, which can be expressed by various instruments." Elsewhere he declares "The sound of colors is so definite that it would be hard to find anyone who would express bright yellow with bass notes or dark lake with treble" (Kandinsky, 2011). Therefore, both music and architecture is understandable by means of physically similar waves in spite of different characters of the audible and visible waves.

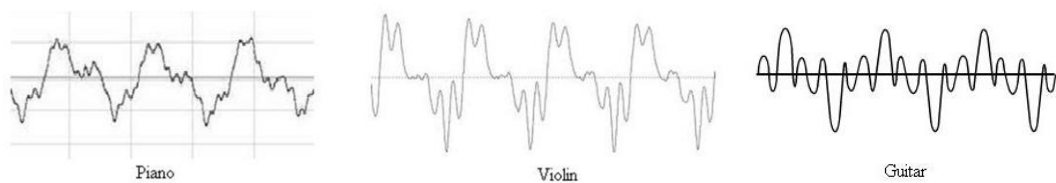


Figure 10: Different Sound Timber (URL 13)

Both waves move through different mediums in spite of absorption and reducing the wave intensities. Musical wave can be transferred in any elastic material like air (audible sound) water (bubble sound) and even solids (the sound other side of the wall that penetrated through the wall). Visible waves result to our visionary on the contrary just penetrate through the transparent material. Whereas the character of sound and light waves is different, the material that each wave can penetrate into is not the same. For instance, sound can reach us from invisible part of a room, but because light cannot

penetrate into solid masses, it seems invisible. On the contrary, the street can be seen from a window but the vehicle noise are not audible within a double glazed window. Effect of different character of transmitter can be seen easily in a music studio, where in one side of an insulated window musicians or singers play a piece without having any noise from other side, and concurrently, they can communicate them by light wave via windows (Fig. 16). Consequently this differences should be absolutely taken into account for architects, for both designing obstacle for unfavorable parts and transparent design for more welcome portion apart from the sound and acoustical design.



Figure 11: Music Studio (URL 14)

Both audible and visible waves are received by our ear and eyes, and interpreted by a complicated procedure within our minds. For example, based on Isabelle Peretz & Max Coltheart research, interpretation the sounds in any forms are based on modularity and phonological and musical lexicons. The differences of musical and vocal understanding process caused some patient unable to understand melody (Music without voice) but able to understand lyric and people's speeches. (Peretz & Coltheart, 2003). On the other hand, we may see each one person concentrate on one part of an architecture that others do not care. Thus, as Kant declares perception takes place in the mind based on their background and priority (Kant, 1987).

Apart from the understanding process, we must not forget that music may be heard on many different levels, alike observation of architecture. For example in music, some hearers doesn't pay much attention to the music whatsoever, others like the sound of the music and doesn't really focus on the lyrics as much, and some listeners really listens to and analyzes lyrics. Also in architecture, users a building or a vuilt environment in different levels.

### **3.2.2 Sound Wave & Environment**

The site where the building is to be located on is crucially important in creating an effective design. Therefore, characteristics of a site is to be understood thoroughly. Martin clearly cited in his article: “We hear not just without ears, but with our entire bodies” (Martin, 1994). Eventually, sound of site is also need to be seen by architects to prevent uncompleted analysis that may be resulted in some flaws in the final project. Apart from the importance of sound of site, whether audible or visual, silence that makes sound perceivable is also important. We should also listen to the silence of the site as well as audible one, whether by our ears or eyes. (Muecke, 2011). On the other hand, Daniel Libeskind in his essay ‘the walls are alive’ cited:

“Buildings provide space for living but are also de facto instruments, giving shape to the sound of the world. Music and architecture are related not only by metaphor, but also through concrete space. Every building I have admired is, in effect, a musical instrument whose performance gives space a quality that often seems to be transcendent and immaterial.” (Muecke, 2011, p.172)

Music like architecture is a multi-layered art that under the influence of the material characteristic. Both artists are need to be aware about each layer criteria to have a final

artistic prominent product, though the whole product always seems to be perceivable. When we comes through a piece of music, the sounds combine together for making a harmonically, pleasant, and influential product, like architects' who combining different pleasant parts to comprise a monolithic architecture.

Composer uses graphs for their music analysis both for each note or the whole music. All the combined sound waves, known as a piece of music, is shown alike graph called 'envelope', whereas the overall structure of a music just fits inside the red line (Fig. 18). The envelop, clearly shows the ups and downs in any music intensity, beats, rhythm and other significant factor for music perception. On the other hand, as the graph shows the circumstances of sounds, land formation show simplicity, repetition, illusion/perception, events, phase-shifting, complexity and sudden alteration of density from a musically point of view (Martin, 1994). Finally, new version of observation on the site and documentation is needed that use site character as the solo material of sound. (Muecke, 2011). Therefore any environmental line can designate an analyzable musical note. For instance a mountain can be introduced with its skyline or the some sections that there is a possibility to be interpreted as a musical note.

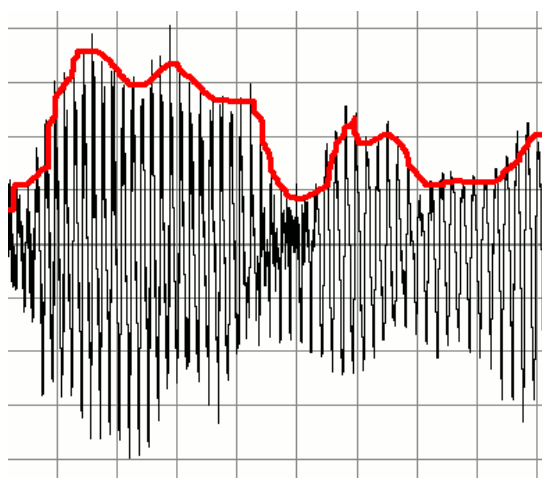


Figure 1712: Signal of Sound and Its Envelope Marked with Red (URL 15)

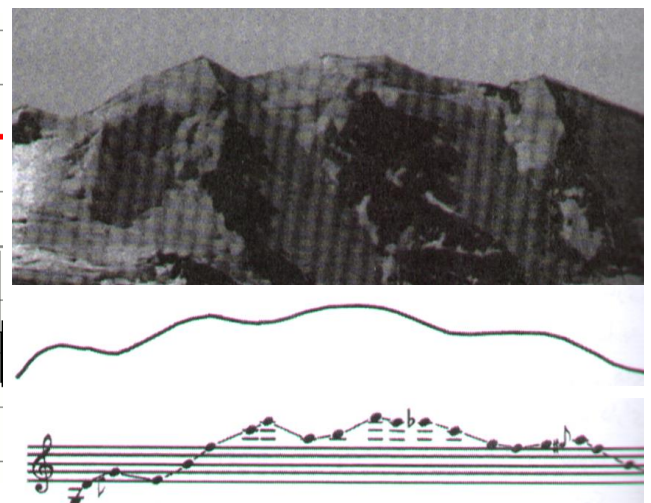


Figure18: Interpretation of a Mountain as a Musical Notes (Falamaki, 2008)

From architectural point, the envelope graph of the environment and site silhouette aims to find a better combination and harmony with the background of the site. For example, the skyline of the New York and Toronto are interpretable and analyzable from a musical point of view (Fig. 19 & 20). With a brief look to skylines of the cities, the monolithic of the each city is visible via the rhythm and repetition beats of skyscrapers. This process and analyzing system are also feasible in different scales. For an instance and in a narrower view, looking at The Cologne Cathedral in Koln illustrated and cleared the dissimilar characteristic of the left and right of the building (Fig. 21). This intentional different resulted in directed architecture and one side tendency toward the entrance of building. Consequently, architectural interpretation of musical graph of a city, site or even a building analyses can enrich the architectural design process, and accordingly the architecture, by understanding more about the musical graph and perceptions.



Figure 13: New York City and its Silhouette (URL 7, Edited by Author)

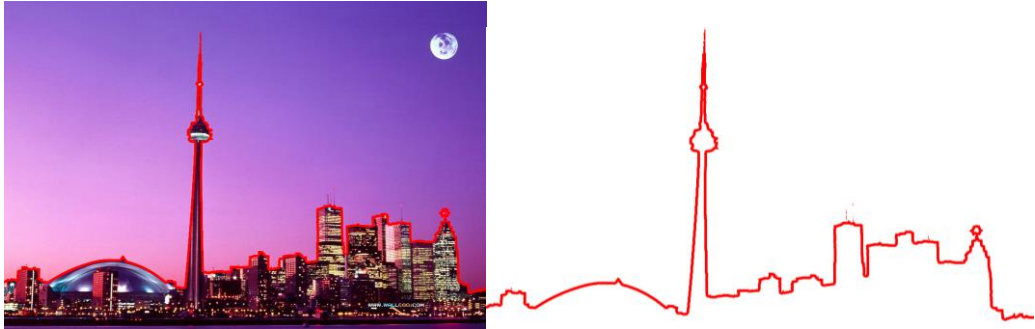


Figure 20: Toronto and its Silhouette (URL 16, Edited by Author)

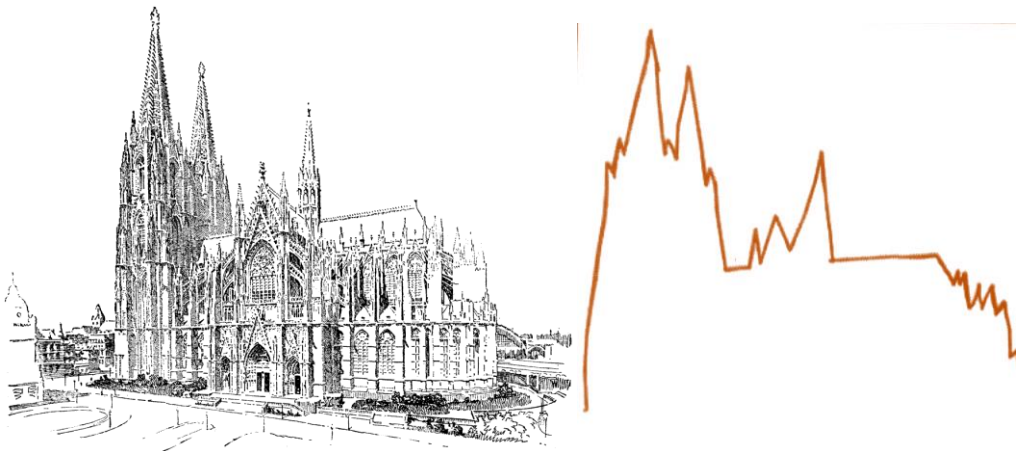


Figure 21: The Cologne Cathedral, Koln, Germany and its Musical Line (URL 17, Edited by Author)

A brief look through the characteristic of audible and visible waves shows several architectural and musical issues are rooted in their material. Producers, transmitter, and perceiver are the three main utilities of a wave effective in design. As an example, a part of building can be hidden by not allowing the perceiver come or obstructing his visions. In addition, observation with musical techniques through environment, (specially, silhouette, skylines and sections that possess inherently graph vividly) can enrich the analysis and understanding of a site or a single building that may result with effective designs.

### **3.3 Effects of Mathematics on Music and Architecture**

Mathematic is always mentioned as an interdisciplinary science whereas assist and correlate with other science, especially in calculation process, and arts. Not only the trace of math coexist in realm of music and architecture, mathematical issues are always insisted as the root of music and architecture by composer and architects respectively. Vitruvius also in his book 'Ten Books of Architecture' explains that: "the architect should know music in order to have a grasp of canonical and mathematical relations" (Walden, 2012). Therefore, this part goes through effect of numbers, proportion (ratio of two number) and rhythm (repetition of proportioned objects) in both fields in brief.

#### **3.3.1 Numeric Orders**

Mathematics, whether or not, has vast extent in usage with different complexity level. Hardly ever effect and usage of math is well-known in arts like music and architecture and people believe on soul as spring of art. It may be an unanticipated issue that most of mathematicians agree that the soul is the wellspring of mathematical thought (Johnson, 2001). As an instance, Iannis Xenakis a pioneer composer architect, declares he employs mathematics as a mean to structure thought and composition something that may seems irrelevant to realm of math. Effect of math in music, like many other fundamental issues, is better understandable for composer and professionals than ordinary listener who may just perceive a superficial effect of math in arranged musical note in a piece of music. Indeed, math can go deeper into the internal comprehension of music (Xenakis, 2008). William L. Schaaff declare that "Mathematics is, on the artistic side, a creation of new rhythms, orders, designs, harmonies, and on the knowledge side, is a systematic study of various rhythms, orders, designs and



harmonies.” (Johnson, 2001, p.700) Finally, the trace of math can be seen in music with different complexity that previously seems as an intellectual, aesthetic and emotional art.

Setting the complicated usage of math in calculations of loads, structure, mechanical issues aside, the trace of simple numerical math in architecture and music can cover the artistic part of the field. For an instance, Aristotle believes the effect of numbers in harmony (Johnson, 2001, p.700). A simple evidence for revealing the effect of numerical issue in music and architecture is numerical sequence known as progression that is an important concept in numerical theory and properties of the integers (Johnson, 2001). Sequence, whether short or long, is simply an order of related numbers deriving somehow from its predecessor. If the sequences of numbers use in design and even figurate known as series (Hersey, 2000). Arithmetical, geometrical, harmonic are three famous sequence order systems used in the both architecture and music.

Arithmetical sequence is the order of number that the difference between the numbers is always the same, that is to say, each number is the previous one plus a constant amount: like 2, 4, 6, 8 or 1, 5, 9, and 13. Geometrical sequence can be produced by adding a proportion of the previous number, or in other words, each number is the previous number multiple with a fixed non-zero number. For example 1, 2, 4, 8, 16 or 2, 3, 4.5, 6.75 or even a well spread applied one in Baroque Architecture: 8, 12, 18, and 27. Harmonic sequence is reciprocals form of an arithmetic sequence, for example, 2, 4, 6, 8 are arithmetic sequence and 0.5, 0.25, 0.16, 0.125 are harmonic sequence. In the harmonic sequence by moving the decimal point the numbers will become the illustrated one: 12.5, 16, 25, and 50. (Hersey, 2000)

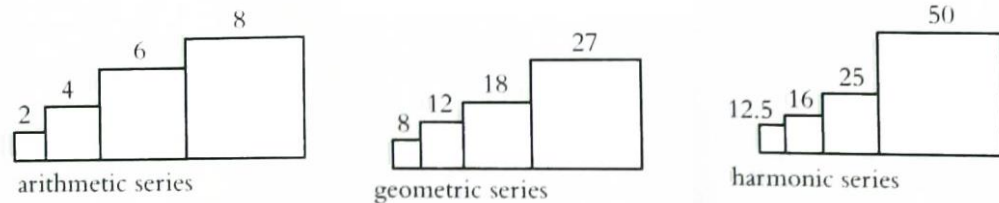


Figure 14: The Three Sequence System (Hersey, 2000, P. 12)

The three short introduced sequences are being used both in music and architecture whether clearly visible or hidden. The sequence orders are not in a fixed directions. Any order whether right to left or bottom to top or vice verses are also can be seen as sequence. In architecture the arithmetic sequence used in number of columns and height if the columns, that may not to be understood as a sequence (Hersey, 2000). In music also, the fade in and fade out are proofs of using this sequences by the idea of composer. Sequence in a more hidden situation can be seen in in the musical note of the piece "The Music of the Night," by Andrew Lloyd Webber. For each note a correlated number is dedicated and illustrated in graph (Fig. 25). The numbers 5, -4, 3, -4, 1, 3, 5, 6, 3, 8 are the rhythmical numbers. For example, the rhythm of 5, 3, 1 are easily can be seen in graph whereas is not easily sensible via numbers. Although the illustration can be in any different figurative format, the line graph shows the numbers gradually decrease in intensity that makes an arithmetic series (Johnson, 2001).



Figure 23: The Music of the Night Notes (Johnson, 2001)

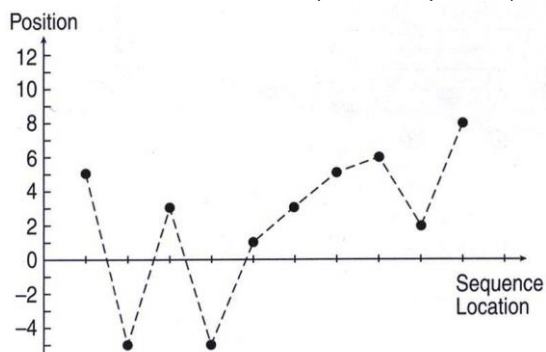


Figure 2516: Note Graph of Opening Two Measures of "The Music of the Night" (Johnson, 2001)



Figure 2415: Arithmetic Sequence in Architecture (URL 18)

### **3.3.2 Proportion and Interval**

Setting the math and numbers aside, the relation between numbers is another important factor. As the same as having a harmonic color in cloth harmonic numeric relation is an important issue in art especially in music and architecture that aim to influence people's feeling. The relation between two numbers, that is as 'Interval' in Music and 'Proportion' in Architecture, in one side and the most pleasantly 'ratio' on the other side are the essential issues.

Ratio or proportion in architecture and interval in music provide geometry of pleasant forms. Based on Francois Blondel belief musical ratio lies at the origin of architectural proportion (Hersey, 2000). On the other hand, Alberti believes that "harmonic proportions in architecture have to be borrowed from the musicians" because of the clear foot step of the numbers in their works (Leopold, 2005). In addition, Xenakis who worked on formulizing the aesthetic and proportion in music and also architecture believes that producing a harmonic sounds is not achievable but by understanding proportion that is rooted in geometrical math (Xenakis, 2008).

Francois Blondel believes that unity between music and architectural proportion is not related to pure math, but the pleasant proportion is grounded in physics (Hersey, 2000). Vitruvius's discussion of proportions was rooted in Greek music theoretician, Pythagoras who discovered in ancient times several harmonic intervals (Walden, 2012). In Renaissance and Baroque periods, other numerical ratios and harmonic intervals were also added in music and architecture. Blondel in his theory, that is still being used, dedicated those numerical ratios for the eight well proportionated rectangles as the pleasant ratios both in music and architecture (Hersey, 2000). The pleasant proportions of Blondel that are based on musical interval used in one of

Baroque designs (Figure 27 & 28). Remarkably, Bernini used the pleasant ratio shared in music and architecture in his proportionated room and in an elevation (Hersey, 2000).

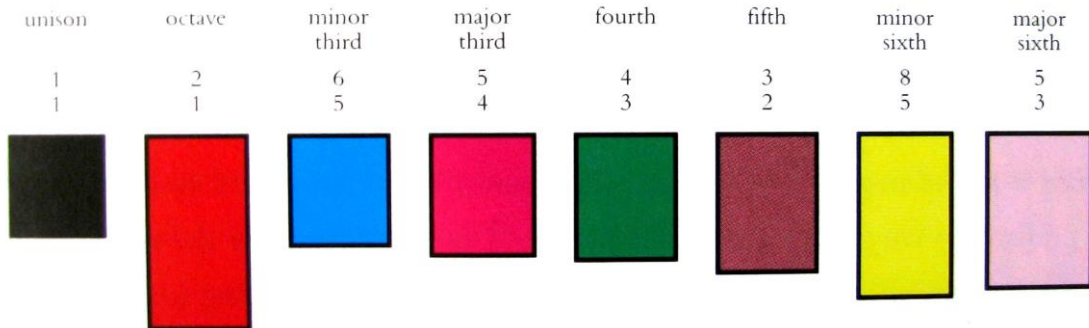


Figure 26: Blondel's Scheme of Eight Consonant Musical Interval, Their Numerical Ratio and Their Geometrical Rectangles. (Jerome, 1971, P.37)

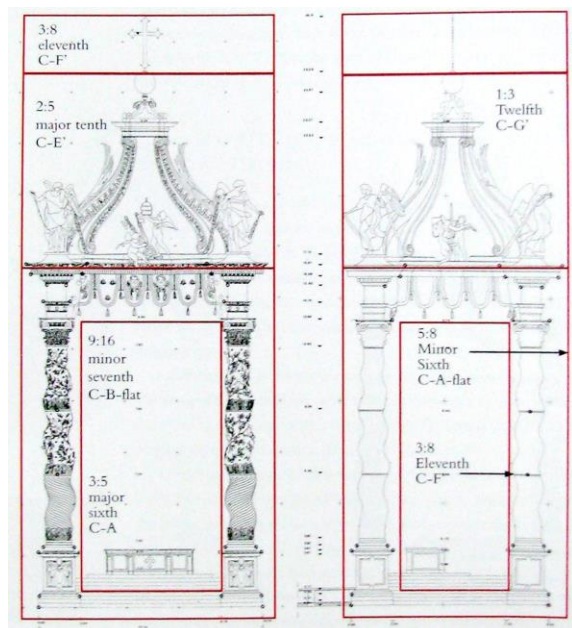


Figure 27: Musical Ratio Overlaid on Bernini's Design (Hersey, 2000, P. 48)

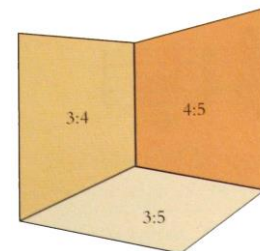


Figure 28: A Room with Musical Ratios (Hersey, 2000, P.46)

Apart from, Goethe also introduced ratio in color that an influential factor on form in architecture. He dedicates a number to each color, and explains a harmonic combination of color. He set yellow 9, orange 8, red 6, purple 3, blue 4 and green 6. Thus having orange and blue color beside each other can result in 1:2 proportion, and red and green result in 1:1. (Goethe, 2012) that both of them seems as pleasant color combination.

Dissonance ratio is also important though they are not generally pleasant, remember the effect of contrast. There are lots of ratio systems in the world of numbers but just a few ratio are indicated as resonance. Blondel was the person firstly introduced some dissonance and inharmonic proportion in music and accordingly in architecture. The dissonant sound, in music some may be used for gaining the attentions, absorbing interests or even having a negative long-lasting effect, like horns on some sports car in Italy (Hersey, 2000). The inharmonic proportion in architecture also important to abstain in usage or even gaining the attention. The figure below show some dissonance musical dissonant interval in music based on Blondel's idea.

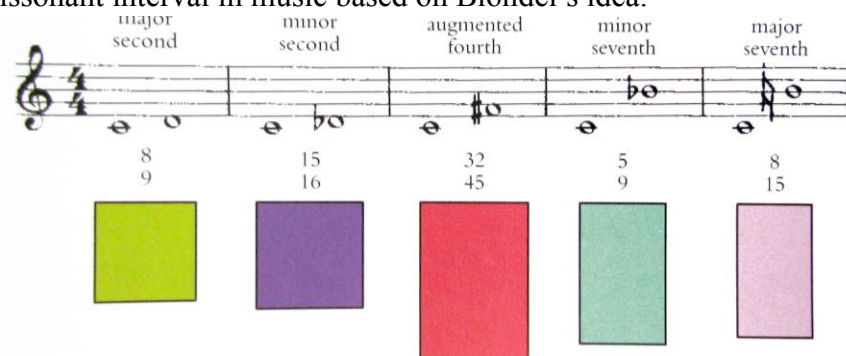


Figure 29: Musical Dissonance! (Hersey, 2000, P.42)

The proportions in architecture and music have two main differences: musical one is more accurate and also unbreakable. For example, the ratio of 17:25 that indicated as a dissonance in music may not look really inappropriate shape of room in the realm of architecture since there is not a great gap between the ratio and 16:24 (or 2:3 that is resonant one). Another unforgettable difference that is being used for architect is related to break of the ratios and forms.

The plate with the proportion of 1:3 (that seems not really well generally) can be broken into three parts with different pleasant proportions (1:0.5, 1:2, 1:0.5) something that is not applicable in music (Hersey, 2000) (Fig. 30).

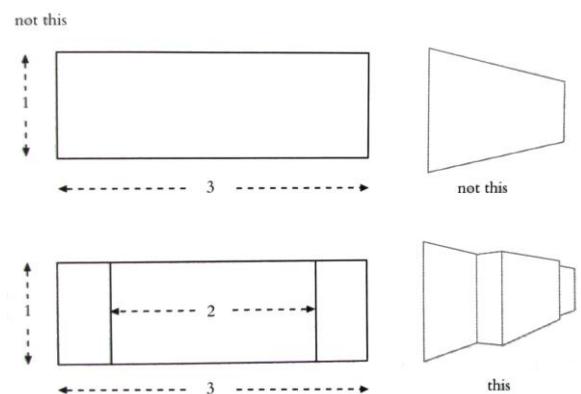


Figure 30: Breaking Dissonance in Architecture (Jerome, 1971, P.43)

Harmonic ratio are not necessarily be built by simply division of numbers. Apart from harmonic sequence resulted in resonant proportion with simple one-digit integers (like 2:3 that is an effable ratio), there are also some other pleasant mystery ratio like golden section and Fibonacci sequence numbers (that are ineffable pleasant ratio like the ratio of 1:  $\pi$  and 1: $\sqrt{2}$ ). (Hersey, 2000)

Golden proportion is an ineffable pleasant ratio. This proportion that is famous with phi,  $\Theta$ , is  $\frac{1}{2}(1+\sqrt{5})$  that is about 1.618. In fact, height versus the width of any shape whether a rectangles or an ellipses or even a divided line should be with this ratio to see pleasure (Hersey, 2000) (Fig. 31). It is interesting that the golden proportion is also called as self-similar sequence whereas by subtracting a square form a rectangle with this ratio of golden section another pleasant golden proportionated rectangle will be remained. The FGCD and also ABFG are golden proportionated rectangle; this is the reason of calling them self-similar ratio (Fig. 32). Since the proportion is an ineffable number the accurate proportion cannot be achieved but by the geometrical drawing, the images below interpret the way of drawing.

$$\varphi = \frac{1 + \sqrt{5}}{2} = 1.6180339887\dots$$

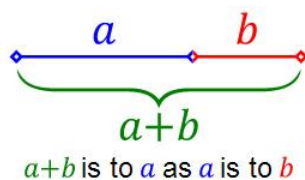


Figure 31: Golden Section Ratio in Line (URL 7)

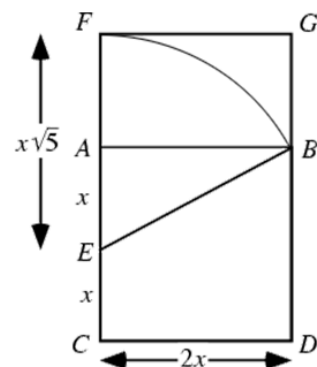


Figure 32: Golden Section Ratio in Rectangle (URL 19)

Golden section like many other various type of pleasant proportion is used in musical composition as well as other arts. Golden section like many other theory and science roots in Greek both from musical or architectural and mathematical point of view. For example in Doryphorus and Venus the Milo sculpture the golden section is illustrated base on musical and architectural ratio in order. Da Vinci also in his painting, Mona Lisa, uses the golden ratio. When the usage come to music, different composers of many styled, schools and eras used the ratio, like Haydn, Mozart in the sonata of 1968 and Beethoven in his Fifth Symphony. (Howat, 1986, p. 187)

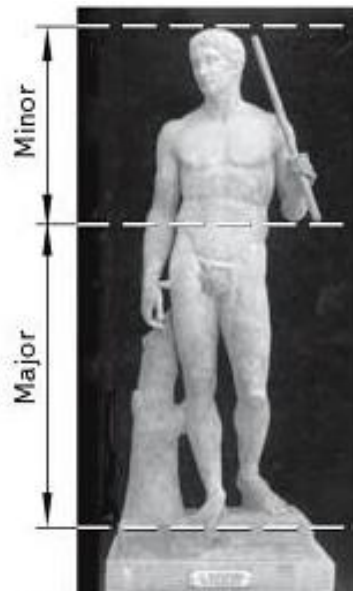


Figure 33: Doryphorus by Polyclitus  
(Stakhov & Olsen, 2009, P.40)



Figure 34: Venus the Milo  
(Stakhov & Olsen, 2009, P. 41)

The trace of golden proportion in architecture is also understandable in different eras. In historical buildings, golden proportion is used in Egyptian pyramids and the Parthenon's façade also. In more nearer eras, Carlo Maderno used the golden section and resonant ratios in St. Peter's building façade (1604-17). Double golden proportioned rectangle is used in main front elevation from the bases of the columns up to the top of the main cornice (Figure 35, Top). In addition, the pleasant proportion is also used from base of the steps up to top of the building with the preferred ratios of 5:9 (Hersey, 2000).



Figure 35: St. Peter Building (Hersey, 2000, P.15)



Figure 36: Egyptian Pyramid (URL 7)



Figure 37: The Parthenon (URL 20)

In Fibonacci sequence, each new number in the series is the sum of the two preceding numbers. Thus the simplest Fibonacci sequence would be 1, 2, 3, 5, 8, 13, and 21. Since Fibonacci series provide a simple way of calculating the golden section of any numbers, calls as the cousin of golden section. For example, 1, 1.618, 2.618 are at the same time golden section series and Fibonacci sequence (Stakhov & Olsen, 2009). Effects of Fibonacci sequence like golden proportion can be seen in many architectures. As an example, the grouped column of a Baroque edifice is formed based on the simplest Fibonacci sequence, 2, 3, 5, 8. There is a group of 2 and 3 in façade, a group of 5 in each side of the symmetrical façade and the 8 clearly visible columns are all remember the Fibonacci sequence. (Hersey, 2000).

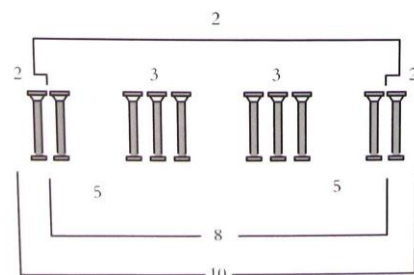


Figure 38: Fibonacci Sequence in Architecture (Hersey, 2000, P.17)



Le Corbusier found the logical consequence and established a new method of proportion based on human's body. He said "The human being is at the same time the source and the purpose of architecture. Therefore the human body which its proportion should be the center of all order." (Xenakis, 2008, p.12). Le Corbusier firstly introduced the measuring system "Modulor" for architecture as a system of proportions in his book "Le Modulor" published in 1950. (Leopold, 2005) He arranged some pleasurable proportions based on human body ratios and 5 noble series of number like Fibonacci sequences (Hersey, 2000). It should not be skipped, proportion is an interrelation dimension and is not restricted to real world dimension, but scale is just designates the real size. Mostly the scale is compared by means of human figure. It might be another reason Le Corbusier used human figure for the dimension of proportions (Schulz, 1965). Consequently, Le Corbusier and Xenakis, his colleague, used the modular proportion that is based on golden section and Fibonacci sequence both in music and architecture in some projects like d'habilitation project (known as Marseille Housing Project) that will be explained in the subsequent parts. (Leopold, 2005)



Figure 39: Marseille Housing Project (URL 7)

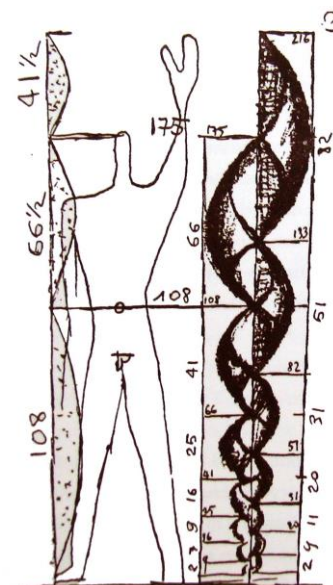


Figure 40: Le Corbusier, the Modulor Man, 1946 (Hersey, 2000, P.212)

### **3.3.3 Rhythm and Sequence**

Apart from the numbers and proportion, rhythm as a repetition of a well-proportioned element is the fundamental criteria for both music and architecture. The trace of rhythm as a fundamental issue in different arts, especially music and architecture, is undeniable. Apart from the mathematics as the origin of composition not only in each note juxtaposing to another, but the combination of them as a whole, rhythm is a fundamental theoretical issue that distinguishes music from some dissonance group of notes that might be called noise. In fact, rhythm is a group or a recognizable fact or a pattern that applies in a periodical of a time. Thus, since the pattern can be perceived by our senses, rhythm is also understandable in both music and architecture.

Contours play an important role in rhythm perception that contrast can be as a manifestation of the contours. Therefore, the effect of contrast is recognizable in the understanding of rhythm. Silences as a part of the motif or melody and musical rhythm, like a second silent time in clock ticking, in architecture also play an important role for comprehending the architectural rhythm, solid walls broken by large open spaces periodically, void and shape, and etc. (Impett, 2010). Le Corbusier, a master of counterpointing objects, used contrast perfectly, to have a rhythmic façade like the La Tourette Project, which will be explained more in the next chapter, in material and elements with void.

Rhythm depends mostly upon the comprising elements that is note or sound in music and architectural shape, form, material and etcetera in architecture. Repeated elements that can be called "beat" is understandable with ear and vision in music and architecture respectively. Howard Goodall in his series, *How Music Works*, expresses the reciprocal relation between rhythm in music and heart beat even from the time of being

in the womb. On the other hand, rhythm in sonic world can assist perception of visual rhythm in architecture. (Leopold, 2005). Thus the idea of rhythm in a visual composition resulted in some repeating elements in architecture that can be seen from musically point of view also. Consequently, rhythm, in music, can separate the time in different sequences, and, in architecture, the repeated part can divide any architecture into pieces of sequences.

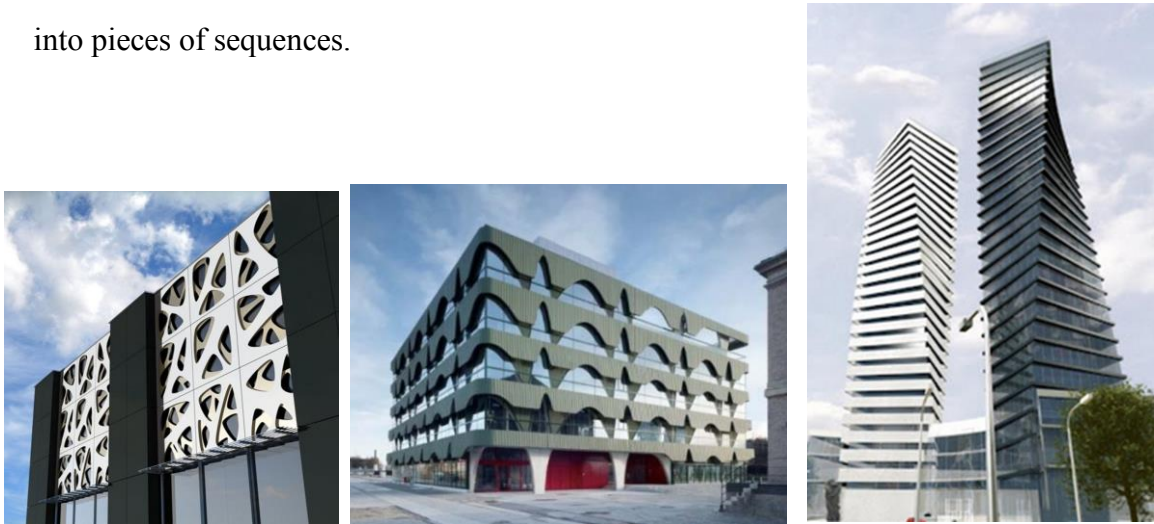


Figure 17: Rhythm in the Façade of Buildings  
(Left: URL 21, Center: URL 22, Right: URL 22)

Sequence as a related issue and alike rhythm can be seen in any arts such as music, dance and film (Muecke, 2011) but from architectural point of view, the sequence results in making pattern and module that can affect the sense of continuity. Since both rhythm and sequence have internal repetitious pattern, might result in prediction of subsequent part of music or hidden part of architecture. Lynch and Myer: “a basic sense of rhythm of attention will strengthen the sense of continuity, whereas too sudden a change in the tempo will snap and thread.” (Pallasmaa, 2012, p.25) Consequently, sequence shapes the path experience and makes it rich, rhythmic. It enables well-joined transition and also balanced movement in architectural design. (Muecke, 2011)

Like music that rhythm and sequence are ordered in time, the sequences of architectural experience are in row of path and circulation process. For example, in

modern architecture that circulation and approaches to building significantly considered, circulation with certain intervals have also impact on façade elements. Eventually, it is not a surprise that, Kevin Lynch in his book 'The Image of the City' mentions that path is the predominant city element for most people thus need more awareness (Muecke, 2011). In a larger scale, the path can be in freeway also. Like in music that each note last for a temporary moment, visual note in a car passing the freeway are not lasting permanently and plays prompt harmonies. Music that sometimes define as aural understandable elements through time, in architecture the visual element expresses through time. From this point of view, the row of trees, series of masts attached to the roadside, various heights, shapes, and flowering patterns are the note transmitter as instrument by means of light as the musicians. (Martin, 1994).

In contrast to music and freeway rhythm and sequence perception that almost always fixed in time and perceived in special order, spatial rhythm, and sequence is not necessarily fixed. Linear rhythm and perception sequence is more dependent upon way of walk, faster or slower look around, reverse thus it is totally free to construct sequences. (Muecke, 2011). Since the perception of sequence is not necessarily replicated twice in the same manner, the sequence as results of motion, is not concern in architecture rather the rhythm that is independent from the observer is mostly considered in spaces and architecture (Muecke, 2011).

In conclusion, this chapter by closing one step toward each fields shows there are some fundamental characteristics similarity in music and architecture. As the table below briefly summarized, some similar significant and influential concepts like space, time, world, shape and form are belongs to both fields although there can be seem some similarities and differences (Table 2). From another point of view, there are similar

characteristics in visible wave in architecture and audible wave in music resulting in some commonalities like similar wave systems and components, and accomplishment of sound and voids that are notes and buildings in music and architecture respectively. Lastly, both music and architecture are founded on mathematics that is the most well-background interdisciplinary knowledge. They borrow similar terms, numerical orders, and mathematical rules from each other.

Table 2: Commonalities and Differences in Mutual Theoretical Concepts (Author)

| Commonalities and Differences |                         |  |
|-------------------------------|-------------------------|--|
| Architecture as Frozen Music  | Time                    | Virtual and Real Time  |
|                               | Space                   | Physical and Intuitional perception  |
|                               | World                   | Perceiver at center of edge of the world / Real world & Imagination World / Existence of Whole Architecture & developing of music in time / Not definite Position in Architecture & Pre-defined Position Music |
|                               | Shape                   | Defining Shape by note & Geometry<br>Motif and Architectural shape   |
|                               | Form                    | Musical note & Architectural Elements<br>Musical and Architectural Principles of relationship  |
| Wave                          | Sound & Light           | Sound and Light Wave System<br>Producer, Transmitter, and Receiver   |
|                               | Wave and Environment    | Building and Voids & Notes and Silence   |
| Math                          | Numeric Order           | Arithmetic Series<br>Geometric Series<br>Harmonic Series   |
|                               | Proportion and Interval | Harmonic Proportion & Interval<br>Pleasant Proportion & Golden Proportion  |
|                               | Rhythm and Sequence     | Rhythm in Architecture and Music   |

## **Chapter 4**

### **ARCHITECTURE BASED ON MUSIC**

Hitherto it is clear that music and architecture are the two interrelated fields of art with the similar origin, terms and concepts. It is observed that music and architecture as tools of communication and cultural heritage of environment always influence each other throughout the ages. In contemporary times also, music is again a source of inspiration and interrelated fields for architectural design. This chapter aims to point out the connection is far beyond the similar theoretical issues. To achieve this aim, selected architectural examples are presented to illustrate the trace of music in architectural realm. From this point of view, this chapter is categorized by complexity level of interaction from simplest direct transferring musical figures through architecture, and musical orders and disorders to the most complex one that concept of buildings affected by music.

## 4.1 Architecture based on Musical Image

The simplest way of interaction between music and architecture is the direct analogy to a musical images in architecture. Because of the intimate nature, this interrelation seems not to be sufficiently complex, however, it influences architecture positively and becomes a part of it in different scales of environment. Respectively city, buildings, and furniture scales are to be focused in this subchapter.

Yet, it might be significant to know some instruments are designed also by architects before moving on to a discussion of architectural cases. Richard Meier is one of those architects designed a piano for Rudolf Ibach Sohn in 1995 (Fig. 42). In line with his architectural discourse, he uses geometrical form and eliminates the “piano curve” with a rectilinear form. He also uses metal legs instead of wooden traditional one. In addition, since many pianists rely on the shadow of cast during the performance, he changes all the keys to same color. Similarly, Daniel Libeskind designs an instrument for German piano-maker Schimmel in 2003 (Fig. 43). In contrast to typical concert grand with about nine to ten feet, he designed a nineteen-foot length piano. Based on the confession of Schimmel, "It's a piece of architecture: slim, long, elegant," (Muecke, 2011).

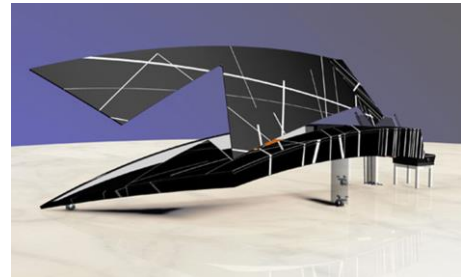


Figure 42: Richard Meier 1995 (URL 23)

Figure 43: Grand Piano, Daniel Libeskind, 2003, (URL 24)

#### 4.1.1 Musical Image in Urban Scale

Peter Cook, an old member of Archigram group, theorizes the ideal plan of a city by basing on piece of a violin by Ernest Bloch, named “Bloch city”. He considers music as a direct architecture. In the early 1980s, he transferred graphic form of a violin notes of a concert into composition of the plan of an ideal city (Capanna, 2009).

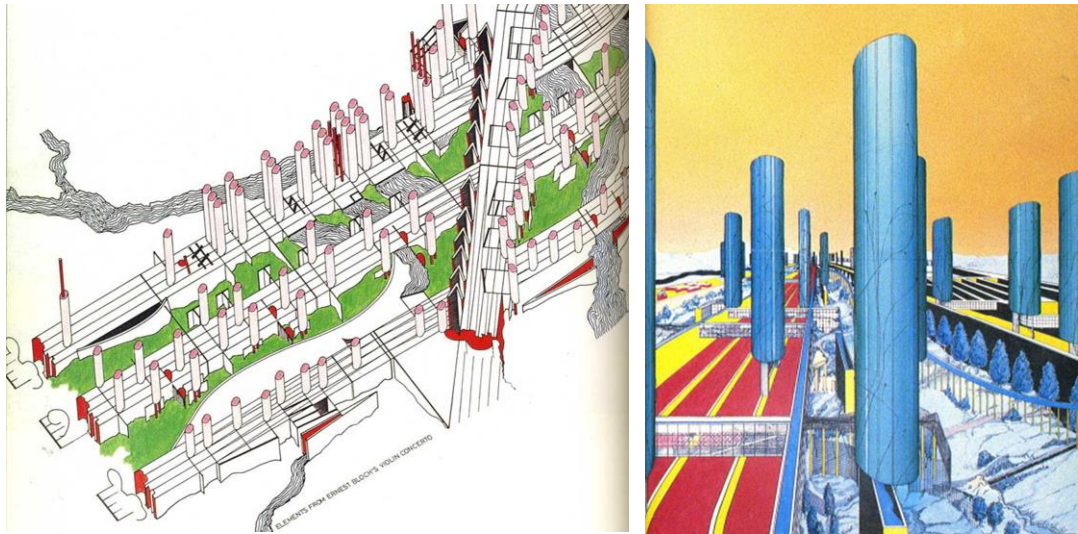


Figure 18: Bloch City, Cook, 1983, Master Plan (left) and Tower and Bridges (Right), (URL 25)

There are simple reinterpretations of musical figures in the ideal city. He mentions as the same as written music, limited in external left and right, the ideal city should accordingly have a beginning and an end of the physical space represented by silence. According to the image of the piece of music, the city is comprised of three parallel staves as urban highways diagonally cut by a forth one that link them all in horizontal direction. He proposes the notes as tall cylindrical skyscrapers, the stave as street, the supporting marks as walls, and the dividing “bars” of the beats are represented as bridges, rhythmic separations (Capanna, 2009).



Another direct transfer of musical image into architecture is related to the design of a bridge that is even a symbol of a city. Many instruments possess rhythmical length of string for producing different harmonic sounds. In modern times, wire as a construction material is introduced to the field of architecture. Accordingly, several bridges have inspirationally produced with underlying structural idea of cables. In regard to rhythm and proportion in strings of an instruments, musical images can be found in the harmonic cables used in bridges like Jerusalem Chords Bridge in city of Petach-Tikva, Israel (Fig 45).



Figure 19: Jerusalem Chords Bridge in city of Petach-Tikva, Israel  
(Left Top: URL 26, Left Bottom: URL 27, Right: URL 7)

The harp and lute as two similar musical instruments can be found in several cultures dating back to Middle Ages. These instruments transferred into architecture by Santiago Calatrava in the design of bridges. He designed a bow-shaped and angular harps for the bridge at the Universal Exhibition in Seville in 1989. After a three-year execution time, the project clearly illustrated the interrelation of image of a musical instrument in architecture.



Figure 46: Alamillo Bridge in Seville, Andalusia, Spain, 1992 (URL 28)



Figure 47: Egyptian Wall Painting, Harp, 15 BC (Muecke, 2011, P.183)

The lute which is a string-base instrument becomes an inspirational source for Calatrava. He designed a series of bridge regards to the harmonic strings. The bridge which is named “Lute” is the representation of the lute in a larger scale. In fact, he embodies a special sense of movement, a musical, rhythmic with his bridge designs. (Tzonis & Donadei, 2005).



Figure 48: “The Lute” Bridge Santiago Calatrava, Northernland (URL 29)

#### 4.1.2 Musical Image in Building Scale

The images and forms of music sometimes become inspirational for the design of building in architecture. The Piano House is one of those well-known buildings designed by the company of Huainan Fangkai Decoration Project Co for the Faculty of Hefey University of Technology in China. As it is seen, the building is designed for music lovers and it is composed of a transparent violin possessing transparent stairs, leaning against a piano. This building with its special concept aims to attract new development in the vicinity (URL 30).



Figure 20: Piano House (URL 31)

Walt Disney Concert Hall, a master-piece of Frank Gehry, is another recognized building complex that has deeper usage of musical shapes. Gehry who is involved both in music and architecture used resonance that takes place in musical instrument to achieve the pure sound and to provide the best quality of music for every listeners. In fact, Gehry designed a musical instrument in the body of architecture (Muecke, 2011). In Disney Concert Hall, the sound is experienced through a big model by trial and error to achieve the best quality and pure sound resonance (Golbert-Rolf & Gehry, 2002). Consequently, not only the color and material of an instrument which is wood but also the resonance of a musical instrument have played an important role in this building.



Figure 50: Walt Disney, Gehry, Model (Golbert-Rolf & Gehry, 2002, P.65)



Figure 51: Walt Disney, Gehry (URL 32)

The concept of Performing Arts Centre KILDEN is based on a geometrical shape basing on a mystery musical line by ALA Architects. Setting the four functional zones of the building aside, it consists of a 1200-seat auditorium, a 750-seat theatre and two smaller halls as performance spaces. The artistic performance area and being in waterside firmly emphasis on artistic curvilinear wavy line that represent musical contours. The musical lines express the aesthetic understanding in this building and results with a harmony and adaptation of sea waves. Material of the roof also contributes to the representation of musical lines since it is clad with wood which is the base material of musical instrument due to the perfect resonance capability.

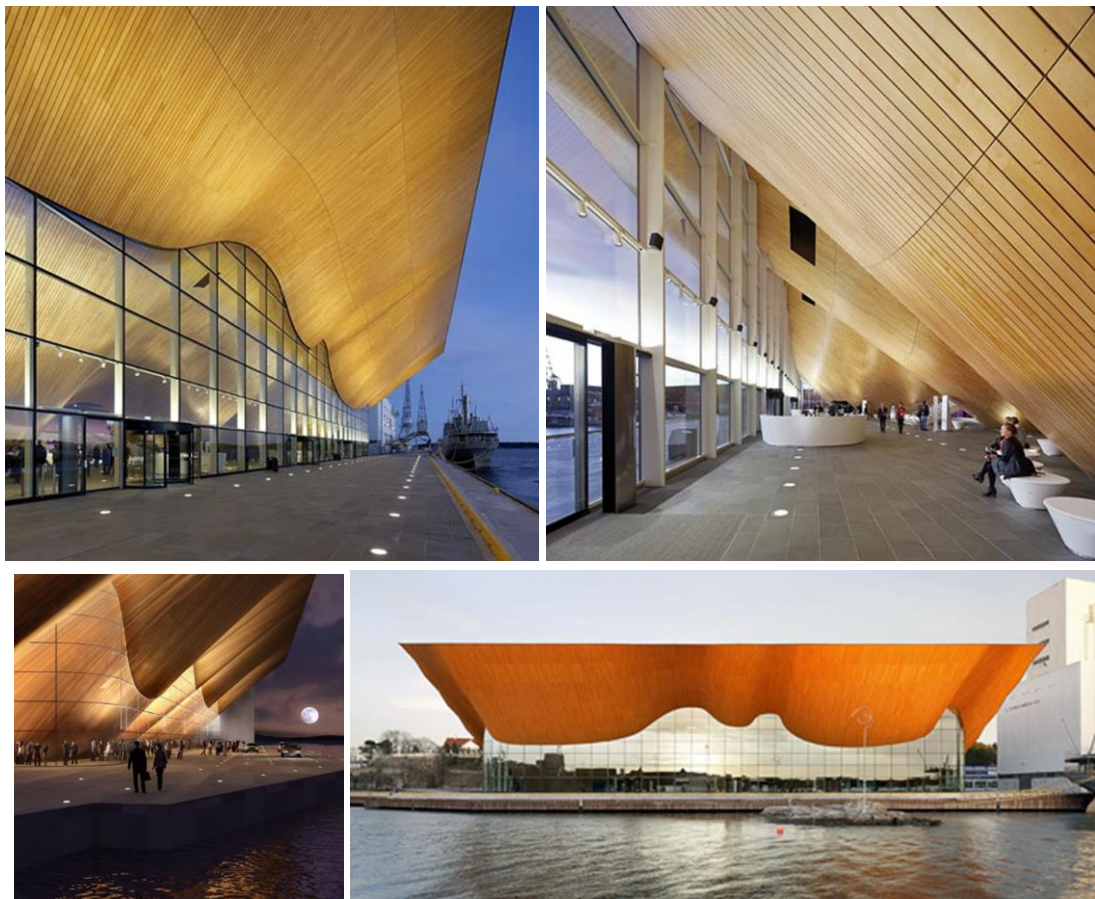


Figure 21: Kilden Performing Arts Center by ALA Architects  
(Bottom Left: URL 33, Others: URL 24)

### 4.1.3 Musical Image in Components of Space

Musical images become source of inspiration also for the design of certain components of space. Pools, staircases, even sometimes street and indoor furniture are designed with references to the musical images. Canadian Aqua-Tech Company designed a pool for Burney who was an ardent guitar collector with exact shape of a guitar, named as “Pool Studio”. They design a nineteen-meter guitar-shape pool with all the details in the backyard of house. The detail lines of guitar image in the pool are blurred with each movement on the surface of water that makes the line waves (URL 33).



Figure 22: Swimming Pool (URL 34)

Another striking design transferring musical image into architecture is a metro-station staircase in Sweden. In fact the designer aimed to combine the pleasure of space with the vertical circulation function of the staircase. When the staircase is observed, finding from the interview with the users and statistical analysis reveals that this designer has utterly achieved his goal. Remarkably, this staircase is mostly preferred instead of escalator next to it to go up and down. Statistically, 66 per cent of users is attracted with the particular design of that staircase and chose it for circulation although there is an escalator next to it. In fact, this staircase indicate power of an effective and sensitive design in affecting and changing human behaviors in an environment (URL 35).



Figure 23: Piano Stairs before and after Changes  
(URL 36, Edited by Author)

Sometimes, musical images are used for the design of certain furniture which are also for decoration of indoor space as well is being used for specific purpose. The design of a bar vividly illustrates how a furniture in the form of a Contrabass can store and hide the utensils of drinking (Fig. 55). Apart from, guitar, volume bars, and some other musical image and concepts have been utilized in the design of furniture like tables and hangers. Indeed, from outside all appears as a musical instruments which might reflect the aesthetic taste derives and interest of users in music (Fig. 56). Consequently, it can be argued that musical images sometimes have the potential to be source of inspiration for design at different scales. Especially in buildings and furniture scales they concisely or superficially influenced design.



Figure 55: The Secret 'Contrabajo Mueble Bar' (URL 37)



Figure 56: Furniture with Figures of Musical Instrument (URL 38)

## 4.2 Architecture Based on Musical Principle

Conversion of musical image into architecture is the direct version of interaction between music and architecture. In this part, the musical terms or musical principles which are commonly used in architecture are focused. Generally, architects who are interested in this approach, are having good level of knowledge in both music and architectural realms. One of the most known architects, Le Corbusier used his logical and mathematical abilities to inspire from music. “Undulating Glass Panes” that firstly applied by Le Corbusier in collaboration with Xenakis was an innovation in architecture. Moreover, the pure mathematics of the modular is applied in rhythm in different scales of architectural space (Xenakis, 2008). In contrast to the sound order and organization principles, Daniel Libeskind inspired and utilized disorganized sound characteristics known as noise in the realm of architecture.

#### 4.2.1 Sound Orders in Architecture

Peter Tonkin in association with Landscape Architects Taylor Cullity Lethlean designed a sculpture for over 2 kilometers of a freeway in Melbourne, Australia. The project called “Craigieburn Bypass” make a special experience for the passers with the speed of 110km. This project designed by aspiration of undulating panes that rooted in musical principle and conveyed into architecture firstly by Le Corbusier. It won lots of architectural prizes like RAI Victoria Joseph Reed Award in 2006 and Urban Design award in 2006 by Australian Institute of Landscape Architects Award for Excellence in Design in 2006. The musical rhythm is perceived with the simple concave and convex folds, not only in aggregation, but in rhythm of colors also. With this respect, musical principles are very simply utilized in the field of design in a very creative way. Without a doubt, passengers using this freeway have the pleasure of the created effects. Furthermore, this is the project which also indicates the importance of interrelation between different fields of art for more creative works and methods in design (URL 43).



Figure 24: Freeway, Sculpture,  
Melbourne, Australia  
(Down: URL 43, Up: URL 44)





The Monastery La Tourette (1952-1960) designed by Le Corbusier and Iannis Xanakis is the first building having undulating panes. It is located on a sloppy site as one rectangular block for church and related functions and an U-shaped residential part around a courtyard. (Kathleen, 1984)

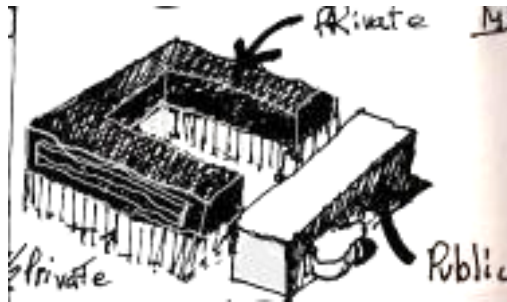


Figure 58: La Tourette, Proposal Concept (URL 39)

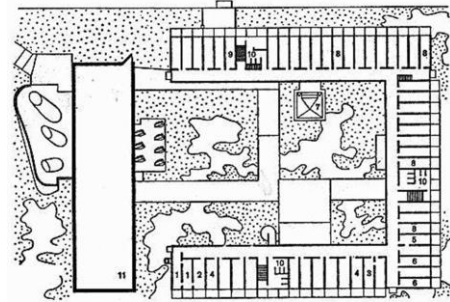


Figure 59: Two Distinctive Parts of Building (URL 40)

The division of the 366 cm height glass walls is one of major characteristic of the project made it unique. At first a simple mathematical progression line is proposed, but he decided to use more sophisticated solution to distribute the ribs based on musical rhythm called “undulations” (Fig 60). In horizontal division of the rhythmical glass sheets, the footstep of music changed the simple same size division into golden section ratio (Xenakis, 2008). With combinational organization of horizontally and vertically melodic intervals, he designs the rhythmically façade (Fig. 61) (Sikiaridi, 2004).



Figure 60: La Tourette Building (Left: URL 40, Right: URL 39)

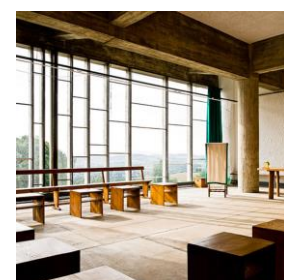
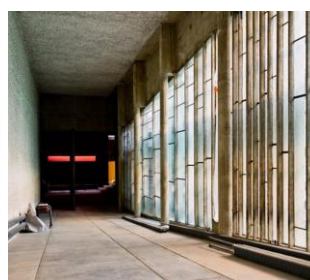
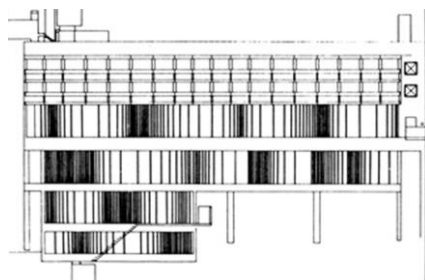
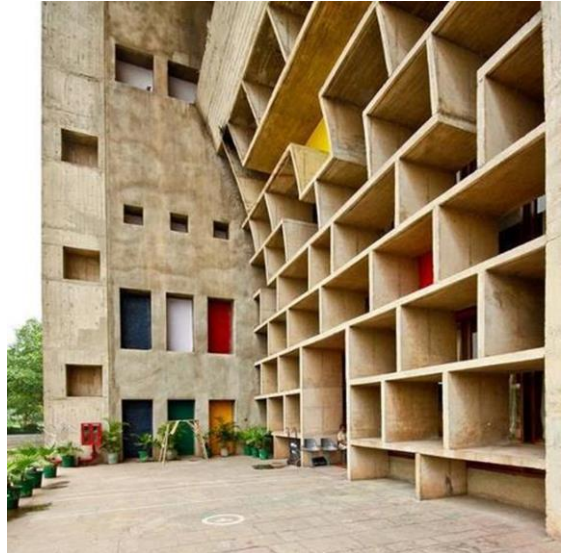


Figure 61: Façade Drawing & Interior Illumination (Left: URL 41, Center: URL 40, Right URL 42)

Le Corbusier was one of the pioneer architects used musical rhythm in his project. Apart from the undulating glass, he considered rhythm of music mostly injected to the façade of the buildings. In 1951, Le Corbusier designed a residential complex related to music in Chandigarh, India. In this project, 750 people inhabiting, large sheets of glass are supposed with columns llocated within musical rhythm and they are admitted as “musical glass panes.” It is also worth to mention, the “shoe box” method of construction with combination of pre-stressed concrete units is also applied within this musical rhythm (Fig. 62) (Xenakis, 2008).



Interior Illumination  
(Xenakis, 2008, P.163)



Chandigarh Rhythm  
(URL 45)

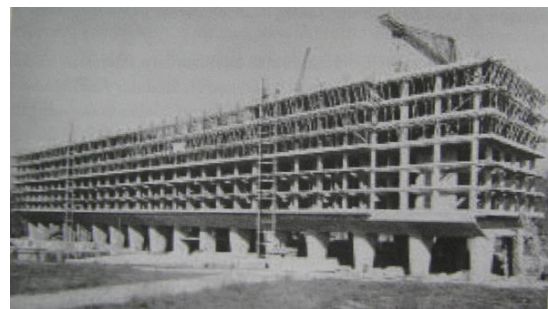


Figure 25: Chandigarh Undulating Glass (URL 46)

Marseille Housing Project known as “Unites d’ Habitation” in 1948 is designed to occupy about 1600 people by Le Corbusier. He wanted to design “city within a city” by including different functions like restaurant, gym, hairdressers, and residential units (Xenakis, 2008). The façade of the Unites d’ Habitation is a striking example of concurrent visual horizontal and vertical rhythm (Fig. 63). As Corbusier in his book, *The Modular*, structured the proportion based on human body ratio, the proportion of a module of this project has almost golden sections ratio rooted in male physics with the raised arm proportion (Le Corbusier, 1954). The equal span by assist of artistic idea changed from a simple repetitive façade into a more complicated rhythmical one. Consequently, like a polyphony music that has more than one rhythm simultaneously, this building possesses more complicated and artistic rhythm may unrecognizable for ordinary people (Hersey, 2000).



(URL 48)



Modularity (Xenakis, 2008, P.14)



Figure 26: Marseille Housing Project (URL 47)

#### 4.2.2 Noise Disorders in Architecture

Another shared theoretical issue both in music and architecture is “Chamber” rooted in modern era thought. Unity and fragment are mentioned as two important issues in the new way of thought in modern time. Chamber works do not move toward neither unity nor fragmentation. In spite of great effect of geometry, this theory strive to eliminate geometrical orders in lines. Libeskind declares, it is alike “reduction to a sign of its absence”. Accordingly, this treatment may result in not to considering as designed architectural drawing. Chamber in music is interpreted as noise disorders. In fact, it might manifested by a noise within a music that cannot be said neither it is just a noise whereas it is part of a music, nor it is a music since does not have musical order. The chamber works comprise series of abstract line compositions in black ink on white paper, without geometry or substructure and accordingly unbreakable. Eventually, Libeskind, initiator of the theory, exhibited 28 drawings chamber works designed by himself in October 1983 (Fig. 64) (Hays, 1998).

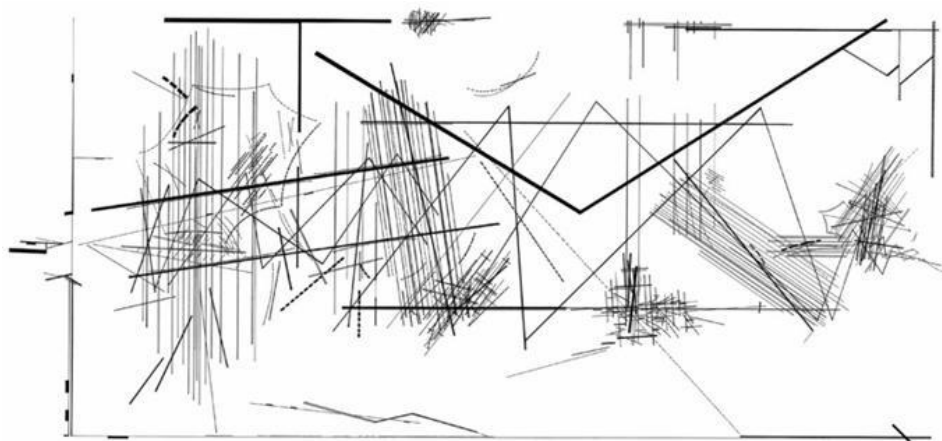


Figure 27: Chamber Works, Daniel Libeskind, 1983 (Capanna, 2009, P. 258)

Chamber in music and architecture that may be very cryptic since they are founded on geometry. The interpretation of chamber work in architecture, may result in some unrelated line and in music that is based on harmonic notes can recall the noise as a

result of lacking any substructure. Consequently, Daniel Libeskind designed a museum for Jewish people based on chambers work as an inspiration source to show unsatisfactory of Jewish people from Holocaust event. Not only he designed a zigzag form for the whole structure of building that is like a disordered organized structure, the opening of the building is also influenced by the idea of chamber (Fig. 65 & 66). Finally, as the pictures below show, he designed unstructured openings as chamber with dramatic space behind (Capanna, 2009).



Figure 65: The Jewish Museum Windows (Left: URL 7, Right: URL 49)



Figure 66: Drawing of Museum as a Chamber Work (Capanna, 2009)

Briefly, the principles and thoughts borrowed from music have played important role in the development of creative and innovative projects in architecture. In regarding to illustrated projects, undulating glass and modularity as sound orders and chamber works as noise disorders are regarded as innovation and creativity activity in the field of architecture. In this respect, it might be argued that music and its concepts and principles become sometimes certain issues in architecture forcing the limits of creativity and innovation.

### 4.3 Architecture based on Musical Concept

This part pivoted on architectural projects which have indirect and complex references to the field of music. Although very rare examples are found, in this category, the most striking and interaction solutions take place. In this regards, Steven Holl and Iannis Xenakis' work comes forward as the influential products combining music and architecture. In particular, Xenakis, a composer architect, is the pioneer of the field.

#### 4.3.1 Indirect Use of Musical Concept

One of the rare samples of a building based on musical concepts is Stretto House by Steven Holl in 1989-1991. As the same as ideal city theorized by Peter Cook that was completely based on musical images, this building is completely designed inspiration from musical concepts (Capanna, 2009). In fact, this building is designed based on concept of music in hidden or indirect manner that may not to be understood in a first glance. Accordingly, the building is designed in parallel to Bela Bartok's "Music for Strings, Percussion and Celestra" (Martin, 1994). The composer, Bartok, declares "we are concerned not only with achievement of purely scientific issues, but also those which have stimulating effect on composer. According to natural order of things, practice comes theory." (Martin, 1994, p. 57)

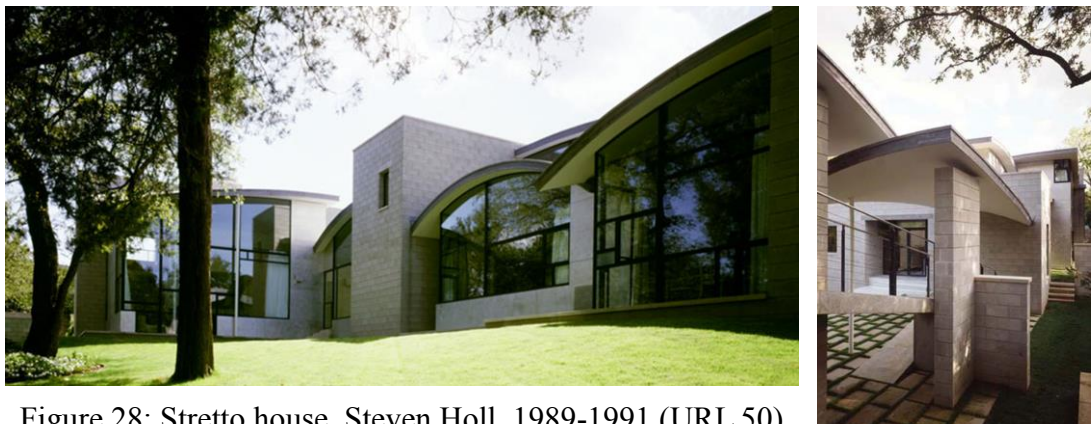


Figure 28: Stretto house, Steven Holl, 1989-1991 (URL 50)

Stretto House is located in a green country, Texas, adjacent to three ponds banned with three concrete dam. The projects was also aimed include some concrete blocks as “spatial dams” in combination of “aqueous space” flowing through. Regarding to the music of Bartok that made up four distinct movements, the project is formed accordingly in four clear parts comprising from solid forms associated with the form of dams and curved one interpreted as liquids (Martin, 1994).

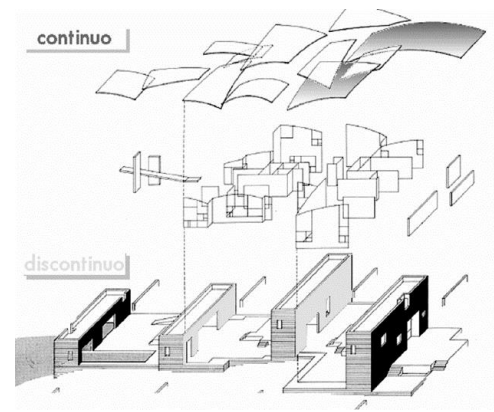
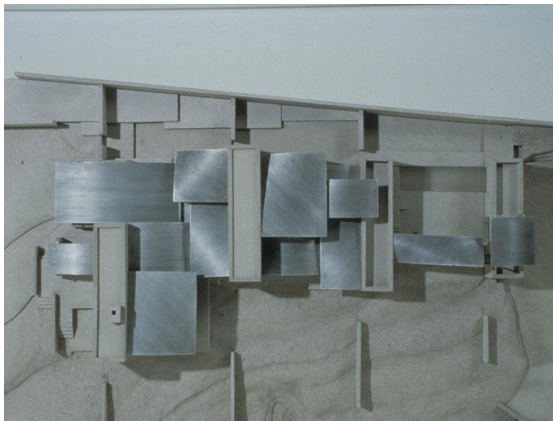


Figure 68: Stretto House Site plan (URL 50) Figure 69: Spatial Dam, Aqueous Space (Capanna, 2009, P.269)

As the same as the music possessing both heavy (percussion) and light sound (violin) simultaneously, the building is comprised of two elements in each four separated parts represent each musical notes. Orthogonal walls are containing the service areas as heavy elements and light curved metallic roofs are as the light elements. (Capanna, 2009).

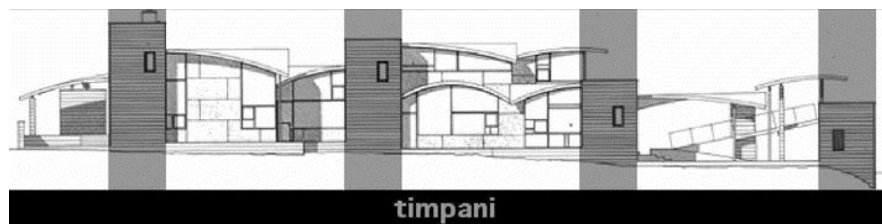


Figure 70: Stretto House Timpani Interpretation (Spatial Dam) (Capanna, 2009, P.270)

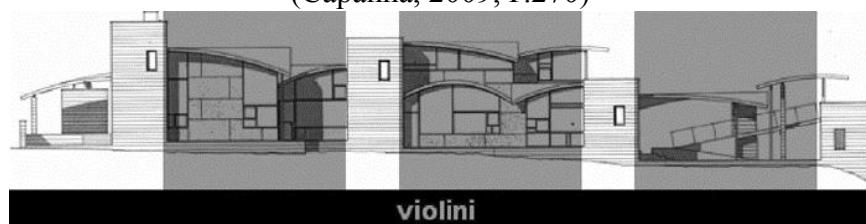


Figure 71: Stretto house Timpani Interpretation (Aqueous Space) (Capanna, 2009, P.270)

Composer of the music, Bartok designs the music based on folk theme. He believes that vernacular or local music of any place can ultimately be traced to a few primeval sources like the golden mean and Fibonacci series in any parts from the whole piece whether symphony or sonata to the movement of smallest phrase (Stakhov & Olsen, 2009). Eventually, the building is accordingly used this local tones. The effect of Fibonacci sequence (1, 2, 3, 5, 8, 13, 21, 34, 55, and 89) can be seen in the structure of the building. As the same times, Golden Section determines in the proportions of the building from parts to the whole (Martin, 1994) including the ratios of walls and openings or solid and void. The ground and upper floors with 21 by 13 feet recall the typical feature of the Fibonacci series (Capanna, 2009). In brief, every surface of the building has the trace of the Golden Section and Fibonacci Sequence in regards to the Bartok's idea.



Figure 72: Spaces with Golden Section Ratio (URL 45)

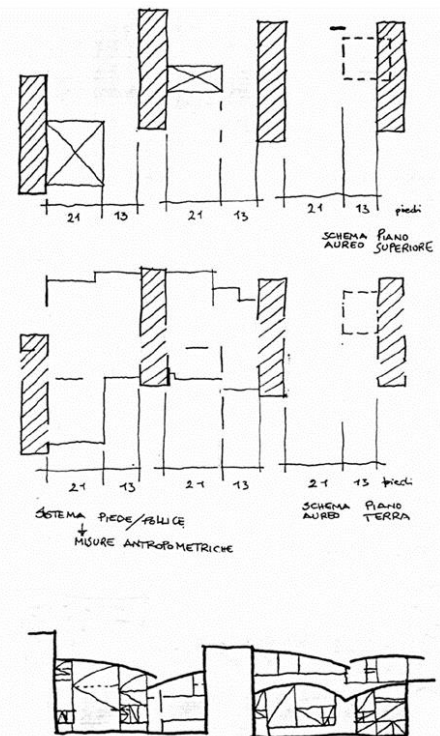


Figure 73: Golden Section in Organization

(Capanna, 2009, P. 267)



### **4.3.2 Direct use of Musical Concept**

Architects considering musical concepts are actually the designers strive to erase the boundaries between different fields of art like Iannis Xenakis (1922-2001) who was a composer, architect, mathematician, engineer and media artist in spite of training originally as an engineer. He was working in the office of Le Corbusier and become an internationally known composer, designer. Specifically, Xenakis works in different fields and transferred them from one field to another, from engineering to music, from music to architecture and visual events (Sikiaridi, 2004). Since he was originally an engineers, a wide range of ‘transfers’ from the mathematical-scientific world is clearly visible in his multidisciplinary works.

This experience of working simultaneously in architecture and music and this dual sensibility for architecture and music enabled Xenakis to approach musical form in an architectural way and to compose architecture as a complex of (dynamic) relations. Not only Xenakis as a composer was able to convey technology in music and visual world of music, he could transfer the musical shape that rooted in math like hyperbolic parabolic surfaces in architecture. Xenakis implemented the structure of music, in architecture. (Sikiaridi, 2004)

Apart from the architecture with music, these buildings are designed for a new way of performance. Polytope and diatope as two building were aimed to improve the way of listening music either by ear and eye ((Xenakis, 2008). He, in an interview, stated in 1996: “this represents, in a sense, an encounter between two different music, one to be seen and the other to be heard.” Elsewhere, he introduced diatope “Music to be seen.” (Xenakis, 2008). Thousands of light source in different color, may be cooperated with the lasers, and hundreds of adjustable mirrors are attached in a space surrounded by a

musical architecture to create some light patterns to show some abstract forms “lotuses”, “galaxies,” and “wheels” and in one word metaphysical ambiance of the work (Sikiaridi, 2004). Each person within a 46-minute journey in sound having a spectacular experience a combination of aural, visual world (Xenakis, 2008). He performed a computer-driven showers of light, spirals, undulating or pulsating sequences and amazingly he is able to tell stories in music (Hofmann, 2002). Consequently, these buildings apart from new innovation of forms firstly introduced the new method of performance, combination of sound and light.

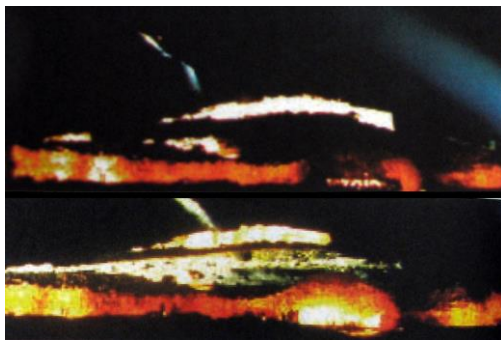


Figure 7429: Performance of Polytope de Cluny (Xenakis, 2008, P. 234)

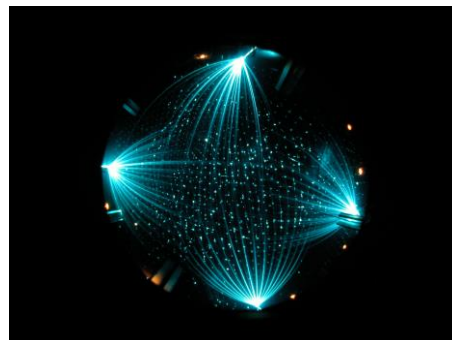


Figure 75: Xenakis Diatope, 1978, Sound and Light (URL 51)



Figure 76: Xenakis Laser in Polytope de Cluny (Xenakis, 2008, P.228)

Xenakis for the first time combined the architectural material into media space. It can be considered an early model of the emerging ‘hybrid’ spaces, that the ‘virtual’ world in come to the real tangible world (Sikiaridi, 2004). Finally, he used a computer to arrange all the changes of media and accordingly in real architectural world and

thereby he provided a connection between light, color, images, rhythm, sound and architecture in an inseparable way (Xenakis, 2008). One of the buildings that were designed based on the musical composition for a specific performance of light and sound is the Philip pavilion in Brussels World's Fair. (Sikiaridi, 2004). Xenakis says:

*“That was the first time I'd done something completely by myself something entirely different, with new surface solution. I had proved for myself that I was able to create something in the field of architecture that had not existed before. In the Philip pavilion I realized the basic idea of Metastasis: and in the music, here too I was interested in the question of whether it is possible to get the form one point to another without breaking in the pavilion it resulted in hyperbolic parabola shapes.” (Xenakis, 2008, p. 99).*

As a result, apart from the innovations in performance, architecture in regards to the composer-view of Xenakis also has many creativities. Like the concept of musical notes that comprises by two main categories of continuous, smooth, and light sound that he called them irrational/emotional and discontinuous and heavy instruments he structured his architecture based on combination of curvilinear and straight line. Moreover, as the same as the continuous glissandi in music, he wanted to eliminate the borders between walls and ceilings. He achieved steady flow of curved surfaces alike music by means of having engineer knowledge and reinforced concrete. In addition, like glissandi that has great supportive rule he designed the envelope-like of architecture by ruled surfaces reach to hyperbolic parabolic surfaces (Sikiaridi, 2004). Consequently he could design and build a new theme of architecture without any supporting structure that rooted in musical knowledge.



Figure 77: Metastaseis (Glissandi) in Combining Wall and Ceiling (URL 40)

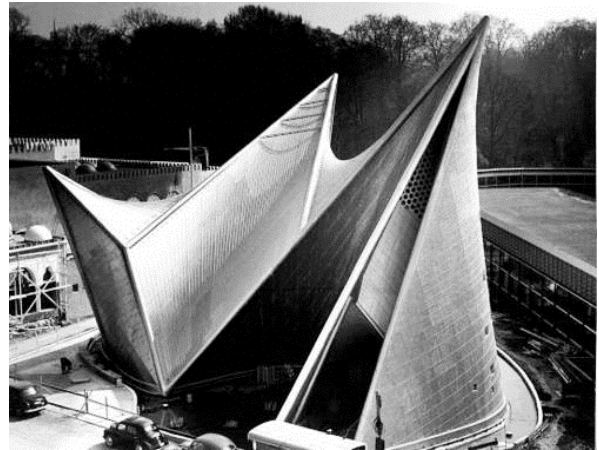


Figure 78: The Philips Pavilion, Le Corbusier/Xenakis (URL 52)

Another sample of architecture used musical principle is based on the curved shell of the Philip Pavilion is Polytope. This structure is physically movable and made of red vinyl stretched over a metal frame. This architecture like world fair new style of performance is used and like the previous one the architecture, music, texts, and lights are combined in a hybrid world (Xenakis, 2008) Consequently, the three mentioned cases can easily reveal the different level of interrelation and combination between music and architecture to be unable to separate.



Figure 79: Diatope Structure & Building (URL 53)

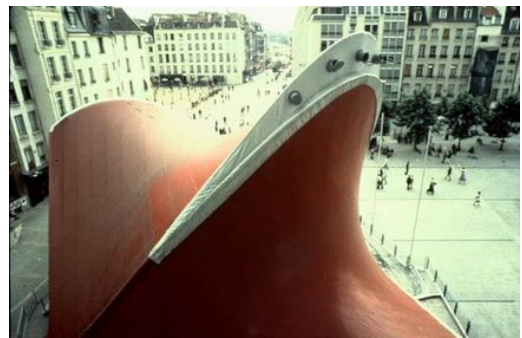


Figure 80: Sample of Diatope Performance (URL 53)

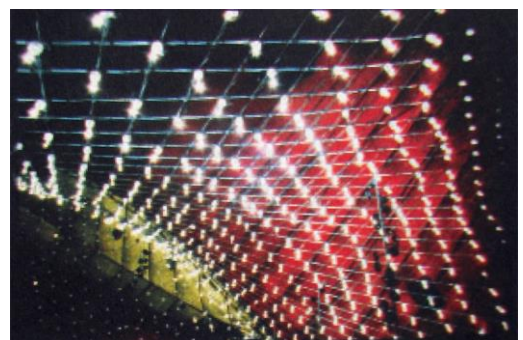


Figure 81: Light Flashes on Suspended Cables, (Xenakis, 2008, P.250)

In conclusion, this chapter was an endeavor to show the interrelation between music and architecture can go beyond scholars and theoretical matters. In regards to the summarized explained information in table below, the simplest interaction between music and architecture are visible in three different scales in architectural realm from master plan of an ideal city to furniture designs (Table 3). Musical orders and noise disorders can be the inspiration source of even international architectural master pieces. Lastly, a deep perception in both music and architecture can enrich a building ideas and concepts initiated wholly on the basis of musical concept. This complicated interrelation required well knowledgeable artist can be seen in different scale of buildings from a single house to public performance buildings and change the building to a memorable edifices in history of architecture.

Table 3: Criteria of each Architecture Designed based on Music (Author)

|                 |                 | Commonalities and Differences  |
|-----------------|-----------------|--|
| Musical Images  | Urban Scale     | Ideal City & Note Figures<br>Bridges and Musical Instruments   |
|                 | Building Scale  | Building inspired outside of Musical Instrument<br>Building inspired by inside Musical Instrument<br>Building inspired by Musical Line |
|                 | Space Component | Musical Instrument Figures   |
| Musical Orders  | Musical Orders  | Undulating Glass Panes<br>Rhythm and Sequence<br>Modularity and Proportion   |
|                 | Noise Disorders | Disorganization of noise   |
| Musical Concept | Direct Usage    | Whole structure<br>Fibonacci Sequence<br>Golden Proportion   |
|                 | Indirect Usage  | Harmonic Proportion & Interval<br>Pleasant Proportion & Golden Proportion  |

## Chapter 5

### CONCLUSION

Nowadays, architectural design has gone beyond its physical material and has moved to an advanced level of complexity by means of technological developments, literature outcomes and accordingly new ideas and philosophies. Interdisciplinary works have also been enhanced drastically especially in architecture which is an influential art in our whole life named accordingly “Mother of All Arts”. Another inseparable art from our life is music. Both music and architecture, as manifestations of culture and social characteristics, not only affect our lives but also have influence each other in different history at different levels. In the contemporary era, the interrelation between the fields has reached to its highest complexity that even become a source of inspiration for design in architecture.

By an overview on music and architecture, different general interaction between both music and architecture can be revealed. As the table below summarizes the interaction between music and architecture can be seen through the three main aspects which are (i) music and architecture as art, (ii) Music and architecture as tools of communication, and (iii) music and architecture through history as they are explained in chapter 2 (Table 4). Both music and architecture not only belong to artistic classification but also concern with the mutual concepts like creativity and imitation. Art is a system of signs, music and architecture can be regarded as tools of non-verbal communication. Thus music and architecture as types of communication can result in having some common

concepts in the realm of sign such as monumentality, folk, religion, and function in both fields. Furthermore, music and architecture, as cultural heritage, root in social structure of the environment. Therefore, the fields as a result of being a manifestation of the society characteristic have different interrelations at different levels of complexity throughout the history; from simple acoustic science in ancient times to the high level of complexity in contemporary era.

Table 4: Theoretical Overview (Author)

| A THEORETICAL OVERVIEW ON MUSIC AND ARCHITECTURE |  |  |
|--|--|--|
| Music and Architecture as Art                    | Music and Architecture as Tools of Communication                                   | Music and Architecture Through History   |
| Definition<br>Creativity<br>Imitation            | Sacred and Monumentality<br>Folk and Vernacular<br>Religion and Belief<br>Function | Ancient Times<br>Middle Ages<br>Renaissance Times<br>Baroque Times<br>Modern Times |

Based on the content of chapter three and by concerning the table given below, the interrelation between music and architecture in narrower point of view can be observed in three main categories including similar theoretical concepts, common wave system and math as root of both fields (Table 5). Architecture is experienced by our simultaneous perceptions by our senses, but since there is no corporeal material in music, the perception mostly takes place in intuition. Space in architecture can come into existence when physical boundaries of space are defined, and in music, it can be perceived and illustrated imaginary by experiencing a piece of music over the time. Time, as a significant term in modern architecture, can indicate the physical and virtual aspects which focus on clock time and order of perception of an architectural experience respectfully. In contrast, time in music is just an intuition perception of the

order of continuity period of notes. Furthermore, virtual form of music and real form of architecture have some similarities and also share terms such as position, location, move, and change, in spite of the radical different characteristics of the worlds. Subsequently, music and architecture have similar fundamental theoretical concept such as time, space, and form despite their different perceptions and dissimilar worlds.

Table 5: Commonalities and Differences (Author)

| Commonalities and Differences between Music and Architecture |  |   |
|--|--|---|
| Architecture as Frozen Music                                 | Wave                                     | Math  |
| Time / Space<br>World<br>Shape / Form                        | Sound & Light<br>Wave and<br>Environment | Numeric Order<br>Proportion and Interval<br>Rhythm and Sequence |

Audible waves producing music and visible waves revealing architectures. In this regard, not only they have the same components and system of wave but also similar point of view and interaction in design and analysis process of the music and architecture are visible. On the other hand, both music and architecture are based on math and mathematical subcategories; it is something that is insisted by different scholars from the first architectural theoreticians, Vitruvius and Alberti, to the modern time researchers. The relation can be the order of single numbers such as harmonic sequences or ratio of two numbers called proportion or intervals in architecture and music. Rhythm is also another shared term rooted in math and geometry named child of math by Galilei. Rhythm, as an inseparable part of music, interprets order of perception in architecture and can be manifested as simple as a row of pillars or continuous changes in a monolithic architectural form. In this respect, the trace of math and other fundamental theoretical issues coexist both in architecture and music.



In addition, the research has enabled us to see the connection is far beyond the theoretical issues by means of presenting some architectures designed based on music. The table below shows the different complexity level of this interrelation (Table 6). The simplest interrelation that is easily perceivable by ordinary users shows a direct analogy of musical images into architecture from urban scale architecture to components of space. In a more profound interaction, musical orders are convey into architectural design like modularity, rhythm, proportion, musical sequences, and even the disordered music perceived as noises. The most complicated interrelation, which is designing an architecture based on musical concepts needs a well-informed artist in both fields of music and architecture thus the example of these architectures are rarely found. A house designed by Holl and polytope and diatope as performance spaces designed by Xenakis were the evidences show this complicated tangible interrelation. Consequently, the practical and feasible interrelation between music and architecture is at any complex level and absolutely beyond the findings of theories in scholars and literatures.

Table 6: Architecture based on Music (Author)

| Commonalities and Differences between Music and Architecture |                                   |  |
|--|-----------------------------------|--|
| Musical Image  | Musical Principles                | Musical Concept                          |
| Urban Scale<br>Building Scale<br>Space Component             | Musical Orders<br>Noise Disorders | Particular House<br>Multimedia Buildings |

This research, once again, reveals and emphasize that music and architecture are the two main categories of art and they have certain common issues. Common characteristic, worlds, images, principles, concepts and fundamental issues, and also some other numerous factors that have been mentioned in the investigation, prove these two majors are interrelated. The interrelation between music and architecture in different eras is also some evidences showing their everlasting impacts on each other.

Nowadays, we, as architects, should not ignore the potentials of music both in education and practice of architecture. Music can be used as a tool of education to make better sense of understanding of art and aesthetic. Music as a tools of education can cause more profound perception in theoretical issues. On the other hand, music can be a source of inspiration for architectural design at different complexity levels. Architecture can be analyzed and understood by means of music as an assistant and manifestation of aesthetic.

In effect, architecture is always related with the act of creativity. At this point, it is a great curiosity to know more about future roles of music in the creation of architecture, which is more sensible and livable as well as being an art product at the cross section of science and technology. This is to be remained another research topic of future studies.

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