MUSIC AS INSPIRATION FOR ARCHITECTURAL FORM

a comparative analysis of mijikenda traditional architecture and music

UNIVERSITY OF NAIROBI
COLLEGE OF ARCHITECTURE AND ENGINEERING
SCHOOL OF THE BUILT ENVIRONMENT
DEPARTMENT OF ARCHITECTURE AND BUILDING SCIENCE

BAR 613: RESEARCH THESIS

LANGAT VIOLA | B02/3991/2008
TUTOR: ARCH. E. ABONYO

"...Music is a higher revelation than all wisdom and philosophy.
Music is the electrical soil in which the spirit lives, thinks and
invents..."

Ludwig van Beethoven

DECLARATION

I solemnly declare that this thesis is my original work and has not been presented for the purpose of awarding a degree in any other University or Institution. This thesis is submitted in partial fulfilment of the examination requirements for the award of the Bachelor of Architecture degree, in the Department of Architecture and Building Science at the University of Nairobi.

AUTHOR ..... DATE: .....

LANGAT VIOLA | B02/3991/2008

SUPERVISOR ..... DATE: .....

ARCH. ERASTUS ABONYO

YEAR MASTER ..... DATE: .....

ARCH. MUSAU KIMEU

CHAIRMAN ..... DATE: .....

ARCH.ERASTUS ABONYO

For Simon and Victoria

ACKNOWLEDGEMENTS

For your expertise, guidance and enthusiasm,
thank you to my thesis advisor, Arch. E.
Abonyo and my Year Master, Arch. Musau
Kimeu.

For your insight, honesty and time,
thank you to the lecturers of the Department
of Architecture, University of Nairobi.

For your love, support and pride,
thank you to my family-Simon, Victoria and
Cheptoo Langat.

For your encouragement, thoughtfulness and
spiritual and physical help,
thank you to all my friends at the University
and outside.

TABLE OF CONTENTS

TABLE OF CONTENTS

TABLE OF CONTENTS

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF FIGURES

LIST OF TABLES

ABSTRACT

Built form is a tool of cultural expression. Cultural values must be understood in order to extract symbols and create meaningful art forms. These same symbols belong to other fields of knowledge and the identification and subsequent interpretation of these social and cultural aspects in the various forms of composition: pictorial, poetical, musical and architectural is part of the architect's journey.

The lack of cultural references in Nairobi architecture has led to a general placelessness and lack of identity in recently constructed buildings. This is an issue usually addressed at the beginning stages of design; conceptualisation. A mundane approach to conceptualisation, coupled with preconceptions in the architect's mind due to monotony and fixed approaches leads to the creation of uninspiring, poorly thought out buildings. Architects become tailors and not designers. However, creativity can be enhaced by the ability to work in other creative arts, such as music.

In addressing this problem, the study aims to understand the relationship between architecture and music, investigate the nature of this relationship in the local context among the Mijikenda of Kenya, well known for their music, dances and kaya settlements gaining knowledge on its characteristics and compositional principles in the process and finally understand through case studies the various ways that architectural form can be abstracted from music.

To critically understand the nature of the relationship, past research on the subject is explored with Mahmoud(2009) revealing that this relationship over time has been found to be based on four principles; harmony and proportion, rhythm, texture and ornamentation and acoustics. The principles are treated as variables and are used to study the Mijikenda local case through observation and documentation. The very same variables are used in interrogating the international cases selected to demonstrate the abstraction of architectural form from music.

It is clear from this study that music is indeed a key player in African culture and the understanding of especially the complex rhythms present in Mijikenda music provides numerous possibilities for the creation of architectural form using any of the three methods discussed as case studies, that is, the use of music as either method, inspiration or image in design.

CHAPTER 1
INTRODUCTION

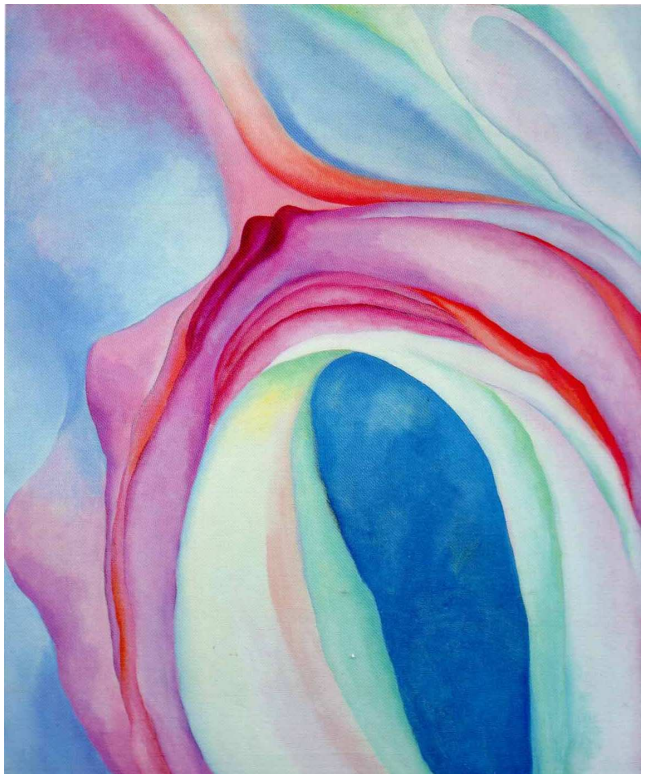


Fig 1.01: **MUSIC-PINK AND BLUE II**

The painter Georgia O'Keeffe was fascinated with what she called "the idea that music could be translated into something for the eye," but her references to music in the titles of her paintings derived equally from her belief that visual art, like music, could convey powerful emotions independent of representational subject matter. In Music—Pink and Blue II, the swelling, undulating forms imply a connection between the visual and the aural, while also suggesting the rhythms and harmonies that the artist perceived in nature.

Sources: Retrieved October 4th, 2014 at 1823hrs from http://collection.whitney.org/object/7759

1.1 BACKGROUND STUDY

The arts speak to each other. Throughout the ages, music, architecture, painting, sculpture literature and poetry have developed in tandem. A paradigm shift in one of the arts has led to changes in the perception of the others. In other ways, one art form has served to inform and enrich another art form. Artists from either field have sought inspiration from other art forms such as painters seeking inspiration from music, as illustrated in Figure 1.01.

All art is a reflection of the culture that has generated it. Our creations express our values, our hopes, our dreams and our fears. They are often a plight to be understood and accepted and are often a call to solidarity. Art unites people and expresses what they have in common. However, there is no direct relationship in the arts and they must be translated before application.

Of great significance is the relationship between architecture and music. Music and architecture are both compositional arts. Music, the ancient art of organising sound in time and Architecture, that of the ordering and configuration of space are united by their common principles, that is, rhythm, proportion, scale, harmony and texture. These principles, in both, are manipulated differently with the aim of expressing different meanings.

Many architects and scholars have looked into the relationships of these two 'sister' arts right from Pythagorean times to when Vitruvius discussed it in his Ten Books of Architecture to Iannis Xenakis, an engineer who worked on La Tourette with Le Corbusier looking at stochastic methods of composing both music and architecture. Many followed along this path, trying to analyse the relationship between the two fields and searching for a link that would inform .

At the University of Nairobi, Masese(1998) explored the basic theory of music and of architecture and established common principles in the creation of both. Njogu (2000) went on to study explorations of this relationship with reference to the built form.

Following their study 15 years ago, this thesis intends to look even more critically at musical composition techniques, vis-a-vis the architectural design process. so as to establish ways that music, in all its wisdom, can inform architectural design and move it toward the achievement of more meaningful and humanistic ideals.

Fig 1.02: MIMESIS OF MUSICAL INSTRUMENTS

Due to the deemphasis and lack of understanding of the enriching possibilities of music and architecture, contemporary architects have turned to more literal and less meaningful ways of abstracting architectural form from musical sources. The original Hard Rock Cafe in Orlando USA is a building placed atop a guitar to emphasise the restaurants rock music theme. The guitar shape however is only appreciated from a bird's eye view.

Sources: Retrieved October 4th, 2014 at 1823hrs from www.orlandounited.com

1.2 PROBLEM STATEMENT

Rukwaro(2012) states that architectural form is the core of the architectural reality and expression. Architecture is a tool of cultural expression. To create architecture that resonates with the people, it is important to understand their cultural background. Only through clear understanding of their cultural values and symbols can meaningful architecture be created. These very symbols belong to other fields of knowledge as well such as music and the capacity to decodify and interpret them is part of the architect's journey.

While there is both a strong relationship between architecture and music and a long history of development in both fields, most architects practicing today make no use of the enriching possibilities(Antoniades,1991).There is widespread lack of knowledge of how to translate the concepts derived from music. The lack of clear understanding on how to translate concepts derived from music to meaningful architecture manifests in either no application of these concepts or a literal translation of symbols from the musical world. These literal translations are usually mimesis of musical instruments or graphical symbols such as notes used in the notation of music as shown in figure 1.02.

African music has received the lowest attention from architects thus excluding a rich repertoire that would add to exciting architectural forms and functionality of buildings in the tropics. This apparent exclusion denies the continent a unique opportunity to articulate forms that cannot be found anywhere else.

This study aims to demystify the relationship between the two fields by examining African musical heritage vis-a-vis it's architecture in order to understand the similarities and differences in the creative approach of the two fields in this context. Thereafter, the study explores ways in which this relationship is made relevant and effectively translated into meaningful architecture thereby making it relevant for designers today who are faced with even more challenges than those of earlier periods. The focus on this relationship will clarify anxieties and misconceptions regarding the relationship between architecture and music and it's proper place in today's world.

Fig 1.03: **MIJIKENDA MUSIC PERFORMANCE**

African music, despite its richness, is largely ignored as a source of concepts for architectural design. The study aims to understand African musical compositions and the nature and role of the spaces that they perform in.

Sources: Author, September 10, 2014

Fig 1.04: **STRETTO HOUSE**

Stephen Holl's Stretto House will be studied with the aim of understanding the explicit application of musical concepts to design.

Sources: Retrieved September 6th, 2014 at 0946hrs from http://cdn.hw.net

1.3 RESEARCH QUESTIONS

1. What is the relationship between architecture and music?
2. What, if any, is the relationship between music and architecture among traditional Mijikenda society?
3. How do architectural projects that are explicitly declared to have been derived from musical ideas pursue that intent?

1.4 RESEARCH OBJECTIVES

1. To understand the relationship that music and architecture have.
2. To establish what relationship, if any, exists between music and architecture in traditional MijiKenda society.
3. To find out how architectural projects that are explicitly declared to have derived from musical ideas achieve their end goal.

Fig 1.05: CEILING OF ALLIANCE FRANCO-SENEGALAISE

The architect, Patrick Dujarric, in designing for the Senegalese people, imbued his building with meaning and cultural relevance through the application of surface patterns found in the traditional art and ornamentation practices of the people making the building relatable to its users and suitable for its cultural context.

Sources: Retrieved September 25th, 2014 at 1134hrs from http://www.tangana.ca

1.5 JUSTIFICATION OF STUDY

Emerging architecture in Nairobi lacks identity and a clear expression of cultural symbolism. Due to colonisation, Kenyan architecture adopted British design ideals thus abandoning cultural references in design. This led to a general lack of placessness in Kenyan architecture. The people, though of diverse ethnic origin, are unable to identify with their architecture. As time progressed, westernisation eroded cultural values even further leading to problems in identifying and abstracting architectural forms from cultural sources.

There is a need to create more meaningful, symbolic works of architecture that a certain people can relate to and have a connection with. These symbols can be abstracted from various sources within culture and nature. As shown in figure 1.05, visual art and all other art can be used to imbue a building with symbolism and cultural relevance.

This study examines the relationship between two diverse fields, architecture and music, in an attempt to reflect on the reading of an architectural project with the aim of decoding graphic signs and motivations, whether they be expressed or implicit, conscious or unconscious and which are part of a group of symbolic memories. As earlier stated, these very symbols exist in other fields of knowledge as well but are expressed differently.

The Mijikenda, a Kenyan coastal ethnic group is selected for this study because of availability of information on both their music and architecture as well as their specific relevance to this study as an ethnic group in the immediate local context which has preserved its music and material culture. In understanding the compositional similarities and differences of African music and architecture, we are able to deeply understand the application of various principles, such as rhythm, harmony, proportion and texture which are all building blocks in the creation of metaphor in a building. The careful composition of form and space based on those principles creates symbolic value in architecture. These principles are shared by both music and architecture and knowledge on the composition of meaningful music will be useful in informing the architectural design process.

The understanding of this relationship will also open up more creative possibilities for the architect. An interdisciplinary approach to design enhances creativity. Involvement with other arts creates some distance between the constraints of reality and helps create the frame of mind necessary to create meaningful work.

Fig 1.06:

PROPOSED ETHIOPIAN PARLIAMENT

The proposed Ethiopian Parliament by Treurniet Architectuur achieves symbolism by abstracting from the Negarit drums. The traditional drums were played atop the hill when a new law came into effect. Besides the symbolic value, the strong rhythm of the drums stands for communication and continuity. Each drum represents a symbolic value we also can find in the Ethiopian flag: Hope (green), peace (yellow) and passion (red).

Sources: Retrieved September 6th, 2014 at 0946hrs from http://www.archdaily.com/331527/

1.6 SIGNIFICANCE OF STUDY

The study will shed light on music as a cultural source of inspiration and how to abstract meaningful architectural form from it. As music is one of the more expressive and communicative arts, an analysis of its tools and methods is likely to open up possibilities for the creation of an architecture that is culturally level and that has an identity.

The study will give insight into parallel principles occuring between architecture and music, highlighting how these principles are applied in communication of various messages in both fields with the aim of learning from the other field. This will aid architects in not just conceptualisation, using music as inspiration, but in actual design given a new understanding of the principles of composition.

1.7 ASSUMPTIONS

It is assumed that it will be possible to establish a link between the architecture and music of the selected community; The Mijikenda.

It will be assumed that the information acquired from specialists in regards to the music and architecture of the Mijikenda will based on an understanding of the subject matter and will therefore be well informed and honest.

1.8 SCOPE AND LIMITATIONS

The study will focus on one Kenyan community, the Mijikenda.

The case studies are limited to projects where the architect has explicity declared and discussed the application of music in their particular work irregardless of geographical location.

The limitations the study might encounter are:

The body of knowledge on the relationship between music and architecture is of differing opinions making it hard to get conclusive statements on factual issues.

Inability to find adequate information on the music of the Mijikenda in the form of transcribed works.

Financial and time constraints in the expected frequent visits to the case studies.

Viable case studies were few and not from Africa as not many buildings have explicitly used music in design.

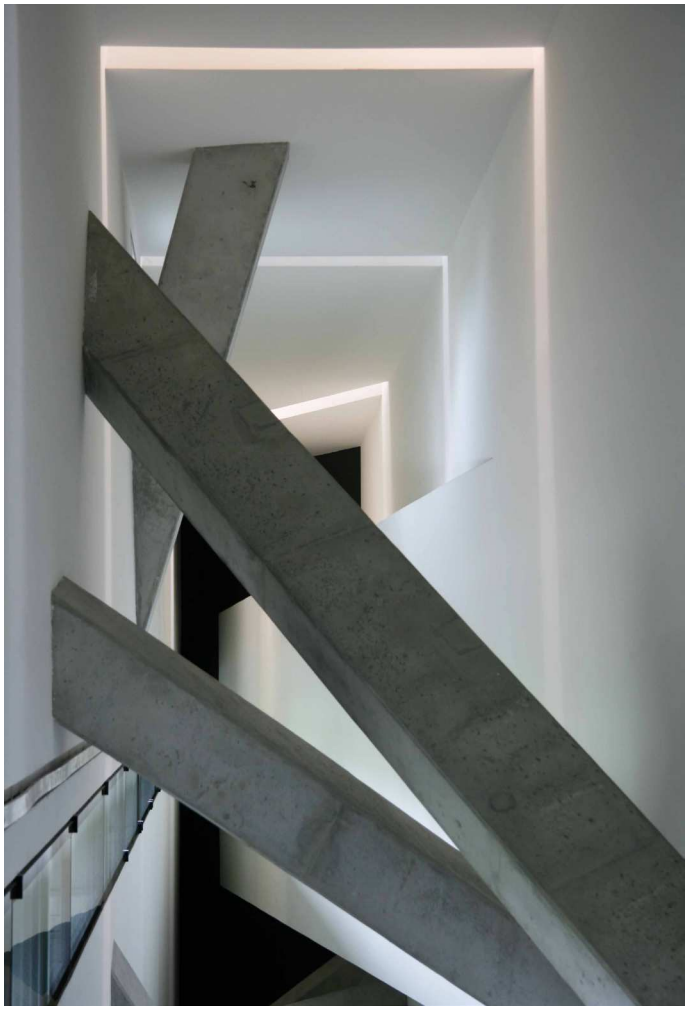


Fig 1.07: INTERIOR OF BERLIN JEWISH MUSEUM

Daniel Libeskind abstracted philosophically from music in order to imbue symbolism in his Berlin Jewish museum which will be studied as an international case study. The image captures the interior of this building showing the beams above the axis of continuity that leads into the permanent exhibition.

Sources: Retrieved September 6th, 2014 at 0946hrs from http://andberlin.com/?attachment_id=6088

1.9 RESEARCH METHODOLOGY

In this study, a deductive research approach, will be taken beginning with the knowledge that there is a relationship between music and architecture, as established from earlier studies. Qualitative research methods, aimed at describing, exploring and discovering more about this relationship, where it applies and where it does not, will then be applied to the selected community. The music and architecture of the Mijikenda will be studied broadly and their overlapping characteristics identified and further discussed.

Theoretical analysis is the foremost research method. This involves selection and discussion of theoretical material and descriptive material in context followed by a detailed comparison of theories in terms of their applicability. Other researchers' works on either of the fields, music or architecture will be analysed and compared.

Case study survey is the other method applied in this research. This involves visit to the sites of interest to observe and document the data required pertinent to the music and architecture of the Mijikenda.

International case studies will be used in answering the third research question. This will involve sourcing of secondary information from books and websites regarding the projects discussed.

Fig 1.08: **CHAPTER BREAKDOWN INFOGRAPHIC**

A simple outline of the organisation of the study.

Sources: Author, February 4th, 2015

1.10 CHAPTER BREAKDOWN

The study is organised as follows:

CHAPTER ONE introduces us to the study which is based on the relationship between two large art forms, music and architecture. The problem, which is placelessness and lack of information on how to abstract from cultural sources, specifically music is outlined. The objectives and questions guiding the research are also defined in this chapter as well as the methods that will be applied in the carrying out of the study.

CHAPTER TWO identifies key similarities and differences in music and architecture according to past work on the same. It consists of arguments from different literary sources shedding light on the key concepts that are shared between the two fields and their interpretation in either field and then subsequently the relationship and how others have interpreted these similarities.

CHAPTER THREE defines the research methodology that will be applied in the carrying out of the research and the answering of the research questions.

CHAPTER FOUR outlines data collected from the visits and study of Mijikenda music and architecture. It involves a discussion on the spaces and forms found in Mijikenda culture as well as how they express themselves through music. This is followed by a comparison of the main compositional principles found in these two fields so as to establish whether or not their attitude towards their creation of music was in any way connected to that of the creation of their architecture.

CHAPTER FIVE is a case study analysis of international case studies selected because of their application of musical concepts to architectural forms in an attempt to understand how to abstract and apply the concepts discussed in chapter two and four to architectural form.

CHAPTER SIX concludes the study stating the conclusions drawn from the findings of the study and making recommendations on how these concepts can be applied to architecture as well as opportunities for further study.

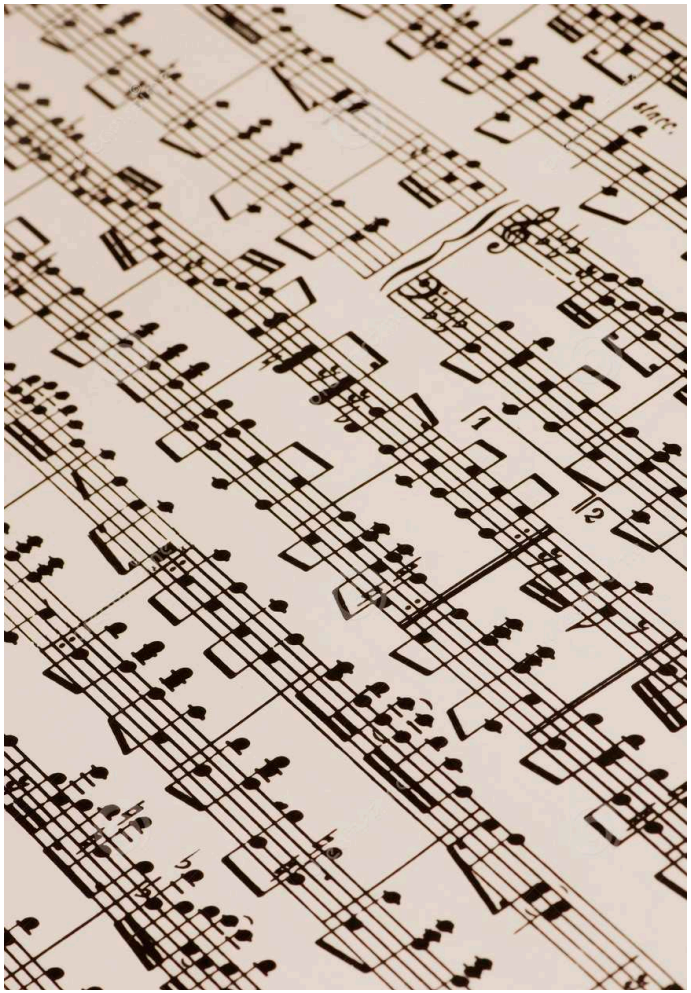


Fig 1.09:

MUSICAL SCORE

Similar to architectural drawings, a composer's musical ideas are communicated through a system of musical notation indicating pitch and duration of notes on a staff, a series of 5 lines and 4 spaces, which are later interpreted by musicians. This is likeable to architectural drawings that are interpreted by a contractor to bring the architect's ideas to light.

Sources: Retrieved February 4th, 2015 at 0930 hrs from http://thumbs.dreamstime.com/z/old-music-score

1.11 DEFINITION OF TERMS

Tone - a musical or vocal sound with reference to its pitch, quality, and strength.

Pitch - the highness or lowness of a particular sound.

Note - 1. A pitched sound

2. A symbol representing pitch and duration of a musical sound.

Staff - five lines and four spaces on which musical notes are written on indicating their pitch.

Chord - a series of three or more notes that combine to produce a pleasing and concordant sound.

Harmony -The quality of forming a pleasing and consistent whole, in music through combination of simulateously produced notes to form chords that are pleasing and in architecture by achieveing a unified balance of parts

Beat - The basic unit of time in music

Metre - The number of beats per measure of equal time in music.

Rhythm - A strong regular repeated pattern of movement or sound, in music, usually according to duration and periodic stress.

Polyrhythm - the simultaneous combination of contrasting rhythms in a musical composition.

Acoustics - the properties or qualities of a room or building that determine how sound is transmitted in it.

Texture - the feel, appearance, or consistency of a surface or a substance; in music referring to the varying tone/sound of various instruments.

Ornamentation - the action of decorating something or making it more elaborate; in music using rapid notes above the written music.

CHAPTER 2
LITERATURE REVIEW

Fig 2.01:

SOUND IN SPACE

The sounds in our environment keep us informed about our constantly changing environment and often elicit an emotional or physical reaction depending on what the sound communicates. Music is a pleasant sound, arranged and organised to provide delight unlike other incidental environmental sounds.

Sources: Retrieved February 4th, 2015 at 1100 hrs from http:// info.acoustiblok.com

2.1 INTRODUCTION

2.1.1 DEFINITION OF MUSIC

Sound is the primordial channel of communication. Every moment, sounds keep us informed about the happenings around us. The patter of rain, the meow of a cat, the whistling of the wind, the wail of sirens, the clap of thunder and other such sounds keep us informed about our constantly changing environment. Silence, which is the absence of sound, serves also to communicate. An unanswered question or a break off midsentence communicates as does the absence of noise on a street which communicates desertion.

Chedd(1970) delineates the science of sound stating that sound originates from the vibration of a body or object. The vibration creates a sound wave, which is transmitted through a medium- often air-to our ears, causing the eardrum to vibrate. The vibrations send off impulses to the brain where they are interpreted.

The sound wave, like all other waves, has a certain wavelength, amplitude and frequency. The wavelength is the distance over which the wave's shape repeats. The amplitude is the maximum displacement of an oscillation measured from the point of equilibrium. The frequency is the number of vibrations per second. Frequency determines the pitch of the sound, that is, the highness of lowness of the sound. The higher the frequency, the higher the pitch of the sound produced.

Musical sounds differ from noises because they are composed of regular vibrations as opposed to noises, which are disordered, irregular vibrations. Musical tones are sounds of specific frequencies that reach the ear at regular time intervals.

Music, according to Kamien(1990) is the art of organizing sounds in time. These sounds are organized based on their pitch to a certain rhythm which communicates a certain message and has a bearing on the emotions and behavior of people.

Fig 2.02:

MUSIC AND CULTURAL IDENTITY

The punk subculture, which centres on punk rock music, includes a diverse array of ideologies, fashions and forms of expression, including visual art, dance, literature and film. The subculture is largely characterized by anti-establishment views and the promotion of individual freedom.

Sources: Retrieved February 8th, 2015 at 0930 hrs from http://clikhear.palmbeachpost.com/

2.1.2 MUSIC AS A CULTURAL IDENTIFIER

Since the beginning of time, music has been used as an expression of cultural identity. Ancient tribal societies used music as a foundation for gatherings and to express their history, ethnicity, and cultural beliefs. Music has changed throughout the ages, but the use of music as an essential part of cultural and individual expression has changed very little.

Music's integral connection to identity is often difficult to recognize, especially in today's society where music may not be viewed as being as message-oriented as it once was. There were times when entire generations or cultures of individuals each knew the same songs. During World War II, entire nations of people sang songs that expressed their national identity with their cause and their connection to their fighting forces. Again, with the protest songs of the 1960's and 1970's, the people of the nation explored their feelings about war, youth, and racial unrest. And, as music as a form of expression has grown, different individuals within the same society have come to identify with varying forms of music as their own individual expression of self.

Whether music is viewed as being an influence on youth or as being influenced by youth, is still secondary to the fact that it has always been present as a socializing factor. Whether that socialization takes place as a part of a group membership or as a way to express individuality, there is no way to ignore the fact that the influence and expression of music expands as the world community shares more of its musical styles. People may find that music speaks to them in a certain way, moves them in a certain way, or that they identify with its message. People may also find that they can use music to express themselves as individuals as well as to conform to a group. Doubtless, music and its connection to individual and group identity will take on new forms as people continue to be exposed to varying forms of music and culture.

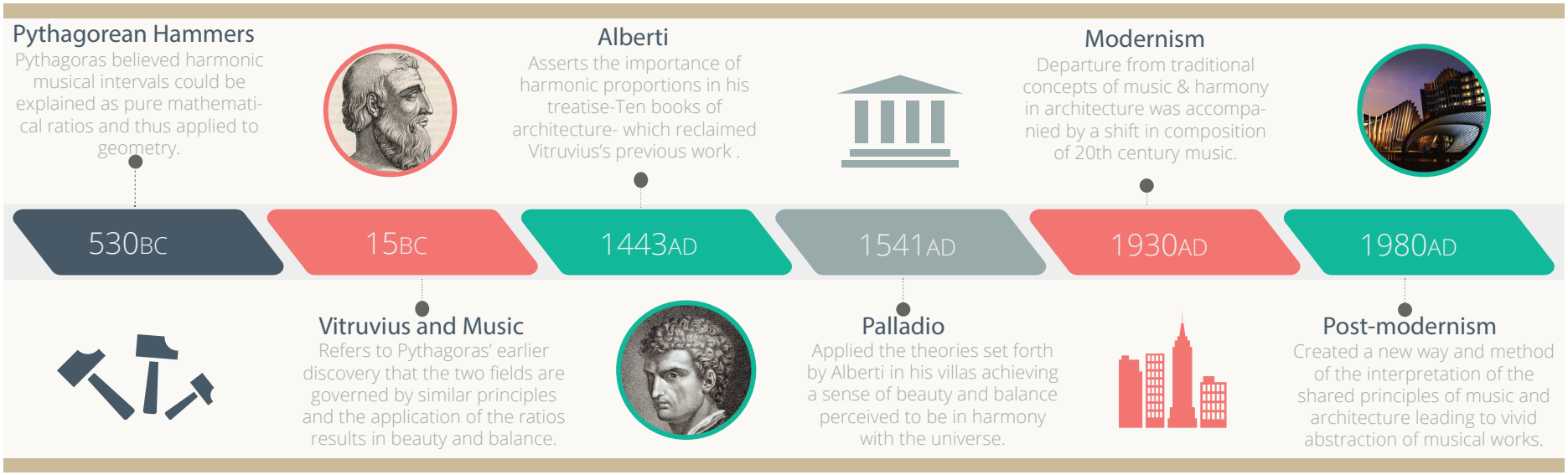


Fig 2.03: INFOGRAPHIC TIMELINE SHOWING PROGRESSION OF STUDIES ON THE RELATIONSHIP BETWEEN MUSIC AND ARCHITECTURE (Author)

2.1.3 INTERSECTIONS OF MUSIC AND ARCHITECTURE

From the earliest documented architectural thinkers, music and architecture were deemed united by an underlying code. According to Pythagoras(570-480BC), who was considered the 'father of mathematics, geometry and music', harmonic musical intervals could be expressed as pure mathematical ratios and thus could be applied to geometry. These intervals or ratios were applied to the design of Greek temples, revealing not just beauty, but ' the music of the heavenly spheres'. They were considered at one with nature and with God.

Vitruvius (15bc) states that " Music, also the architect ought to understand so that he may have knowledge of the canonical and mathematical theory, and besides be able to tune ballistae, catapultae and scorpiones to the proper key…" This makes further reference to the Pythagoras theory that indeed the two fields were governed by the similar principles and application of these ratios in the two fields would result in beauty and balance. At the time the generation of architecture was purely mathematical and precise, as it was believed that beauty was closely linked to mathematics-as held out by Plato.

In the renaissance, architects such as Alberti and Palladio used music in the clarifying of architectural concepts. Aesthetics and beauty were closely tied in with mathematics. As all sciences and arts were assumed to have departed from mathematics, musical harmonies were determined by mathematical calculation. Alberti then applied the harmonic proportions used in the music of the time to the designing of his buildings resulting in proper balance and harmony with the environment.

Antoniades(1990) points out that with the passage of time, the relationship between the two arts has become vague as proportioning systems became less mathematically precise. The principles that we apply in designing modern architecture are still very closely linked with those that are used in the composition of music and proper understanding and creative use of the relationship would lead to a great benefit to the field of architecture. Mahmoud(2009) outlines the possibilities of cross fertilization in these two fields as being pertinent to either proportion, rhythm, acoustics, synaesthesia and deconstruction. Each of these will be discussed in detail.

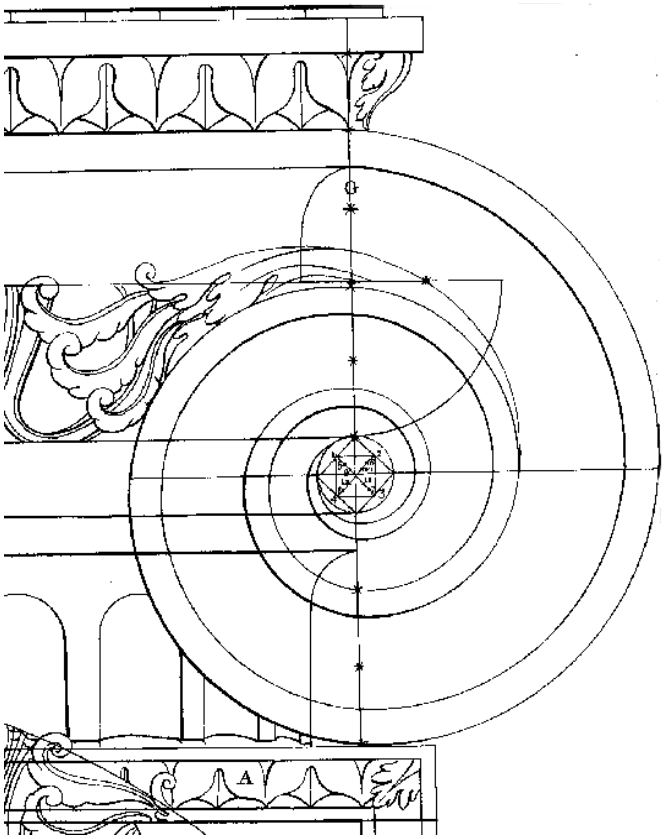


Fig 2.04:

HARMONIC PROPORTIONS

Drawing of an ionic volute designed by Renaissance architect Andrea Palladio, showing proportional relationships derived from theories of Pythagoras who discovered the relevance of musical ratios to design.

Sources: Retrieved October 4th, 2014 at 1823hrs from http://www.wjhamilton.com/music_in_proportion.htm

2.2.ARCHITECTURE AS A SERIES OF HARMONIC SPACES

2.2.0 INTRODUCTION

The Oxford English Dictionary defines harmony as 'the quality of forming a pleasing and consistent whole'. Ultimately, this is the obscure objective of all creative practices. In music, harmony is conceived and perceived as a pleasant unification of different sounds. (Kamien 1992) Balance in music is detected by hearing two different notes played together simultaneously giving a pleasant(concordant) sound. In architecture, we assume that the sense of balance that we perceive is based on sight and visual appreciation, the most obvious form of balance being symmetry. However, in the real sense, the inner ear is the centre of balance in the body. Balance lies within the inner ear and balance in all art forms is perceived at this centre. (Liebeskind,2009)

Early thinkers sought to solve the mystery of the harmony that pervades the universe. Rasmussen(1939) retells the legend of how Pythagoras stumbled upon the discovery of harmonic proportion. As Pythagoras once walked by a blacksmith's shop, he heard the clang of three hammers and found the sound pleasant. On investigation, he discovered that the lengths of the hammer heads were related to each other in the ratio of 6:4:3. The largest produced the keynote(tonic) the shorter was a fifth above and the shortest an octave above it.

The same can be understood using a simple experiment using string. When a string is vibrated it produces a certain pitch. When the string is divided in exactly half, it produces a sound of the same pitch but an octave higher. When the string is divided into 3 parts and the string held at the two-third interval, the string produces a sound that is an interval of a fifth higher than the initial pitch.

In architecture, Ching (1996) defines harmony as the orderly, pleasing or congruent arrangement of the elements or parts in an artistic whole. Harmony in architecture is achieved through proportion. Proportion is the visual relationships of various objects and spaces that make up a whole. It is important that these relationships are in harmony to each other, and give a sense of balance to the overall composition. The essence of rhythm, as Kamien(2004) puts forth is a recurring pattern of expectation and fulfillment.

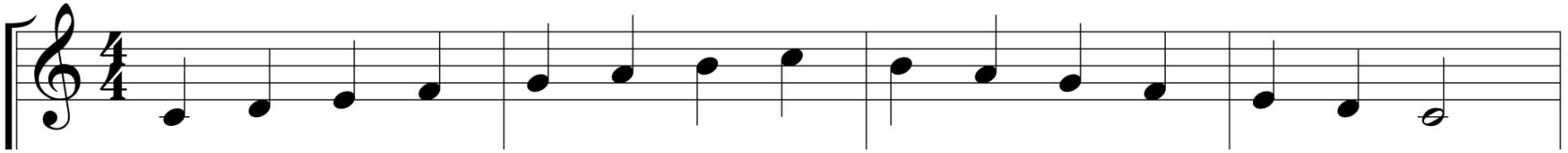


Fig 2.05:

C MAJOR SCALE

Drawing of an ionic volute designed by Renaissance architect Andrea Palladio, showing proportional relationships derived from theories of Pythagoras who discovered the relevance of musical ratios to design.

Sources: Retrieved October 4th, 2014 at 1823hrs from
http://www.pianolessonsworld.com/music_in_proportion.htm

2.2.1 HARMONY IN MUSIC

To further understand the relationship of harmony and ratios in music and architecture, it will be necessary to understand certain aspects of music theory, such as scales and intervals to enhance our understanding of harmony and on why we like certain sounds together and not others.

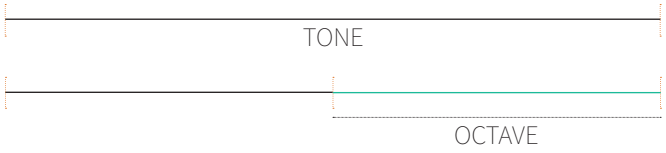
2.2.1(a) MUSICAL SCALES

Musical notes are sound waves of a defined and regular frequency. Frequency determines pitch of a sound. Pitch is the highness or lowness of a sound. Any note that is twice the frequency of another is said to be an octave higher. It is treated and named as the same note only higher. (Schmidt-Jones, 2005). A good example is male voices and female voices. Women often can't sing notes as low as men can but they can sing the exact same note two octaves higher.

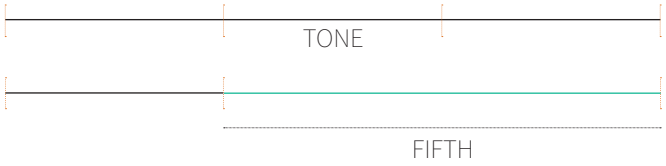
The word octave is a latin word meaning eight.(Oxford Dictionay of Music). This does not mean the note is eight times higher but is twice higher. It is so called because of the division of musical notes into scales. It is important to understand the concept of musical scales before tackling harmony and harmonic structures.

A musical scale is a set of musical notes ordered by fundamental frequency or pitch. The scale could be ordered either in increasing pitch,therefore ascending or decreasing pitch, therefore descending. Scales are generally considered to span a single octave with repetitions of the pattern in higher and lower octaves. In common practice, musical works are built up fully or partly by the notes of a single scale represented on the staff with a key signature as shown.

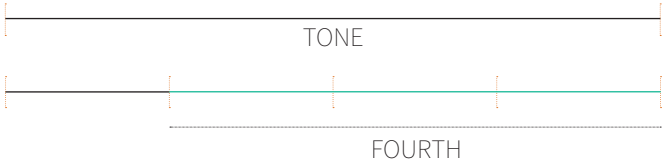
There are 12 notes in the Western music vocabulary. Each of these notes is a semitone apart from one another making up the chromatic scale. The notes of this scale are identified using letternames and are as follows



Division of string in the ratio 1:2 to produce an octave



Division of string in the ratio 2:3 to produce the fifth note of the scale



Division of string in the ratio 3:4 to produce the fourth note of the scale

Division of string in the ratio1:3 to produce the third note of the scale

Fig 2.06: **MUSICAL RATIOS**

Line drawings illustrating musical ratios from division of a piece of string.
Sources: Author. October 10th 2014, 0930hrs

A - $A^{\#}/B^{b}$ - B - C - $C^{\#}/D^{b}$ - D - $D^{\#}/E^{b}$ - E - F - $F^{\#}/G^{b}$ - G - $G^{\#}/A^{b}$

The semitone is also referred to as a half note. A tone or whole note is made up of two semitones(half notes) and is the distance between notes A and B and so on. The highlighted notes are referred to as enharmonics. Enharmonics are notes of the same pitch but with two letter names. The symbol # (sharp) indicates that the note A is raised by a semitone and the symbol ***b*** (flat) indicates that the note is lowered by a semitone. Thus $A^{\#}$ means that the note is a semitone higher than A and B^{b} means that the note is a semitone lower than B (Mahmoud 2009).

However, the human ear distinguishes whole tones easier than it does semitones. Therefore, most western music in the medieval and renaissance periods, which is when the current system of musical notation was developed, is composed using a variety of diatonic scales. A diatonic scale consists of seven notes and repeats at the octave. The natural major, one without sharps and flats is shown below:

NOTE	C	D	E	F	G	A	B	C
INTERVAL		T	T	ST	T	T	T	ST

The other scales use the same interval system but change pitch. For example the scale of D major would occur as follows:

NOTE	D	E	$F^{\#}$	G	A	B	$C^{\#}$	D
INTERVAL		T	T	ST	T	T	T	ST

This sequence of intervals form the basis of all major scales. These tonal intervals are more acceptable to the ear. The notes harmonise with one another while in the 12 tone scale, some notes will be cacophonic when played together. The intervals found in a major scale are easily extracted from a length of string and are the ones important to the derivation of ratios.(Kamien, 2004)

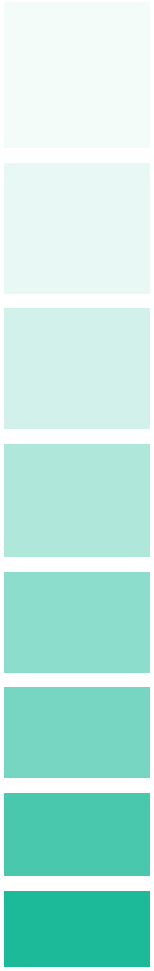


Fig 2.07:

PROPORTIONS IN C MAJOR SCALE

Drawing of an ionic volute designed by Renaissance architect Andrea Palladio, showing proportional relationships derived from theories of Pythagoras who discovered the relevance of musical ratios to design.

Sources: Author. October 10th 2014, 0930hrs

2.2.1(b) INTERVALS

The unit of harmony is the interval (Piston, 1949). An interval is the distance between two musical notes. A harmonic interval is one in which both notes are sounded together and a melodic one is one in which the two notes follow each other along a melodic line.

Intervals suggest the ratios of the pitches to one another. These ratios were used by early designers, such as Vitruvius , in the design of proportional ratios in buildings so as to achieve what was referred to as the music of the universe. It was believed that abiding to natural ratios that the rest of nature made use of would guarantee beauty. (Kamien, 2004)

Suppose a piece of string held at two points produces the pitch C when sounded. If divided into two equal parts and then sounded, the pitch will be C but an octave higher. This pitch is referred to as the tonic degree of the scale, meaning the first note of the scale. When the string is provided into 3 parts, and the longer part of the string sounded, the resultant note is an interval of a fifth higher than a C, making it a G. The G is referred to as the dominant part of the scale. If divided into 4 parts, and sounded at the 3/4 length part then the note F which is a fourth from C will sound. This pitch is the subdominant degree of the scale. If further divided into 5 and 6 parts, then the 6th and 3rd degree would be achieved. These are the sub mediant and mediant degrees respectively. (Mahmoud 2009)

It is important to note that not all intervals sound pleasant. The intervals of the 3rd, the 4th, the 5th and the 6th are the only ones that sound plesant together and are referred to as being consonant. Those of the 2nd and 7th are dissonant-offensive to the ear. Therefore when played with the tonic to form a chord, another note, such as the 5th or 3rd is added to the chord to resolve it. (Kamien, 2004)

When the degrees of a musical scale are rendered into ratio form, one can start to associate shapes that have similar proportional qualities. The tonic, 1:1 could be expressed as a square and the dominant could be expressed as a rectangle in the ratio

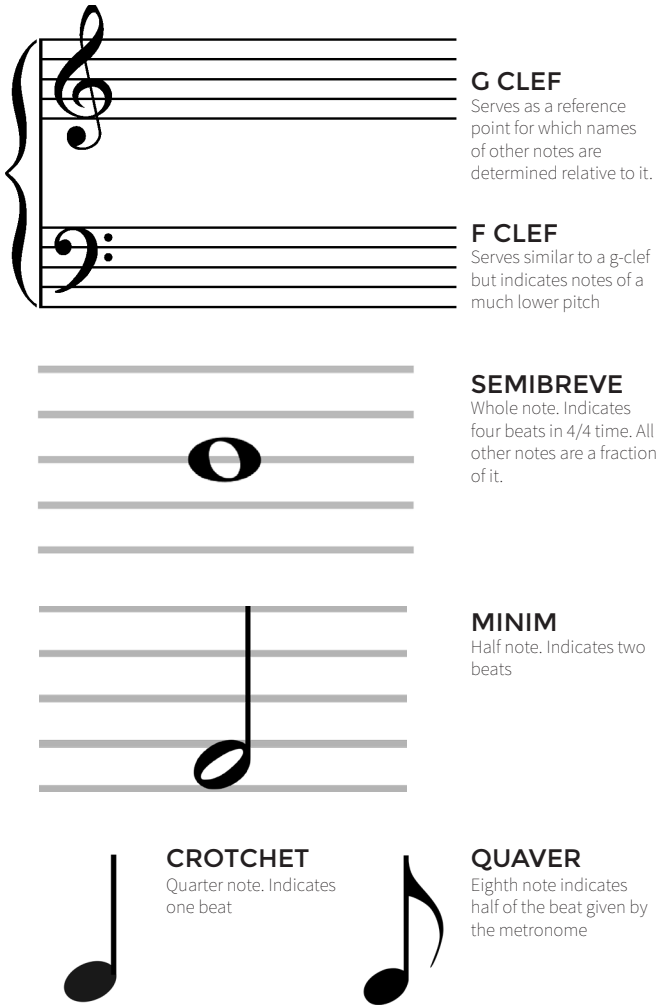


Fig 2.08:

MUSICAL NOTATION SYMBOLS

The above are the most basic symbols used in the notation of musical sounds to communicate the pitch and duration of successive notes.

Sources: Author. October 12th 2014, 0730hrs

2:3. These ratios are not limited to diatonic scales but could also be worked out for chromatic scales. For purposes of the study, we will stick with diatonic scale to explain and better understand the proportional relationships in earlier architectural periods. (Mahmoud, 2009)

A mode is an ordered series of musical intervals just like a scale. However, the starting and ending note determine each mode. There are 7 modes within a scale, Ionian, which begins on the tonic and Dorian, Phyrgian, Lydian, Mixolydian, Aeolian and Locrian mode beginning at the 2nd-7th degrees respectively. Each mode has different tonal qualities, for example, the Ionian mode intervals are T-T-ST-T-T-T-ST while the Dorian is T-ST-T-T-T-ST-T. In the translation of music to architecture, modes are important. While music depends on the starting and ending note, an architectural space can be entered, exited and experienced in many ways. (Mahmoud, 2009)

2.2.2(c) MUSICAL NOTATION

Music is easier to study and share when written down.. Western music specialises in long, complex pieces for large groups of musicians performing together. These performers rely on notation so as to play exactly what the composer intended. The most widely used method of notation is the staff.

The staff is a series of five lines with four spaces between them. Musical notes are written down both on the lines and in the spaces between the lines. Ledger lines are short lines added above and below the staff to extend it. Vertical lines called bar lines divide the staff into components called bars. A light double bar line indicates the end of a section of music while a heavy double bar line indicates the end of the entire work. (Schmidt-Jones, 2007).

Many representative symbols such as rests, clefs, key signatures and time signatures are used on the staff. These give information about notes, silences and their measures. . On a staff, the passage of time is shown on the horizontal axis while the relative position of pitches is represented on the vertical axis. The staff is read from left to right, the earlier notes are on the left. Similarly, higher notes on the staff are the ones above. (Thaddeus-Jones, 1974)

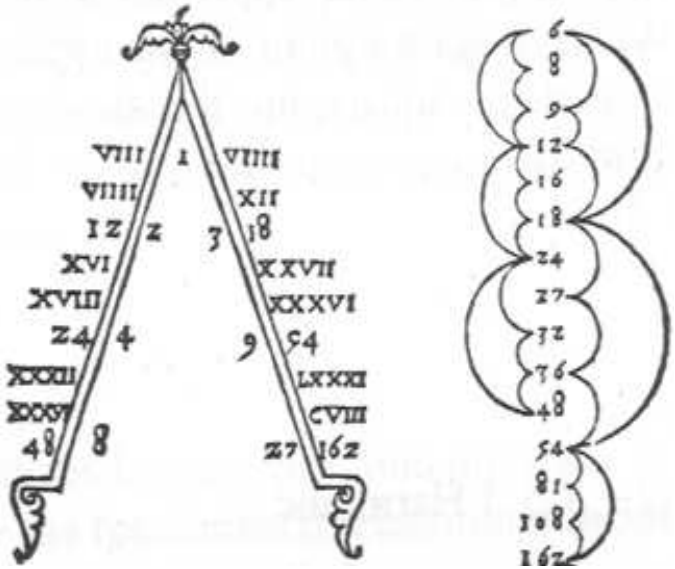


Fig 2.09:

RATIOS FROM GREEK MUSICAL SCALE

Diagram by Fransesco Giorgi(1525) illustrating the series of interlocking ratios resulting from applying Pythagoras' theory of means to the intervals of the Greek musical scale.

Sources: Retrieved October 14th, 2014 at 1823hrs from http://perseus.mpiwg-berlin.mpg.de/GreekScience/Students/Jordana/harmony.gif

2.2.2 HARMONY IN ARCHITECTURE

All comparison of architectural proportions with musical harmonies are metaphorical. However, many attempts have been made to work out principles of architectural proportioning correspondent with the mathematical principles of musical scales.Rasmussen(1959) outlines the development of this thinking beginning with Pythagoras or the early Greeks all the way to modernism.

2.2.2 (a) PYTHAGORAS: MUSIC AND SPACE

Wittkower(1952) goes into detail about the Pythagorean theory of harmonic proportions. As earlier mentioned, it was supposed that Pythogras heard a blacksmith hammering away with instruments of different sizes with pleasing acoustic results. It was from this that he discovered that musical consonances are determined by ratios of small whole numbers. Through a simple experiment using strings of various proportional lengths, he found that consonances in the Greek Musical system, that is, the octave, fourth and fifth could be expressed in the ratio 1 : 2 : 3 : 4. This progression also included two other consonances that they recognised; octave plus fifth (1 : 2 : 3) and two octaves (1 : 2 : 4). This discovery was believed to have been the seizing upon of the mysterious harmony that pervades the universe. (Wittkower,1951)

In the wake of Pythagoras, Plato explained that cosmic order is contained in certain numbers. He found this harmony in the squares and cubes of the double and triple proportion starting from one leading to the progressions 1, 2, 4, 8 and 1, 3, 9, 27. He believed that the harmony of the world is expressed in the seven numbers 1,2,3,4,8,9,27. The ratios between these numbers contain all the musical consonances as well as the inaudible music of the heavens and the structure of the human souls. Wittkower(1951) outlines all this as the beginning of the Renaissance interest in harmonic proportions.

Ching(1943) states that the architects of the Renaissance, believing that their buildings had to belong to a higher order returned to the original Greek proportioning system. These architects believed that architecture was mathematics

Fig 2.10:

PYTHAGORAS' DISCOVERY

Pythagoras found that the consonances in the Greek musical scale could be expressed as mathematical ratios and suggested that a proportioning system based on these ratios would guarantee aesthetic delight.

Sources: Retrieved October 14th, 2014 at 1823hrs from www.learnclassical.com

translated into spatial units just as the Greeks conceived music to be geometry translated into sound. An unbroken progression of ratios was developed from applying Pythagoras theory of means to the ratios of intervals of the Greek Musical scale. These ratios were applied to the dimensions of rooms and facades as well as the interlocking proportions of a sequence of spaces or an entire plan.

He and others compared the harmonic results to the rhythms of a well-proportioned building, and the code of musical architecture was born. Renaissance architects used musical ratios in their architecture. According to Wittkower(1971) they believed that this was important because man was made in God's likeness, therefore, the proportions of the human body are divinely ordained and architecture must conform to this cosmic order.

2.2.2(b) HARMONIC PROPORTIONS IN PALLADIO'S WORK

In the Quattro Libre, Palladio recommends seven shapes of rooms in a defined sequence. Firstly, circular followed by a square room. The third was to have a length equal to the diagonal of the square. The fourth was a square and a third, the fifth a square and a half, the sixth a square and two thirds and lastly, two squares. The sequence is illustrated. Of the seven, only the diagonal of the square as the length of the room is the only one that is not part of the harmonic ratios. These sequences are exemplified in his design of villas.(Wittkower, 1951)

In addition to using harmonic proportions in planning, Palladio also proposed several methods to be used when determining the height of rooms so that they are in proper proportion with the width and length. The height of rooms with flat ceilings would be equal to their width. The height of square rooms with vaulted ceilings would be one third greater than their width. For other rooms, he applied Pythagoras' theory of means to determine their heights. The means are shown below.

In the arithmetic mean, the second term(height) exceeds the first(width) by the same amount that the third(length) exceeds the height.

In the geometric mean, the ratio of the first term(width) to the second term(height)is equal to the ratio of the second term(height) to the third term(length).

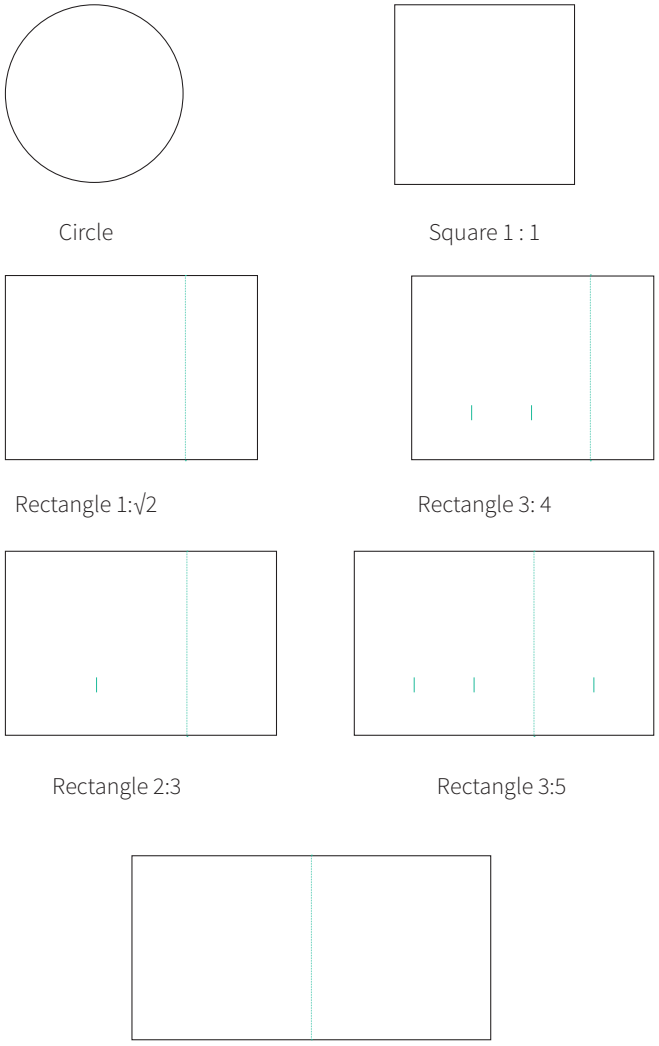


Fig 2.11:

SEVEN IDEAL PLAN SHAPES FOR ROOMS

Palladio recommended the above shapes as the 'most beautiful and proportional manners of rooms' in his Quattro Libri. The ratios of the rectangles are in line with the theory of Harmonic Proportions.

Sources: Author Modified, 14th October 2014

The harmonic mean is more complicated. Three terms are in harmonic proportion if the difference of the two extremes (a and c) is the same fraction of their own quantity. Palladio used these means in his design process.

Palladio took great care in employing harmonic ratios not only inside each single room but also in the relation of the rooms to each other. The demand for the right ratio is the main focus of Palladian architectural conceptualisation.

ARITHMETIC $\frac{c - b}{b - a} = \frac{c}{c}$ (1 : 2 : 3)

GEOMETRIC $\frac{c - b}{b - a} = \frac{c}{b}$ (1 : 2 : 4)

HARMONIC $\frac{c - b}{b - a} = \frac{c}{a} \left(\frac{b - a}{a} = \frac{c - b}{c} \right)$ (2 : 3 : 6)

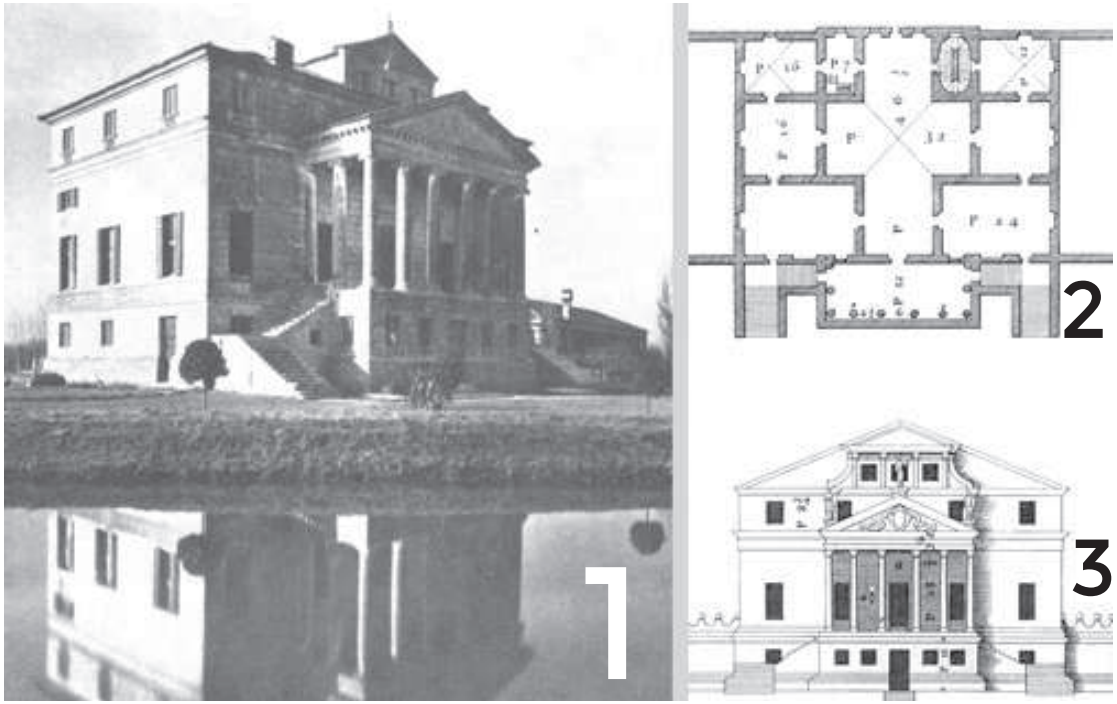


Fig 2.12:

VILLA MALCONTENTA, FOSCARI, ITALY

The Villa is based on strict adherence to the theory of harmonic proportions. All the parts are related to each other. The harmonic series 12: 16: 24: 32 is used. This was in line with the belief that adherence to these ratios will guarantee beauty. The intention was that the structure would apper an entire and complete body where all members agree with each other.

1. Perspective photograph: The proportions of the building, that is the relationship of the length, height and width are in the ratio

2. Plan: In plan, harmonic shapes in the ratio of 2:3, 1:1, 3:2 and 3:4 are used in line with the series 12:16: 24: 32

3. Elevation: the series presents itself in the elevation in the spaces of the intercolumnations being in the ratio 3:4 to the central one.

Sources: Retrieved October 14th, 2014 at 0623hrs from http://www.wjhamilton.com/

In Villa Malcontenta in Foscari, the shapes found are the square, the 3:4 rectangle, the 3:2 rectangle and 1:2 rectangle. The smallest room on either side of the cross shaped hall measures 12 feet by 16 feet (3650mm x 4870mm) creating the 3:4 rectangle. The next room measures 16 feet by 16 feet (4870mm x 4870mm) which is a perfect square. The largest room in the Villa measures 16 feet by 24 feet (4870mm x 7310mm) which is the 2:3 rectangle. The harmonic series 12: 16: 24: 32 is therefore the key-note of the building. The portico is a deviation from this sequence, being in the ratio 8:3. However, it may be looked upon as an 'overture' as it measures 12 feet by 32 feet which are respectively the first and last numbers of the harmonic series.

Additionally, the intercolumnation of the centre is 6 feet which relates to the depth of the portico (12 feet) in the ratio 1:2. The smaller intercolumnations are 4.5 feet, a ratio of 3:4 to the central one. The diameter of the columns, 2 feet represents the smallest unit beginning with 2 from which the ratios can be derived. (Wittkower, 1951)

Fig 2.13:

WOMAN DRUMMING

Drums are most commonly associated with rhythm as in most cultures they were used to give a sense of beat to the music. Especially in Africa, drums are central to the musical culture and dance is often a response to the rhythm of drums.

Sources: Retrieved on 12th January, 2015 from www.womendrummers.org

2.3.ARCHITECTURE AS A STIMULUS FOR MOVEMENT

2.3.0 INTRODUCTION

There are various personalised definitions of the word rhythm. The Oxford Dictionary of English defines rhythm as a strong, regular repeated pattern of movement or sound. The Oxford Dictionary of Music defines it as covering everything pertaining to the time aspect of music- that is, accent, metre, beat and groupings of notes into measures and phrases.

Ching(1943) defines rhythm as any movement characterised by a patterned recurrence of elements or motifs at regular or irregular intervals. He closely links it with repetition and ordering.

Rasmussen(1959) however, takes a novel approach to rhythm. He looks at rhythm as subtle variation within strict regularity and speaks of a row of houses on a street, built individually but using a similar plan as being a rhythmic arrangement. Some architects have attempted to create rhythmic effects that deviate from the norm, such as the various sized windows in Le Corbusier's Ronchamp chapel. Often, the architect is forced to create a regular method of subdivision in the composition, which is simpler both for him and for the builders. This creates a simple rhythm, easily perceptible by all yet meaning nothing. This sort of regularity and precision is man made and exists nowhere else in nature.

The concept of rhythm in music primarily concerns the control of the passage of time(Kamien 2004). Kamien describes it as a recurring pattern of tension and release, similar to lived time in it's endless variety.

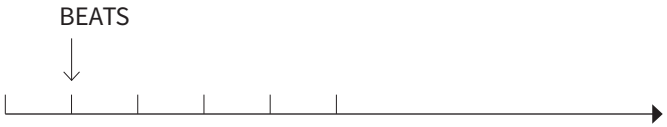


Fig 2.14: THE CONCEPT OF BEAT AND RESTS

Beat can be illustrated as a succession of marks on a time line.

Sources: Author Modified, 14th October 2014

REST	NAME	BEATS
	Whole rest	4 beats or entire measure
	Half rest	2 beats
	Quarter rest	1 beat
	Eighth rest	½ beat
	Sixteenth rest	¼ beat
	Dotted whole rest	6 beats

Tab. 2.01 BEATS AND RESTS

2.3.1 RHYTHM IN MUSIC

Music, in essence, is a temporal art; it is experienced with the passage of time. (Thaddeus-Jones,1974) Composers manipulate and control the passage of time coming up with various delightful rhythms that are interpreted differently and convey various methods. People often select music that is rdered to suit their feelings and moods. The rhythm of music often stimulates movement by causing the listeners to dance.

Rhythm in music has several interrelated aspects: beat, meter, accent, syncopation and tempo. (Kamien, 2004)

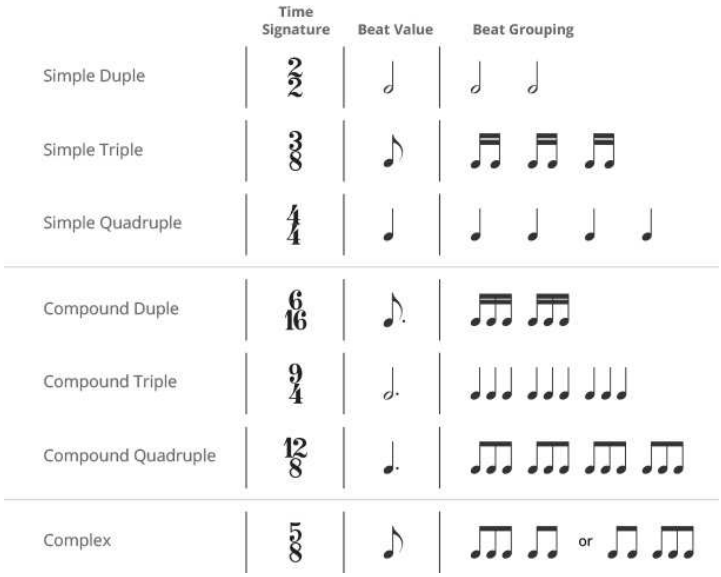
2.3.1(a) BEAT

Beat is a regular recurring pattern that divides music into equal units of time. This can be represented by marks on a time line as shown in the figure. Beats might be frequent or infrequent depending on the mood that the music is intended to evoke. Sometimes the beat is powerful and easy to feel like in rock and sometimes it may be barely noticeable giving a floaty feeling.

The pulse is communicated in various ways. A percussive instrument may pound it out explicitly or it might be sensed in the music as opposed to actually heard. Beats form the background against which the composer plays sounds of different lengths. Notes may last a fraction of a beat, a whole beat or more than a beat.

Baa Baa Black Sheep Have you Any Wool?

Each of the marks represents a beat. Have and youlast half a beat each. The combination of different note lengths is what we refer to as rhythm. Specifically ,rhythm can be defined as the arrangement of note lengths in a piece of music. Thr rhythm of a piece of music is essentiallly it's defining feature. (Kamien, 2004)



Tab. 2.02

METRE

The table above shows the various types of metre and their primary constituent elements.

Sources: Author Modified, 14th October 2014

2.3.1(b) METRE

When singing or listening to music, some beats feel stronger than others. In the above example, the stree comes after every two beats . Therefore we count the beats as **1**-2, **1**-2 as shown below:

Baa Baa Black Sheep. Have You A-ny Wool?
1 2 3—4 | **1** 2 3—4

When a measure, as above has 4 beats, it is said to be quadruple metre. If it has two beats it is said to be in duple metre and if it has three it is said to be in triple metre.

In quadruple metre, the downbeat is strongest but there is another slight stress on the third beat.

Sextuple metre, with six beats in a bar, has the downbeat as the strongest beat and the fourth beat also with a stree. The measure is divided into two 3-beat groups, 1-2-3 then 4-5-6.

2.3.1(c) ACCENT AND SYNCOPATION

An important aspect to rhythm is how individual notes are stressed. (Kamien,2004). One way to emphasize a note is to give it a dynamic accent, that is by playing it more loudly than the notes around it. A note can also be emphasized by holding it longer or being higher in pitch than nearby ones.

When an accented note comes where we could not expect it, the effect is known as a syncopation. A syncopation occurs when an off-beat note is accented, that is, when the stress comes between beats. This creates rhythmic excitement and is one of the most characteristic features of jazz.

TERM	MEANING
Largo	Very slow, broad
Grave	Very slow, solemn
Adagio	Slow
Andante	Moderately slow, walking pace
Moderato	Moderately
Allegretto	Moderately fast
Allegro	Fast
Vivace	Lively
Presto	Very fast
Prestissimo	As fast as possible

Tab. 2.03

MUSICAL TERMS INDICATING TEMPO

The table above shows various terms used to indicate the tempo that a particular work is to be played in.

Sources: Author Modified, 14th October 2014

2.3.1(d) TEMPO

Tempo is the speed of the beat (Schmidt-Jones,2005). We associate fast tempos with energy, drive and excitement and slow tempo with lyricism, solemnity and calmness.

A tempo indication is usually given at the beginning of a piece. These are usually in Italian, like dynamic indicators. The same tempo is not always used throughout a piece. Gradual speeding up may be indicated by accelerando and slowing down by ritardando.

All tempo terms are relative and approximate, different performers interpret them differently. However, the metronome indication, usually shown at the top left of a musical score, provides the exact value of the beat, that is, the exact number of beats per minute.

2.3.1(e) POLYRHYTHM

Polyrhythm is the simultaneous use of two or more conflicting rhythms, that are not readily perceived as deriving from one another, or as simple manifestations of the same meter. The rhythmic conflict may be the basis of an entire piece of music (cross-rhythm), or a momentary disruption(Kamien, 2004). These rhythms usually move at the same linear tempo.

In Africa, societies such as the Mijikenda. Zulu, Yoruba, the Eve, the Akan and the Igbo possess a music rich in rhythmic vitality. It is a music of multiple layers of rhythms. While European classical music has developed complex harmonies of tones, African music has developed a complex interweaving of contrasting rhythmic patterns. The African musician strives for the occurrence of at least two different rhythms at once, and it is precisely this juxtaposition of opposing rhythms that creates the vital spark of African music. (Agawu, 1995).

Polyrhythm in modern music is mostly used in jazz which borrows heavily from African music (Kamien, 2004).

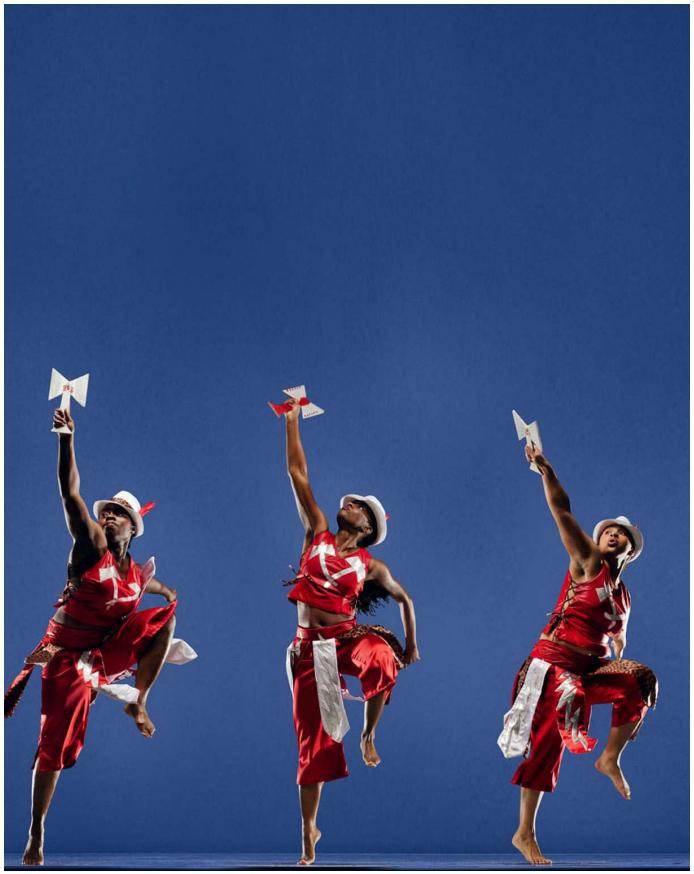


Fig 2.15: DANCE

Beat can be illustrated as a succession of marks on a time line.

Sources: Author Modified, 14th October 2014

2.3.2 DANCE AS RESPONSE TO RHYTHM

The Merriam Webster Dictionary defines dance as a series of rhythmic and patterned bodily movements usually performed to music. In every age and among every race dancing has existed either as recreation or as a religious manifestation or as both. (Oxford Dictionary of Music).

All definitions of dance are tied to rhythmic connotations and dance is largely perceived as a movement in response to rhythm or beat.

2.3.3 ON DANCE AND ARCHITECTURE

Architects have not paid as much attention to dance as other artists-musicians and painters. Studies on dance from a spatial and architectural standpoint have been extremely rare(Antoniades, 1991). There have however been studies on dance formation of primitive peoples and on dances and patterns.

According to Curt Sachs(1930), dance gave birth to the arts because dance exists in both space and time. These comments are outdated today as we are past the concept of separation of the arts based on the time-space issue. It is widely believed today that all arts have a time-space dimension with some emphasizing the one and others the other.

The movements of the dance suggest characteristics and the temperament of the people, while the ultimate conclusion of the writer, based purely on ethnographic evidence, proves the overlapping of the two basic shapes of choreography: the cyclical and the linear. Sachs argues that the dialectic between circle and straight line is to be found again in the two basic shapes of human habitation-the round hut and the hut of right angles-the megaron. Anthropological evidence suggests that the whole of humankind could be classified by the choreographic diagram of their primordial dances. It was found, by Sachs, that there were no dances of linear choreography in countries that do not know the hut with right angles.

Frederick Kiesler(1960) an architect goes further in his analysis suggesting that it is only through dance that we manage to experience the fluidity and endlessness of space. He worked through relationships among time-experiential arts addressing differences

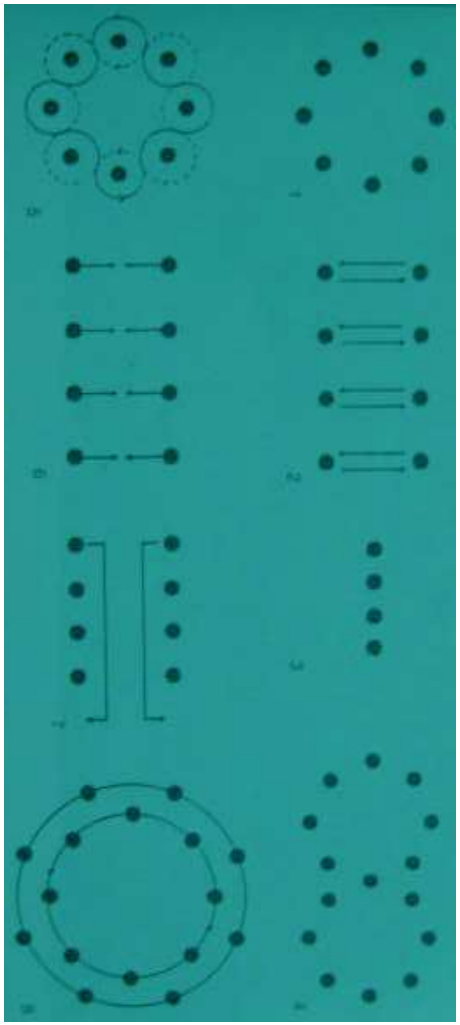


Fig 2.16:

CURT SACHS' BASIC FORMS OF DANCE

An illustration of basic dance formations as studied by ethnomusicologist Curt Sachs.

Sources: Author Modified, 14th October 2014

between various types of spaces; the 'pictorial space' addressed by painting and the 'time space' addressed by dance. In dance, space is real.

Antoniades(1991) pushes this argument further by trying to explain architectural concepts and attitudes of the twentieth century by suggesting that the architecture of the twentieth century has added another group of choreographic formations to the straight line and the circle of earlier civilisations. This new element maybe any combination of the first two with the final result.

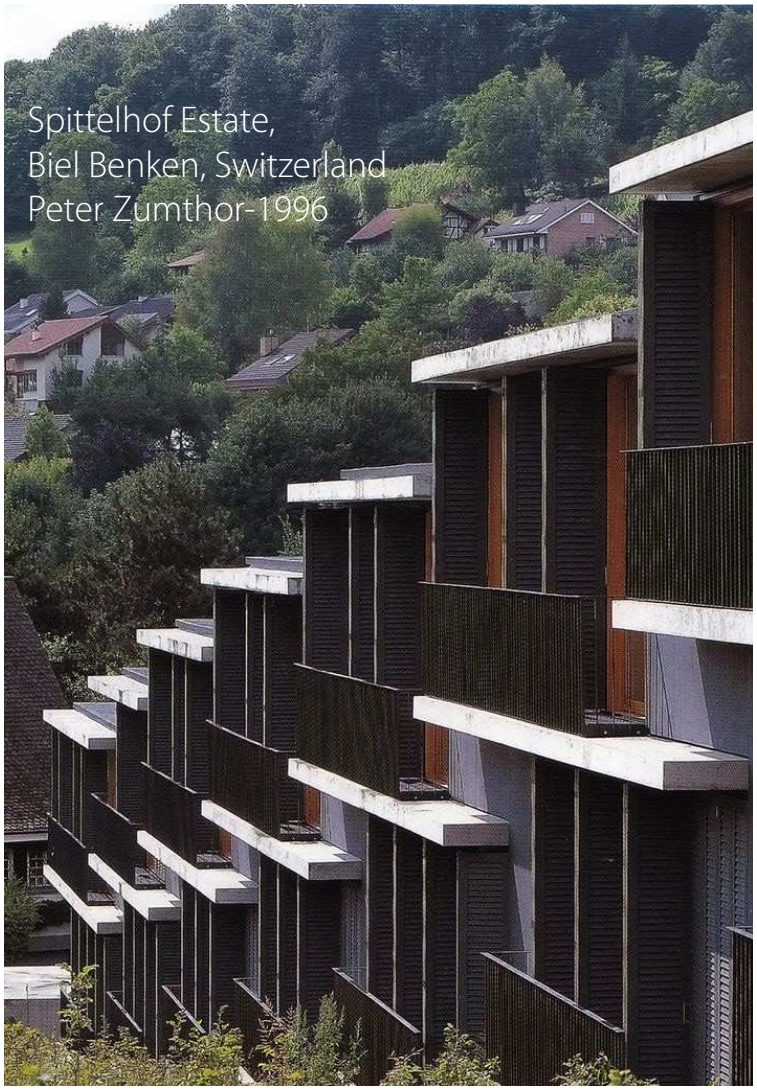
Modern dance is a time-space expressive experience of the free individual living in a group. It is an expression of freedom, individuality and improvisation according to each individual's understanding of the broad context of the rules. The score only suggests broad constraints and the choreography is a participatory affair. (Antoniades,1991)

2.3.4 RHYTHM IN ARCHITECTURE

Rhythm in architecture refers to any movement characterised by a patterned recurrence of elements or motifs at regular or irregular intervals. (Ching,1943). The movement may be of our eyes as we follow the composition or of our bodies as we advance through spaces. Rhythm, in either case, incorporates the fundamental notion of repetition as a device to organise forms and spaces in architecture.

Almost all building types incorporate elements that are repetitive such as beams, columns and windows. Beams and columns repeat themselves to form structural bays and modules of space. WIndows repeatedly puncture surfaces of buildings to allow light, air, views and people into the space. Spaces often recur to accommodate similar or repetitive functional requirements in the building program.

Rhythm in architecture is therefore hinged on repetition and these patterns of repetition can be utilised to organise a series of recurring elements creating resultant experiential and/or visual rhythms.(Ching, 1943)



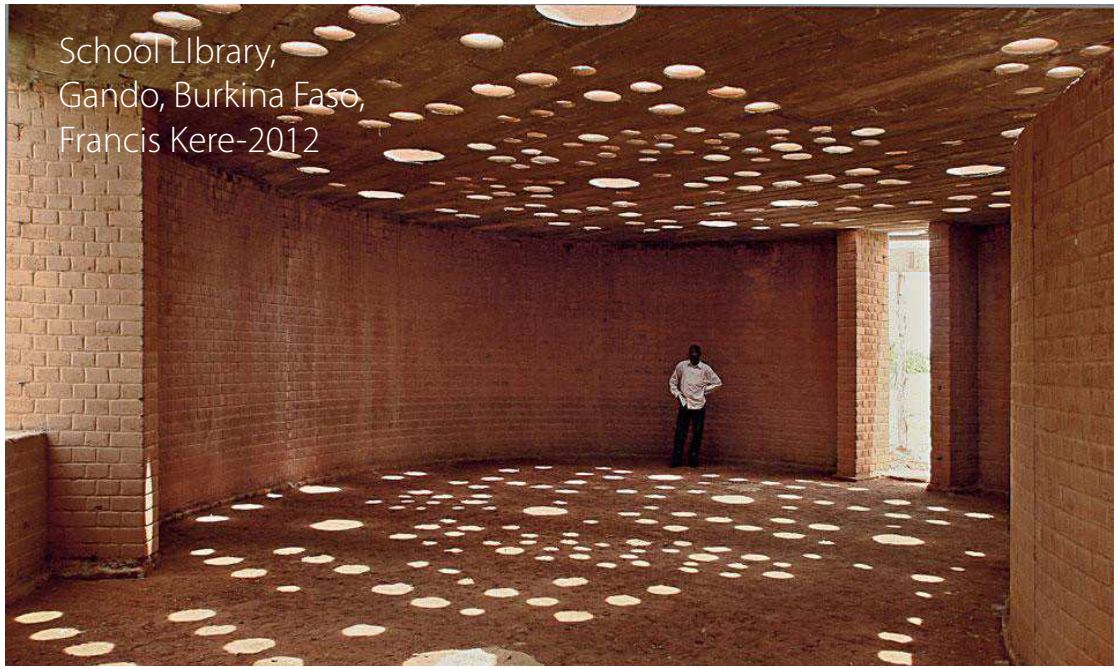


Fig 2.17:

RHYTHM IN ARCHITECTURE

Examples of buildings showing rhythm and movement in architecture.

Sources: Retrieved on 20th February 2015 from www.archdaily.com

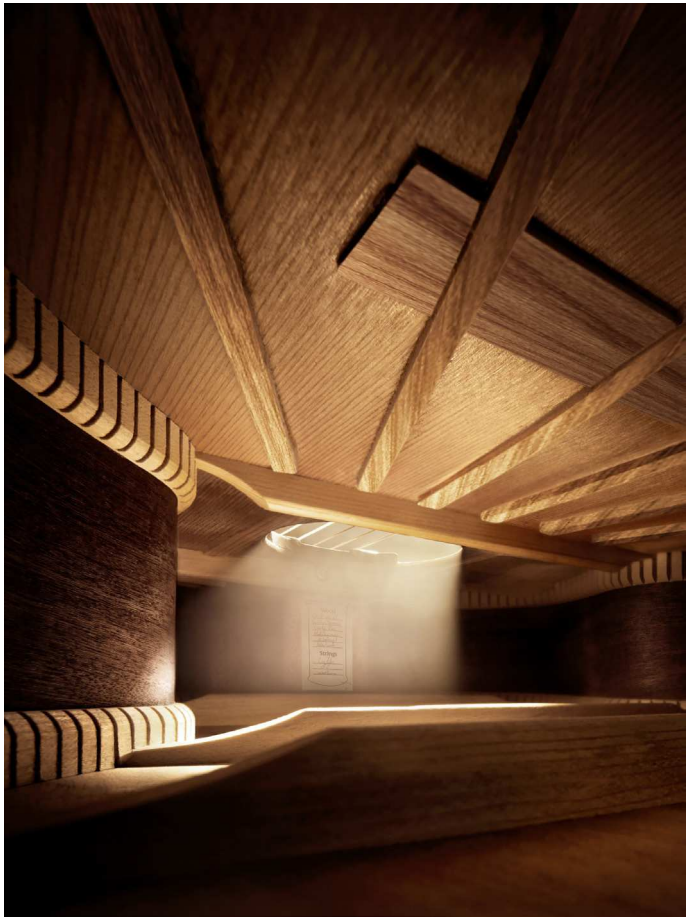


Fig 2.17:

INSIDE MUSICAL INSTRUMENTS

Photograph of the interior of a guitar. Musical instrument tectonics can be a source of inspiration for architecture.

Sources: Retrieved September 19, 2014 at 1423hrs from www.mierswa-kluska.de/portfolios/special effects

2.4.ARCHITECTURE AS A MUSICAL INSTRUMENT

2.4.0 INTRODUCTION

The more tangible form of the relationship between music and architecture is an inquiry into the similarities between the tectonics of buildings and of musical instruments. (Lutz, 2007) In developing the argument that architecture can be informed by the tools of music, Jim Lutz, in his 2007 essay outlines three areas that overlap between the two fields:

i. Forms and Spaces: Can architectural form be defined by emulation of musical

ii. Materials and Finishes: Does the delicate craftsmanship of the construction of musical instruments prevent adaptation of their elements to architecture?

iii. Structure and Mechanics: can the manner in which tensile and compressive forces are dealt with in musical instruments find architectural corollaries?

The Oxford Dictionary of Music defines a musical instrument is a device that amplifies sound. Mahmoud(2009) suggests that architectural spaces can be viewed as large-scale instruments, for example, concert halls synergize the orchestra and blend all the instruments . Concert performances would sound different according to the spaces they were performed in as the spaces each have a unique acoustical identity.

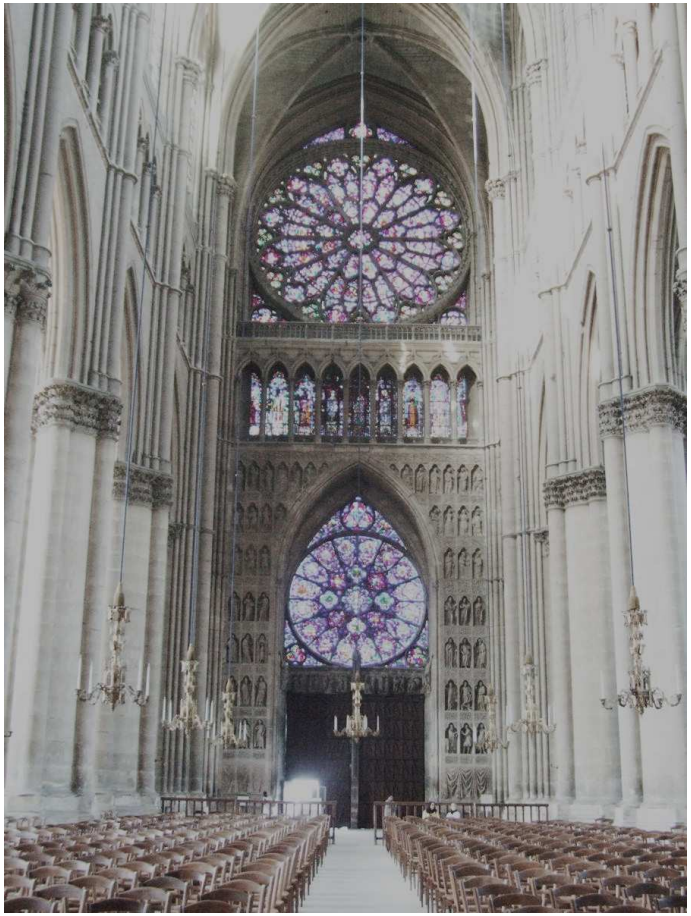


Fig 2.18:

THE CATHEDRAL OF NOTRE DAME

The high ceilings (37950mm in this case) of gothic cathedrals, seemingly reaching to a higher power created vast acoustical resonance chambers that were hampering speech and in turn led to the development of the Gregorian Chant-an early form of sacred music still used in Catholic churches today..

Sources: Retrieved September 19, 2014 at 1423hrs from http://upload.wikimedia.org/wikipedia/

2.4.1 THE ROLE OF ARCHITECTURE IN MUSICAL DEVELOPMENTS

When studied chronologically, it is found that architecture can be said to have contributed to the creation of music just as musical instruments do. (Mahmoud, 2009).

Did architecture have any role to play in the creation of early musical works? Blesser and Salter(2007) suggest that gregorian chants developed as a result of the proliferation of space in Gothic cathedrals. The interior space within cathedrals is similar to that within large natural caverns. Both spaces are characterised by large volumes, with some caverns in the Czech Republic being up to 50000 cubic metres, irregular geometries, randomly shaped surfaces, minimal acoustic absorption and uniform diffusion of sound. It may seem obvious that the creation of a vast resonance chamber in cathedrals was intentional (Blesser & Salter,2007).

Rasmussen (1959) found that though it is a common assumption that the acoustical character of gothic cathedrals was intented to convey spiritual messages, the history of the evolution of sacred spaces in Christianity reveals that churches were not necessarily intended to be the way they turned out. The mother of the cathedral was the basilica, which was a colonnaded space without walls. Early Christians congregated in these spaces until Emperor Constantine declared Christianity the official religion of the Roman Empire. Upon this sanctioning, walls were added for protection from weather and assertion of political power. This altered the aural space. As the need for larger congregation spaces arose, the floor areas became larger and the ceilings dramatically higher, as though reaching to a higher power. The surface materials changed from wood to stone.

Bagenal (1931) explains that the unintended resulting acoustics were not conducive for speech and the priest's words would often blend into each other due to the great reverberation time. However, in such spaces, vowel sounds are heard as tones and sung notes are prolonged. Notes in a sequence may therefore continue for five to ten seconds overlapping with those following it. Gregorian chants developed from the recitation of the Psalms in the churches. The psalms tended to require an inflexion of the voice for

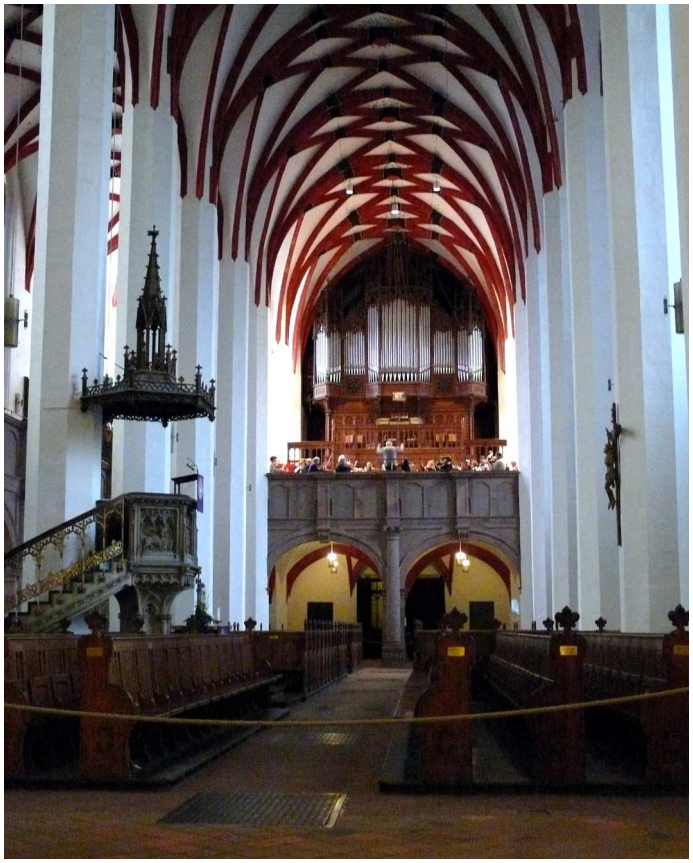


Fig 2.19: **ST. THOMAS CHURCH, LIEPZIG**

The wooden cladding over the stone in the interior of the church altered the acoustics allowing for Bach's musical experimentation.
Sources: Retrieved September 19, 2014 at 1423hrs from http://artandseek.net/files/2012/03/

proper delivery. The long reverberation in churches facilitated the blending between one tone and the other and produced a harmonious effect and the communication becomes a musically tonated one. Gregorian chants to date sound best when performed in spaces of this character and sound disjointed in rooms with short reverberation. This is because the keynote is heard throughout the singing and the other notes are heard at intervals of a third an a fifth as in part singing. Bagenal stated that *"The church building with it's specific tone conditions was in fact a powerful instrument that could be learned by a choir."* (1931)

The unifying tone effect of the church as an instrument is attributed to the discovery that many tunes could go on at the same time, and if musical rules were strictly observed, the effect would be pleasant. From this, polyphony, the singing of many independent parts together at the same time, developed. It was unaccompanied and relied on human voices using the church as their major instrument. Polyphonic music was, according to Bagenal, directly produced by a building form and by the open vowels of the Latin language.(1931)

Moving on to the Renaissance period, Bagenal (1931) suggests that the architectural developments of the Renaissance, such as domed vaults, had an impact on the acoustics and consequently the music of the time. Domes are strong reverberators and create unique sound centres. The Renaissance composer, Giovanni Gabrieli, took advantage of these features when he wrote music- Sonata Pian e Forte-for the Byzantine church of S. Mark's in Venice. The church is built over a greek cross in plan and has five domes, one in the centre and one over each of the four arms of the cross. The church had two music galleries, on the right and left with their respective domes acting as a mighty resonator. The music was heard from both sides, one answering the other.

The reformation brought further changes to churches. German was now used in line with Latin in the church and side galleries were added to the churches.Johanes Sebastian Bach, a renowned Renaissance composer used St. Thomas Church in Liepzig as his instrument. The church is a large three aisled Gothic edifice with level vaults. Large areas of resonant wood were added to the stone after the Reformation. The wood absorbed sound and reduced the reverberation time. Side walls were lined with wooden galleries and private boxes. The galleries came about because the Lutheran system of church government placed the Church under the town council and the members therefore

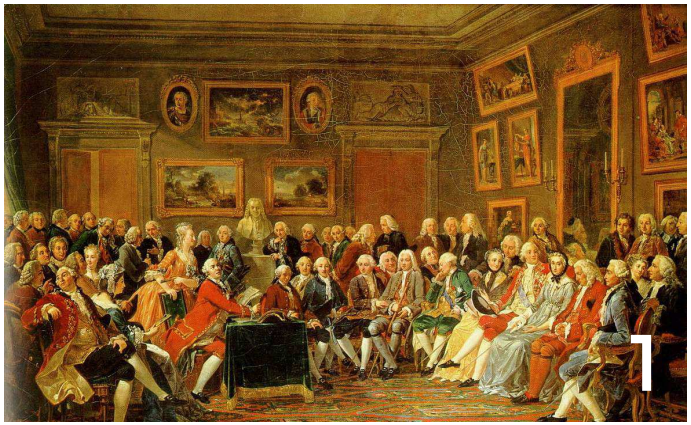


Fig 2.20:

ACOUSTIC DIFFERENTIATION

1. **MADAM GEOFFRIN'S SALON**-Painting by Anicet Charles-Gabriel Lemonnier of a music salon during the age of enlightenment. The acoustics of private houses in the Victorian area were specific and led to the popularisation of chamber music.

2.**MODERN ENTERTAINMENT ROOM**-The use of electronic audio devices caused indifference towards acoustic differentiation of rooms.

Sources: Retrieved September 19, 2014 at 1423hrs from
http://www.buildingscheme.com/
http://www.wga.hu/

had private family boxes. The boxes had richly carved moldings, characteristic of the baroque style and panels and had curtains at the openings. These features helped create acoustics that made it possible for the 17th century development of the Cantata and Passion. Bagenal found the reverberation of the church with the wood additions to be 2.5 seconds as compared to the 6-8 seconds of the medieval church. The absence of athe unifying tone allowed Bach to compose music in a variety of keys.

Further, the Rococo saw the development of new churches to meet new requirements as well as great town houses with more comfortable interiors. The covered entry way led one into a marble hall that resounded with the sound of high heels. The more intimate rooms were acoustically adapted for music. The salon had silk panelled walls which shortened reverberation and the wooden dadoe was used specifically for chamber music.

The Classical period of the late 18th and 19th century was characterised by renewed interest in classical and Gothic works. Creative design gave way to accurate copying of details from earlier buildings. There was no personal conception behind the rooms planned by architects and thus no attention was given to acoustic function of rooms. The exteriors were copies of classic prototypes but the interiors were not designed for oratory or music. The flat ceilings that were typical of the earlier classic buildlings were replaced with slightly domed ceilings which produced acoustical conditions that the architects could not control. Concert halls were also designed casually without consideration of the function that they would be used for. (Bagenal 1959).

Rasmussen(1959) draws attention to the persistence of this indifference towards acoustics in modern architecture. Radio transmission created interest in acoustics but only in as much as sound could be absorbed and reverberation shortened easily, using equipment. Interiors today usually have one wall entirely of glass and the other three are smooth, hard and shiny with an artificially subdued resonance. There is no longer any interest in producing acoustically differentiated rooms though the ordinary human being enjoys variety, including that of sound.

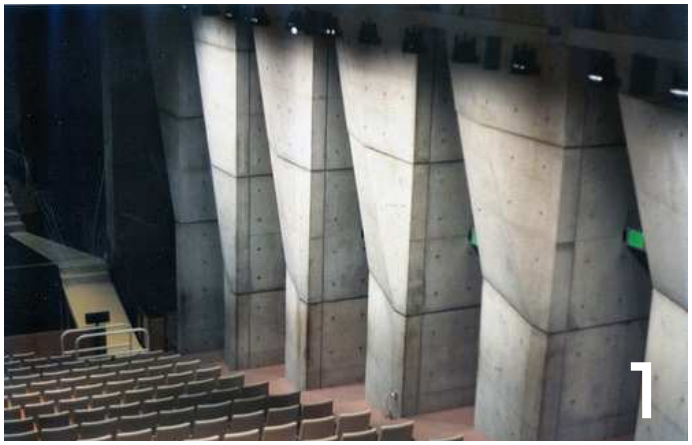


Fig 2.22: MIMESIS OF MUSICAL INSTRUMENTS

1. **FORT WAYNE THEATRE OF PERFORMING ARTS**-Photograph of the auditorium that Louis Kahn conceptualised as a violin enclosed in a concrete case.

2.**PIANO HOUSE, HUANAIN, CHINA**-TDesigned by students of the Hefei University of Technology, the piano-shaped building is currently used to by city planners to display plans and proposed developments. The violin contains circulation spaces.

Sources: Retrieved September 19, 2014 at 1423hrs from
http://www.artsunited.com/
http://www.constructionglobal.com

2.4.2 EMULATION OF MUSICAL INSTRUMENTS IN ARCHITECTURE

As earlier stated, the relationship between architecture and musical instruments would be tackled by examining the similarities between their forms and spaces, their materials and their structure as laid out by JIm Lutz(2007).

2.4.2(a) FORMS AND SPACES

Lutz(2007) discusses a number of works that demonstrate the mimesis of musical instrument architecture. The first project discussed is Louis Kahn's Theatre of the Performing Arts which was constructed between 1966 and 1973 in Fort Wayne, Indiana. Kahn developed a concept based on the violin and it's case. The concert hall-stage and auditorium chamber were his 'violin' and all supporting spaces-the public lobby and the surrounding galleries were the 'violin case'. The violin case serves to protect the delicate instrument. This difference was manifested physically through the use of different construction materials. The chamber was constructed of folding concrete walls while the outer spaces were constructed of masonry.

Lutz further points out that this distinction between a precious instrument and the utilitarian protective casing surrounding it is a metaphor that has been explored by several artists, including Henri Matisse, who painted it, Arman who sculpted it and Stephen Holl, an architect that displays a violin case in his apartment as a surrealist sculpture.

Antoniades(1991) intoduces the subject of mimesis of musical instruments whereby architects come up with novelty sculptures that imitate the architectural form without any abstraction. The buildings in turn appear to be musical instruments planted on the ground at an extremely large scale with the inside organised into various spaces by division. The trouble with this method, he asserts, ,is that the forms are not at all abstracted and concepts drawn but are instead directly imitated which at times make the buildings unsuccesful as architecture but easily appreciated as looking exactly like something else.

Fig 2.24:

MATERIALITY OF MUSICAL INSTRUMENTS

Photograph of the interior of a violin. The resonant woods used in construction inform choice of material for auditorium interiors.

Sources: Retrieved September 19, 2014 at 1423hrs from www.mierswa-kluska.de

2.4.2(b) MATERIALS AND FINISHES

The acoustical performance of musical instruments can be likened to the role of architecture in the development of musical works. Lutz(2007) begins with a modern perspective with the example of the Experience Music Project by Frank Gehry. The project was a museum to house the Jimi Hendrix memorabilia belong ing to Paul Allen which grew to an all inclusive music museum. Gehry chose to employ bits of broken guitars in his initial studies and eventually includeda flowing glass band reminiscent of a guitar's fret board. The end result of the building however did away with a lot of these concepts . In order to develop it further. Gehry got chunks of broken guitar, reminscent of Jimi Hendrix breaking guitars on stage. The colours of these chunks, putple, therefore inspired the purple part of the building.

Lutz refers to another of Gehry's project, The Walt Disney Concert Hall completed in 2003. It features a 'vineyard' style performance space enclosed in undulating metal clad surfaces. Gehry purposely contrasted the finish materials of the auditorium-wood paneled to achieve certain acoustic effects with those of the ancillary spaces-the metal clad surfaces. A musician, Liza Lim(2002) wrote a dedicatory piece for the hall's opening. She describes the building as an instrument fot listening and discusses the use of the Douglas fir, a wood often used for the construction of stringed instruments such as the cello and viola.

Further in this trend, the universal trend for auditoria is to clad with absorbent material, often wood. This trend, likened to resonant musical instruments made of wood has successfully created various feels in rooms and buildings. This trend was realised through the careful study of musical instruments and their ability to produce sound. The materrials employed, that are related to musical instruments are very succesful in achieving desirable acoustical results.(Lutz 2007)

Fig 2.24: ARCHITECTURE AS INSTRUMENT

1. **THE HARP-NIEUW VENNEP BRIDGE-**Photograph of a bridge designed by Santiago Calatrava inspired by a harp.

2. **THE SINGING RINGING TREE-** Photograph of monument by TonkinLiu architects inspired by panpipes.

Sources: Retrieved September 19, 2014 at 1423hrs from
http://broer.no/bro
http://www.tonkinliu.co.uk/files

2.4.2(c) STRUCTURE AND MECHANICS

Buckminster Fuller(1939) noted that many of the instruments that man contrived were, from a structural standpoint, highly demonstrative of mechanical functions. Santiago Calatrava, a notable designer and engineer often referred to musical instruments for a series of bridges he constructed in the Netherlands between 1999 and 2004. The three bridges, named the Harp, the Cittern and the Lute depend on a balance of tensile and compressive forces to produce sound.

Tzonis and Donadei(2005) describe the sister bridges as embodying a special sense of movement, a musical, rhythmical quality. Each bridge is a variation on a cable stayed steel pylon expressed as a spindle, which derives much from Calatrava's graduate thesis. The Harp uses three groups of cables, two Gaussian ones and one planar. The Lute carries two curving roadways suggesting the rounded sound box of it's namesake. The Cittern, a distant relation of the guitar from the middle ages supports intersecting spans from one mast. Lutes and harps from non-European regions bear most similarity to Calatrava's designs- these are the kora from Africa, the Urals from ancient Egypt and bow shaped harps from Borneo and Burma.These instruments prefigure the arrangement of support and strings in the bridges.

Lutz(2007) cites the Luminous Veil by architect Derek Revington as another example of parallels drawn between architectural engineering and music.The veil is designed to serve as a barrier protecting the pedestrian walkway on the upper level of the Bloor street bridge in Toronto where suicide was common, The range is a series of taut vertically strung cables running the length of the viaduct that looks similar to an Aeolian harp, a zither with strings of equal length that are 'played' when winds cause them to vibrate.

Similarly, Dowdy(2005) describes a project by British firm Tonkin Lieu as a large scale aerophone. The project, titled The Singing Ringing Tree relies upon the wind blowing from the moor to compose random tunes as it passes over its 350 pipes. Panpipes, a common instrument in many cultures provided the inspiration for this monument.

Fig 2.25: MUSIC AND ARCHITECTURE

The recently designed Hotel Liesma by Busins and Banka draws inspiration from this age old realtionship between music and architecture.

Sources: Retrieved September 19, 2014 at 1423hrs from http://trendhunter.com/bro

2.4.3 SUMMARY

The review of various texts has revealed that architecture did have an effect on the composition of music. Formal music begun in the church, which is, largely, a building. The developments in church architecture are seen to have caused effects in the developments in musical compostion. The performance of music in enclosed spaces led to the sound acquiring certain characteristics. This led to various styles of composition according to the space coming up. As time went by the music evolved and became more differentiated leading to the detailed musical compositions that we have today.

In addition to the building itself serving as a musical instrument and music being written specifically for it, musical instruments are seen to have inspired many an architect. The forms and spaces of musical instruments are seen to have found various architectural manifestations as have their materials and finishes, which have greatly influenced the acoustical designs of concert halls and their structure and mechanics.

As architecture continues to look beyond its traditional boundaries for inspiration and intervention, the realm of music continues to provide a source of ideas that is rich with possibilities.

CHAPTER 3
RESEARCH METHODOLOGY

Fig 3.01

ALTAR OF HEAVEN, BEIJING

The Altar of Heaven is one of the 18th Century Imperial Buildings studied by Zhang to establish the role that music played in it's design. Chinese musical scales as well as other environmental sounds played a key role in the design of the building.

Sources: Retrieved January 25th 2015 from https://ilgilerimbilgilerim.files.wordpress.com/

3.0 INTRODUCTION

The relationship between music and architecture has been widely studied. In the University of Nairobi Department of Architecture, Gloria Masese (1998) studied the subject taking a theoretic approach to the subject and delineating the similarities and differences of the two fields from an analysis of literature. Her study was focused on the Western and in particular classical music and architecture.

In 2000, Njogu went on to look at modes of application of music in architectural design and the potential for cross fertilisation between the two fields again focusing on Western music, particularly the stochastic works of Iannis Xenakis. This study was also largely a secondary analysis of literature on both fields.

Studies on Western music and architecture have been carried out severally in other institutions of learning. Others such as Zhang(2007) have investigated the relationship between the two fields in the Eastern Setting. Focusing on musical design in 18th century Chinese architecture, she explores how certain archi-music practices were expressed by examining two surviving imperial buildings in Beijing; the Altar of Heaven and the Zither Rhythm Studio built in 1749 and 1757 respectively. This study was carried out through on-site survey's of the building and theoretical analysis of historical documents.

In 2009, Mahmoud carried out a study on music and architecture focused on Egyptian culture and specifically historic Cairo. He was able to look at the direct and indirect influence of music by making a comparison between the characteristics of the traditional Arab music prevalent in the region and the architecture. Music was used as a cultural identifier to unlock 'hidden dimensions' shared in language music and architecture. The case study method was used to gain a deeper understanding of Cairo's heritage and afterwards design was used as a research method by using concepts of the Arabic melodic modes, *Maqams*, discovered from the case study to create a place for listening, *al Masmaa*.

TABLE 3.01: DATA REQUIREMENTS AND SOURCES

DATA REQUIREMENTS	IMPORTANCE IN STUDY	DATA SOURCES	DATA ANALYSIS
Mijikenda music	Useful for derivation of key compositional characteristics	Audio visual material Observation Photographs Sketches LIterature Review	Tables Sketches Notes Photographs Video Recordings
Mijikenda Architecture	Derivation of design and organisational principles	Observation Sketches Photographs Literature Review	Sketches Tables Notes

The table above outlines the data needed to carry out the study successfully. The information collected will be used to analyse the attitude towards both music and architecture and to arrive at certain conclusions about compositional principles applied by the Mijikenda in their designing and composing of music. This information will be useful for those that are looking to abstract from this particular cultural source as the guiding principles will be clearly presented.

3.1 RESEARCH PURPOSE

As earlier stated, the objectives of the research are as follows:

1. To clarify the relationship between music and architecture
2. To establish whether there is any relationship between the music and architecture of pre-colonial Mijikenda society.
3. To describe ways in which music can be applied to the creation of architecture.

These objectives point at an exploratory research purpose. The research aimed at gaining a deeper understanding of and new insights into the relationship between music and architecture. The literature review revealed much inquiry into this relationship in Oriental and Western settings. This study looked at the African setting, with it's unique musical characteristics vis a vis it's architecture. A wide-angle focuswas used to examine the depth and breadth of this relationship in an attempt to learn more about it and formulate possible areas for further investigation. This will be useful in determining whether indeed such a relationship exists or not as well as suggest overally how contemporary architects are incorporating music in their conceptualisation.

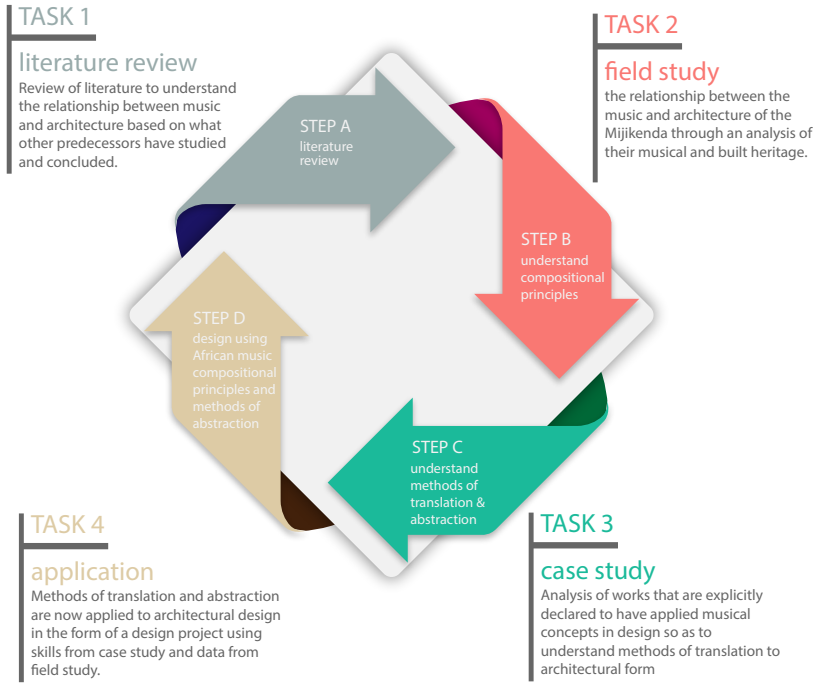


Fig 3.02

RESEARCH APPROACH

An infographic showing the research approach ending in the eventual application of the application of knowledge gained.

Sources: Author, February 25th, 2015

3.2 RESEARCH APPROACH

Studies carried out in the last ten years in the Western context have taken an explorative approach, studying characteristics of music and architecture in-depth independently and correlating them with the characteristics of the architecture. Mahmoud (2009) has attempted to carry out the study in the African setting in Egypt by first generally discussing musical concepts and then discussing their relevance to architecture. He then goes further to discuss the characteristics of Egyptian music and then uses design as a research method to explore his theme.

In this study, a deductive approach, beginning with the knowledge that there is a relationship between music and architecture, as established from earlier studies, has been taken. Qualitative research methods, aimed at describing, exploring and discovering more about this relationship, where it applies and where it does not were then applied to the two communities selected. The music and architecture of the two communities will be studied broadly and their overlapping characteristics identified and further discussed.

3.3 RESEARCH STRATEGY

In line with exploratory research, two methods were used in carrying out the research.

Theoretical analysis is the foremost research method. This involved selection and discussion of theoretical material and descriptive material in context followed by a detailed comparison of theories in terms of their applicability. Other researchers' works on either of the fields, music or architecture were analysed and compared. The works that will be reviewed are:

The Kaya Complex: Thomas Turner Spear

Folk Music of Kenya-George Senoga Zake

Case study survey is the other method applied in this research. This involves visit to the sites of interest, Kwale and Malindi to observe and document the data required pertinent to the music and architecture of the Mijikenda specifically.

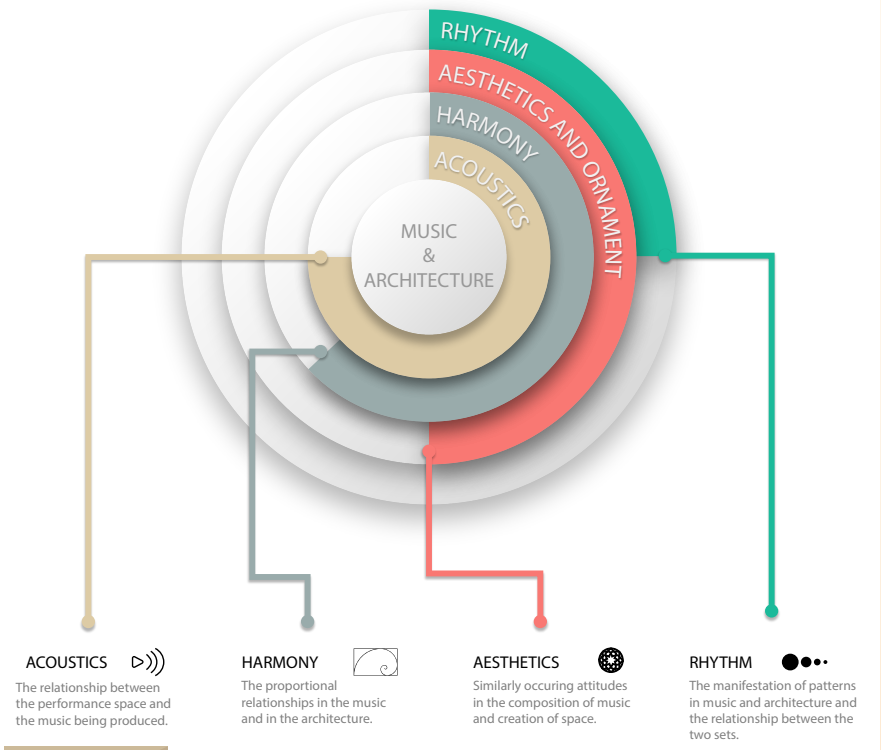


Fig 3.03 RESEARCH VARIABLES

Infographic showing the four research variables and a brief explanation of what they are about.

Sources: Author, February 25th 2015

International case studies will be used in answering the third research question. This will involve sourcing of secondary information from books and websites regarding the projects discussed.

3.4 RESEARCH VARIABLES

As determined from the literature review, there are some compositional

principles occuring in both architecture and music. These principles were used in the examination of the music of the Mijikenda, as well as their architecture. The variables are:

i. Harmony and Proportion

Harmony is examined in music and a relationship to proportional relationships in architecture are drawn

ii. Rhythm

Rhythmic patterns in music are related to those in Africa and a relationship is sought.

iii. Colour and texture

Tone colour, texture and ornamentation in music are related to ornamentation and surface articulation in buildings.

iv. Acoustical performance

The role of architecture in the shaping of music is discussed in detail.

The same variables were used in the analysis of the International Case studies so as to give a clear idea about how the music is translated into architectural form

3.5 SAMPLING

Non-probablistic, purposive sampling is used in selecting the cases for study. This is because the area of study is relatively narrow and there are few examples of architecture that has been created from musical concepts. The study aims to shed light on this so as to encourage such experimentation.

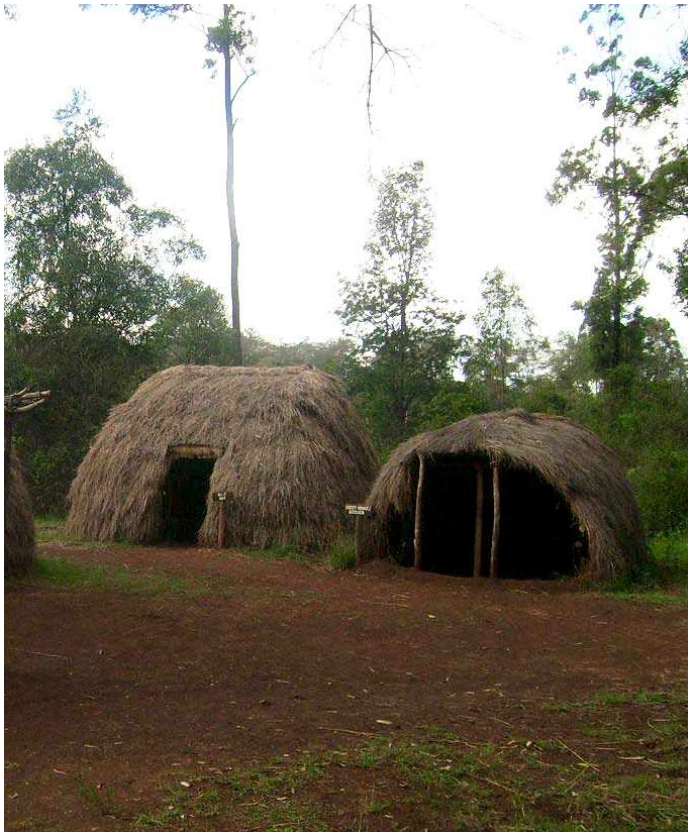


Fig 3.04

MIJIKENDA DWELLING

Typical Mijikenda dwellings that form part of the kaya, the Mijikenda settlement.

Sources: Author, October 21st 2014

3.6 CASE STUDIES

3.6.1 LOCAL CASE

One local case were selected for this study; the Mijikenda of the Kenyan coast. This is in a bid to establish any links, conscious or unconscious that their music has with architecture. It is important to note that no such study on African music had previously been carried out.

The case was selected firstly because of availability of a large body of work discussing both their music and architecture. Mijikenda dances and songs are widely performed and have been preserved while the protection of Kaya as a UNESCO World Heritage Site ensures that the architecture is preserved and information regarding their architecture and way of life is documented. It is therefore possible to obtain information on their music and its creation as well as on the principles governing their construction methods.

In addition ,the case was selected because of its relevance to the study. The Music of the Mijikenda widely adapted into modern hits remains culturally relevant today. The study aims to investigate the relationship between African music and architecture and the Mijikenda are close to home. The Mijikenda put up semi-permanent houses in large settlements known as Kaya. The organisations of their settlement will be key in understanding their approach to order.

In carrying out this assessment of the music and architecture of the Mijikenda, the following aspects were looked at:

i. Harmony

The music was analysed according to it's tonality, it's harmonic components such as scales and harmonic structures. According to the literature review, harmony was the first and clearest relationship that architects from earlier period found. In the quest for universal beauty, musical harmonies were applied to architecture. The study of harmony also required an analysis of proportional relationship in vernacular Mijikenda architecture to establish whether or not such a relationship existed, consciously or unconsciously.

Fig 3.05

MIJIKENDA MGANGA

Music is not only for entertainment, it also bridges the physical and magical worlds. A traditional doctor, *mganga* sings accompanied by an idiophone-kayamba as he performs his work.

Sources: Retrieved January 25th 2015 from https://www.magiccarpetjournals.com/

ii. Rhythm

An analysis of rhythmic patterns in Mijikenda music was carried out. Various patterns occuring in their music were compared to the attitude towards rhythm in their architecture. The factors considered in rhythm in architecture were facade rhythm and planning rhythm.

Dance formations, were assessed and their relationship with the built form, as they in essence are a definition of space, discussed. The performance space is also contrasted with the dance formation in an attempt to establish whether these formations were as a result of the spaces in which the dances were performed. 5 dances from different sub-tribes were used in the study.

iii. Aesthetics and Ornamentation-Colour and texture

The nature of the musical composition and performances of the Mijikenda were assessed. Ornamentation in the music and dance performances was compared to ornamentation in the built form.

iv. Acoustics

The performance spaces used by the Mijikenda were assessed and the impact of the spaces on the performance and composing of the music.

The subjective selection of the cases maximises generalisation of insights leading to even more conclusive research on the subject matter. The exclusion bias that may result only leaves room for even further investigation into the relationship between music and architecture on the African continent.

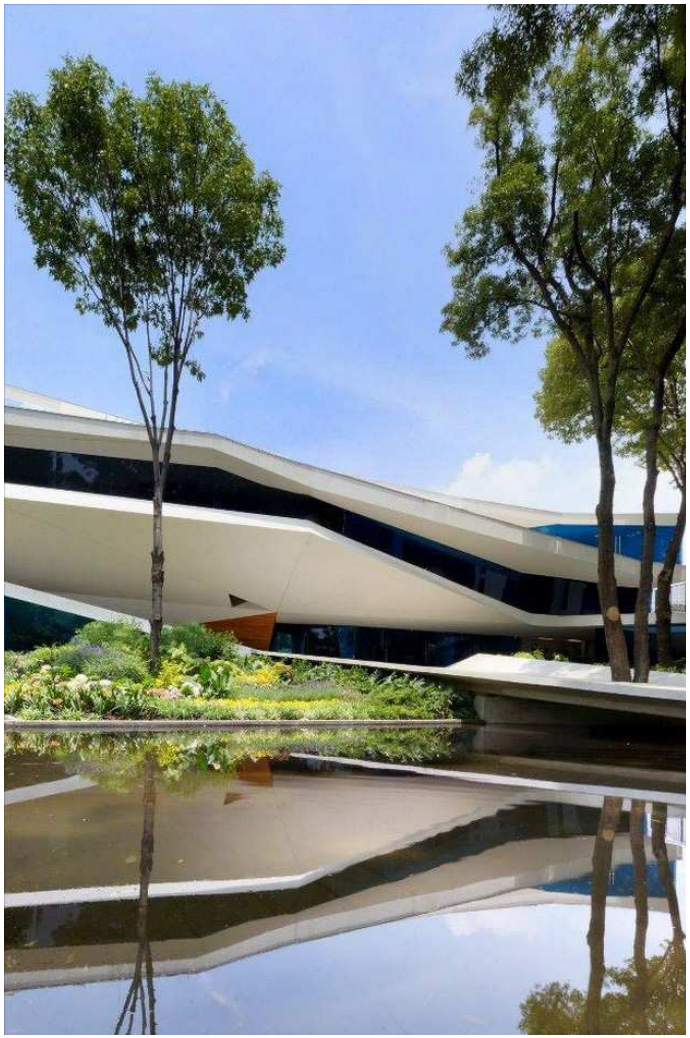


Fig 3.06

ROBERTO CANTORAL CULTURAL CENTRE

This Cultural Centre in Mexico, inspired by a conductor's movements during a musical performance is studied as an example of use of music as image.

Sources: Retrieved January 30th 2015 from https://www.archdaily.com

3.6.2 INTERNATIONAL CASES

The international cases were also selected using purposive sampling. The reason for this is that there are limited projects with music as the core organising concept. The projects were selected to illustrate three major ways that music is used in the architectural design process as follows:

i. Music as Method-Stretto House

This was selected so as to illustrate deconstruction and abstraction of a musical work and its subsequent translation into architecture. The architect, Stephen Holl, used Bela Bartok's Music for Strings, Percussion and Celesta as the main inspiration and organising principle for this building. The study sheds light on how this was achieved.

ii. Music as Inspiration-Berlin jewish Museum

This case was picked in order to understand how music can be used as inspiration for architectural form. The architect does not abstract directly from a musical work but instead draws inspiration and ideas from the Schonberg's Moses and Aron that he uses in his design. This is an irrational expression of the music.

iii. Music as image-Roberto Cantoral Cultural Centre

This refers to the method whereby music is used directly as an image or where images from music and music performances are incorporated in the design.

Fig 3.07 **DATA SOURCES FLOWCHART**

An infographic showing the methods of collection and sources of the data required to answer the research questions.

Sources: Author, 25th February 2015

3.7 DATA REQUIREMENTS

To carry out the study according to the stated strategy, data needs were identified as:

i. Literature and information on the two fields independently for comparison

ii. Musical scores and architectural drawings pertinent to the area of study

iii. Audiovisual material

3.8 DATA SOURCES

3.8.1 PRIMARY SOURCES

Audiovisual material were obtained first hand by the author by visiting the area and observing the performance of the music and making deductions. Sketches of buildings visited were also made.

3.8.2 SECONDARY SOURCES

Being a theoretical study, secondary data sources are key as the research entails an analysis of past research on the specific fields in that community and the drawing up of parallels and differences between the music and architecture of the area. These secondary sources include:

i. Books

ii. Theses and Academic Papers

iii. Journals

iv. Websites and Blogs

3.9 DATA PROCESSING AND ANALYSIS

The data was collected in the form of notes and sketches.The analysis involved a search for patterns and similarities between the two fields.

Consistencies and inconsistencies in the data are identified and explained in a narrative. The final report is a narrative with descriptions of the relationships. Sketches depicting the principles in architecture and illustrations of the same in the music were used in the compiling of the report.

Tables will be used in comparing and contrasting and will communicate the relationship directly.

CHAPTER 4
DATA ANALYSIS

Fig 4.01

MAP OF KENYA

Kenya map showing Mijikenda Territory.

Sources: Author Modified, 25th February 2015

4.0 A BRIEF HISTORY

The MijiKenda are a coastal Bantu tribe living along the Coast of Kenya in the area between rivers Sabaki and Umba. This area stretches from the border with Tanzania in the South to the area near Somalia border in the north. As shown on the map, they occupy the area closest to the Indian Ocean.

The origin of the MijiKenda is said to be Shungwaya, a region in southern Somalia. They migrated southwards from Shungwaya sometime in the 16th century. Their migration was prompted by the expansion of pastoralists particularly the Akwavi Maasai, Galla or Orma. Tradition further relates that the original settlers founded six individual fortified villages known as makaya on the ridge running parallel to the Kenyan Coast. Three more kayas were added at some time later. From details in legends, the date of establishment of the first kayas is suggested to be around 1560 and the last 1870. For centuries, the legends purport, the early kayas thrived with their inhabitants developing distinctive languages and customs. Eventually, dispersal away from the fortified villages began due to population pressure and internal conflicts.

The legends are said to be corroborated by 19th century written histories of the Swahili coastal trading towns which flourished from the 12th to the 14th centuries with the traders from the coast intermixing with people inland. An influx of Mijikenda people around the 17th century into these Swahili coastal towns followed. Portuguese 17th century documentation implies that the Mijikenda were settled along the coast by the early 17th century. Historically, these Mijikenda ethnic groups have been called the Nyika or Nika by outsiders. It is a derogatory term meaning “bush people.”

Studies of coastal languages can also support the legends. The nine separate dialects which the nine clans of Mijikenda speak are closely related and linked to other languages along the coast of Kenya and Tanzania. Studies of these languages suggest that a proto ‘Sabaki’ language in Somalia split into Mijikenda, Pokomo and Swahili during the 16th and 17th centuries.

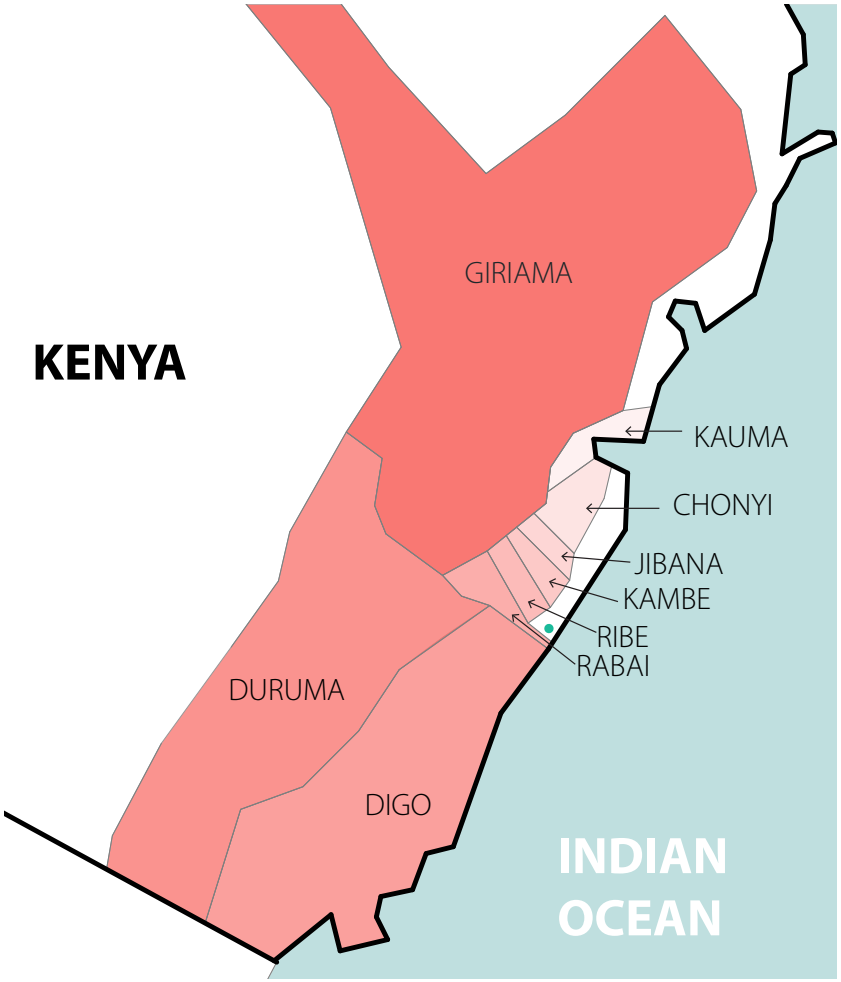


Fig 4.02

MAP OF KENYAN COAST

Partial Map of Kenyan coast showing settlement of the 9 Mijikenda subtribes.

Sources: Author Modified, 25th February 2015

The word MijiKenda translates to 9 homesteads; miji for homesteads and kenda for 9. Mijikenda is comprised of 9 subtribes-symbolised in this case by homesteads. The 9 subtribes are Giriama, Digo, Kambe, Kauma, Chonyi, Duruma, Ribe, Jibana and Rabai. They all speak different dialects.

The Digo clan are said to be the first group to leave the Shungwaya ancestral homelands, followed by the Ribe, Giriama, Jibana, Chony, and Kambe. There are several oral traditions related to their migration, but all report that they settled in places on the way and in time split into two groups, founding Kaya Kinondo and Kaya Kwale. At the beginning of the 17th century further dispersal took place from the two main centres and secondary kayas were established. From Shungwaya, each of the groups brought their own ritual talismans known as fingo, which were buried in the new settlements. The Rabai, Kauma and Digo people formed later along the coast of what is now Kenya, assimilated Mijikenda identity and built their own kayas.

The Miji Kenda cultural organisation is based on a clan system. Clans are patriarchal and consist of several family groups with a common ancestor. Age-sets- those initiated at the same time, determined the role and social standing of clan members. There were several clans within a subtribe and the number of tribes varied from one sub-tribe to the next.

Like other Kenyan tribes today, Mijikenda people have assimilated to modern cultural practices, resulting in the disappearance of many of their traditional customs. Most Mijikenda people are now either Christians or Muslims; however, some still practice their traditional culture or a mixture of Christianity or Islam with their traditional religion. Islam is more widespread among the Digo than in the other Mijikenda sub-tribes.

This study however will examine their traditional music and traditional built form. It will be based on academic writings of previous scholars that delineates the built form of Traditional Mijikenda society as well as the musical practices. The aim is to understand their appreciation of the compositional arts and to relate their music to their architecture.

Fig 4.03

MIJIKENDA MALE DANCER

Mijikenda male dancer preparing to begin the performance. The dancer is dressed in shuka and adorned in feathers and beads.

Sources: Author, 21st October 2014

4.1 MUSIC OF THE MIJIKENDA

Music permeates Mijikenda life. It is used to entertain; as part of dances, plays, religious ceremonies and rites; and to mark events such as birth, naming, initiation, marriage and death. Singing and instrumentation are so interwoven into life that the abstract word *music*-as used in the west-is not used though there are words for song, dance and poetry.

As in many African societies. the song is the primary form of musical expression. The song is present in all stages of life. Songs were composed to be sung at the birth of a new child, at the naming of a child, at initiation ceremonies, at weddings, during wars, upon death, and for work at various stages. Songs were composed to pass on messages, to warn, to encourage, to congratulate and to convey emotions such as joy or sorrow.

Utilitarianism is one of the major characteristics of African art and similarly music. Music and dance in African culture were not simply for their own sake but were vital aspects of life. Music is an integral part of Mijikenda culture and is used to communicate, pass literature, welcome heroes among other ritual functions.

Music serves as a cultural determinant as it is present at all stages of life and is unique to the particular community. It is also important to note that the music is closely associated with dancing.

Music is a social activity in which alomst everyone participates. It is performed outdoors and there is spontaneous music making as well as performances by specific groups at ceremonies. There is no musical notation; musical tradition, like folklore and history, is transmitted orally.

Fig 4.04

MABUMBUMBU ENSEMBLE

Drums are the centre of a Mijikenda music performance. Rhythm is the heart of Mijikenda music and the variation of rhythms provided by the drums and other accompanying instruments provides the rhythmic variety that their dances require.

Sources: Author, 21st October 2014

4.1 ELEMENTS OF MIJIKENDA MUSIC

4.1.1 RHYTHM AND PERCUSSION

Rhythm and percussion are highly emphasized in Mijikenda music reflecting the close link between music and dance. The music features complex polyrhythms; usually, several different rhythmic patterns are played simultaneously and repeated over and over and each instrument goes it's own rhythmic way. T Many rhythms may be introduced without prior notice relating to key or tempo. Polyrhythm is useful in communication of the various sections of the song or dance. Dancers may choose any of the several rhythmic patterns to follow- for instance one dancer may follow a section played by the drums while another may follow one played by a flute or other instrument.

Cross- rhythm is a different structure where two rhythms are played against each other. This is a very highly developed concept where the musician, usually an instrumentalist can deal with two or three rhythms at the same time. The melody in most cases is short, monotonous and repetitive but it is effective. The entire song could be four bars long but the rhythmic variations could ensure the dancing goes on for at least an hour.

Rhythmic ornamentation, such as accacciaturas which are crushed notes are used. Syncopation, a common characteristic in modern jazz music which is the playing of a short beat before a long one is used in the creation of meaning and in the introduction of passages.

4.1.2 DANCE AS RESPONSE TO RHYTHM

Dances are usually performed during specific ceremonies and almost always when music is performed.. There are different dances for girls, women and men though some dances are performed by both men and women.

The dances are usually performed by the singers. The soloist leads the dance and the singers join in and dance. Among the Mijikenda, song and dance are synonymous: people dance when music is played.

Dances consist of rhythmic movements of the legs, head, shoulders and hips. The dancers however are disciplined and the presence of elders is respected. The concern

Fig 4.05

HUMAN BODY AS INSTRUMENT

The human body is used in Mijikenda dance performances as a percussive instruments through stamping of feet, slapping of thighs and chest and hand clapping. This adds to the rhythmic variation of the performance.

Sources: Retrieved on November 15th 2014 from http:\\www.singingwells.org/

for morals is emphasized by the openness of the performance arena.

Mijikenda dances are performed with instrumental accompaniments. Different body parts move in time with the drums or other instruments in a multi rhythmic dance where the head, shoulders and the rest of the body move in their own rhythms.

The human body can also be used as a percussive instrument-hand clapping, foot stamping and slapping of the chest or thigh are common in dances and add to the rhythm of the performance.

From the literature review, it was noted that dance is an art of space in time. It is a dynamic definition of spaces that is intended to communicate various messages. The spaces that dances define are important in the understanding of a particular community's understanding of space.

4.1.2(a) ROLE OF DANCES

The importance of dance among the Mijikenda is the marking of life experiences. There were dances to celebrate occurances and ceremonies such as weddings, there were dances purely for enjoyment and others for ritual ceremonies.
Dance is in itself a language, more powerful than gesture and more eloquent than words. It is an expression of emotions.

4.1.2 (b)PERFORMANCE SPACES

The dances are performed within the central courtyard of a kaya known as a mhala. There are various levels of Kaya, the sub-tribe kaya's, the clan kayas, the village kaya's and the family kaya.

The performance space is determined by the scale of the performance and how many people the ceremony involves. The largest performances are carried out at the Sub-Tribe mhala and more private dances and ceremonies at the various levels.

Fig 4.06

DANCE FORMATIONS

Different dances had different formations. The various formations depended on what the dance was about and the spaces defined implied different things. Above is a dance for unmarried males and girls who stood facing each other.

Sources: Author, 21st October 2014

4.1.2(c) DANCES OF THE MIJIKENDA

Mijikenda dances will be studied according to three characteristics:

i. Formation

This will look into the shapes and patterns formed by the dancers within the performance space.
From past research dance formation is often directly related to the shape and planning of buildings. An analysis of various Mijikenda dance formations has been carried out.

ii. Aesthetics

Dancers are usually dressed in costume. This varies with the type of dance. Body paint and adornment are also often used by dancers.
Unlike in the western serting. the audience remains in close proximity with the dancers. Among the mijikenda, dances are performed in the mhala or central courtyard. The dancers form an ellipse within the courtyard and the audience form an outer ellipse surrounding the performance. Throughout the performance, a reciprocal call and response relationship is maintained with the audience surrounding them. Their dances are participatory and members of the audience may join in and dance.
The integration of performance and audience as well as spatial environment is a key aesthetic feature of these dances. In addition, rhythm frequently forms a dialogue between dancers, musicians and audience.

iii Movement

Movements from daily life are used in the dancing. Angular bending of arms, legs and torso are characteristic of their dances. Fluid movements are also noted in these dances. Movement and rhythm cannot be separated. With the Mijikenda drum ensembles, such as the Mabumbumbu, rhythm is the major determinant in dance movements. These rhythms go by repetiton and intensification until a climax is reached.

TABLE 4.01: ANALYSIS OF MIJIKENDA DANCE FORMATIONS, SPACE AND AESTHETICS

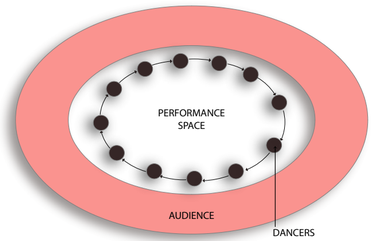
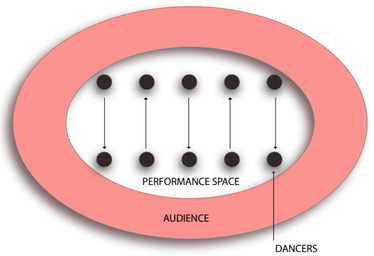
	FUNCTION	PERFORMANCE SPACE	DANCE FORMATION	AESTHETICS	ANALYSIS OF SPACES
NGOMA YA KAYA(RABAI)	The dance was performed at the new year, which commenced in November. Musicians approached the elders taking a goat and some beer after which the ngoma ya kaya would begin. The elder will pour some beer in his horn, mboko, pour a little on the ground and sprinkle some on the drums to bless them.	Mhala- Performed at the courtyard space of the clan's kaya. The soloist stands at the centre and performers form an ellipse around the soloist. The audience forms an ellipse around the performers. The ellipse shape provides a sense of enclosure. It also facilitates the participatory nature of Mijikenda music performances.The performance spaces are at three levels, the soloist, performers' and audience spaces which are all implied and not clearly defined.		The dance is accompanied by ngoli(horn) to announce the breaking of a new year and njuga jingles. Feet are stamped to add to the rhythmic texture. Each of the instruments are introduced at various stages to indicate a new section. There are various song transitions which lead to a change in dance movements. The dancers stamp their feet while moving around in the ellipse.	The elliptical dance formation is synonymous with the Mijikenda built form which is centred on elliptical dwelling units which are arranged around an elliptical courtyard to form a homestead. The performance space is outdoors, ideal for the loud and complex rhythmic nature of the music that would be otherwise overwhelming in an enclosed space. The performance space is also seen to be intimate, as the audience surrounds the performers providing a sense of enclosure. In addition the implied boundaries of space as oppposed to clear definiitions encourage participation from the audience.
SENGENYA (DIGO)	This was a dance performed for entertainment by unmarried girls and men. Married girls were not to take part in the Sengenya dance.	The Sengenya is performed at the central mhala belonging to the subtribe. This was the biggest performance space. The audience defines the elliptical shape leaving the central part for the performers. The performers in this dance stand in two lines facing each other and approch each other as the dance progresses. The performance space retains it's loose elliptical form due to the natural configuration of the court.		The drummer is the most important participant of this dance and is known as the *sogora.* The second most important person is the soloist-ngui. Men jump vigorously and stamp with the right foot to the accompaniment of drums, patsu and nzumari. Girls move gracefully in contrast shaking their shoulders and hips with their feet remaining on the ground. The fluid rhythmical body movement is enhanced by the costumes and bead ornamentation in blue, red and white. Ostrich feathers are tied high on their necks to emphasize the contractions of the necks and shoulders.	The courtyard is large enough to accomodate a larger audience. The implied spaces still hold with the audience at the periphery. The dance formation; two rows facing each other are not synonymous to the built form. However the audience still forms an ellipse around the performers, both because of the natural shape of the courtyard from the arrangement of structures as well as to maximise viewing angles and create a sense of intimacy. The audience, as in the other dances are welcome to join in the performance and the close proximity to the performance as well as the lack of separation facilitates their participation. The soloist is free to move around the dancers and the space as he pleases even beckoning or pulling members of the audience into the performance space.

TABLE 4.01: ANALYSIS OF MIJIKENDA DANCE FORMATIONS, SPACE AND AESTHETICS

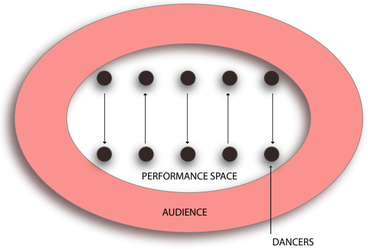
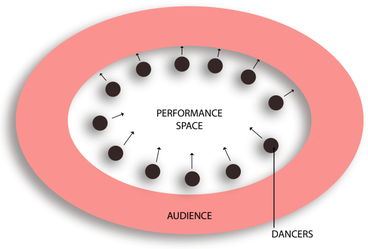
	FUNCTION	PERFORMANCE SPACE	DANCE FORMATION	AESTHETICS	ANALYSIS OF SPACES
GONDA-GIRIAMA	This is a dance performed by unmarried men and women for entertainment. Like the Sengenya, the married were not to participate.	Performed at the courtyard space of the clan's kaya and sometimes at the sub-tribe *mhala*.. The soloist moves around the dancers who stand in two rows-men and women- and face each other moving forwards and backwards. Dances were rehearsed in a space called the *chinyaka* where they danced in the night till dawn. Soloists also taught new songs then.		The dance is accompanied by mabumbumbu and vyapuo drums. The rhythm is very intense and rapid. The girls wear costume- mahando-which help to reveal hip movement while men wear the usual vitambi and shuka. Feathers, shells and beads are also used for ornamentation. Men jump vigorously up and down. Dancers move forward and backwards. Movements are characterised by short small contractions in shoulder and staccato like jumps in rhythm with the accompanying music of the drums and song.	Similar to the Sengenya dance, the dance formation; two rows facing each other is not synonymous to the built form. However the audience still forms an ellipse around the performers, both because of the natural shape of the courtyard from the arrangement of structures as well as to maximise viewing angles and create a sense of intimacy. The audience, as in the other dances are welcome to join in the performance and the close proximity to the performance as well as the lack of separation facilitates their participation. The soloist is free to move around the dancers and the space as he pleases even beckoning or pulling members of the audience into the performance space.
KIMUNGWE(JIBANA)	A celebratory dance performed by middle aged and married men and women of the Jibana. It is a dance for special occassions only, usually the third and fifth days after the burial of a deceased member of the Kimungwe dancing group.	The dance is performed within the courtyard of a homestead. The dance venue is agreed upon by the dancers, it is usually a village *mhala*(courtyard). They stop at the outskirts of the village- *chanze*- and a goat's horn is sounded announcing their arrival. The dancers than proceed dancing from the *chanze* into the homestead where the dance is performed.		Main instruments are mabumbumbu, a horn, jingles and whistles. The dance begins with drums, after which the men clap twice and stamp their feet. One of the women hesitantly dances towards the men, moving only during the clapping and stopping during stamping of feet. On reaching where the men are, she nods at one of the men and returns to her place. The man follows her, stamping his feet. Girls wear the usual mahando and men wear jingles	The performance space for this dance is more private. It is held in a homestead and the audience consists of fewer people. A new space-the *chanze*-where the dance begins is introduced. A new processional quality of the performance is introduced implying certain spatial consequences.

TABLE 4.01: ANALYSIS OF MIJIKENDA DANCE FORMATIONS, SPACE AND AESTHETICS

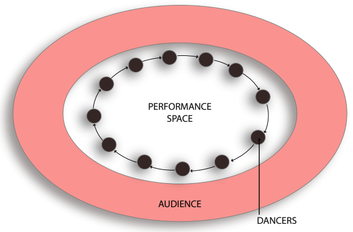
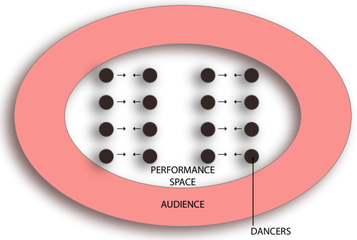
	FUNCTION	PERFORMANCE SPACE	DANCE FORMATION	AESTHETICS	ANALYSIS OF SPACES
DELE(CHONYI)	A dance to ward off evil spirits. It was a dance for the needy, those who were poor and could not raise dowry to marry wives. These needy people started clearing bushes and tilled the land and started a dance-the dele- which attracted girls and won their hearts.	Performed in the village *mhala*. The performance space was elliptical in shape, with the audience and performers defining various levels of space. The audience for this dance ideally is the girls to be wooed and the definition of the audience space is greatly diminished. The idea is to get the audience to dance with them.		Accompanied by mivungu which are bamboo tubes hit vertically on the ground causing the air column to vibrate to suggest pounding of corn. Also accompanied by jingles which are sounded by stamping feet on the ground.	The dance formation is synonymous with the elliptical built form. The audience forms an elliptical space around the performers who are in an elliptical formation. The elliptical shape provides the necessary degree of enclosure and feeling of intimacy that is required. As a majorly participative dance, the audience is encouraged to join in.
VUNJA MKEBE(DURUMA)	Performed by both married and unmarried men and women. The dance is a competitive one between two groups dancing at the same time but with their backs to their opponents.	Performance space is the mhala courtyard either at clan or sub-tribe level. There are two sets of performers with their backs to each other in competition. More spaces are defined in this dance. Two sets of performance spaces, used concurrently, as well as the enveloping audience space still elliptical.		Accompanied by mabumbumbu, vyapuo and goma kuu, all drums as well as njuga. It is a heavily rhythmic performance with a lot of emphasis on the drums. As the name suggests-vunja mifupa-means break your bones- and suggests very vigorous dancing. The most vigorous and entertaining group emerges victorious. Male dancers wear vitambi and shuka and adorn themselves with ostrich feathers on the upper arms and leg jingles. Women wear mahando. Men shake their shoulders and stamp their feet while women shake their shoulders facing men.	The positioning of the audience around the performers defines the performance space. They form an ellipse around the space. The two sets of performers carve out their own performing space by the dance configuration. There is an implied separation of the space belonging to each group and that of the audience. The audience participates through cheering and not through direct participation as it is a rehearsed dance. The audience and performance space are therefore perceived to be two separate spaces in this instance unlike in the other dances.

TABLE 4.02: ELEMENTS OF MIJIKENDA MUSIC

Rhythm	Polyrhythmic Cross-rhythmic Dance and movement accompany music
Tonality	Pentatonic scale is used Limited melodic range Language restricts tonal range
Harmony	Singing is done in unison Instruments are not harmonised strictly Parallel chords when many people sing in different pitches.
Texture	Monophonic texture (no harmonies) Polyphonic texture (interweaving of parts)
Ornamentation	Call and response Improvisatory and spontaneous

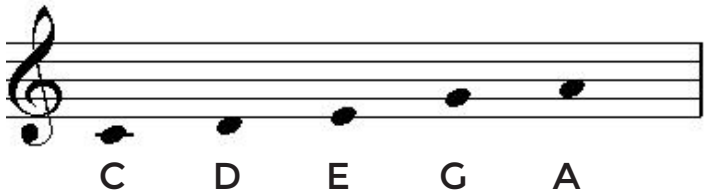
4.1.2 TONALITY AND HARMONY

The music of the Mijikenda is written in the pentatonic scale. A pentatonic scale is a musical scale or mode with five notes per octave in contrast to a heptatonic (seven note) scale such as the major scale and minor scale. The pentatonic scale was used by many world cultures, including the Greek, Japanese and Chinese. The word pentatonic is from the Greek word pente, meaning 5. This is a scale with five notes per octave, as opposed to the usual major/minor scale which has seven notes per octave.

Fig 4.07 PENTATONIC SCALE

Intervals in pentatonic scale.

Sources: Author modified, 21·10. 2014



The pentatonic scale is important in terms of melodic compositions. The music is easy to listen to and is particularly applicable where the improvisatory technique is used. Much of Miji Kenda music depends on improvisation by a soloist and instrumentalists and a choral refrain from the other performers. However, upon interatction with Arabic-Swahili the glissando was introduced to the musical voabulary. The glissando does not fall in the pentatonic scale. Songs do not however begin and end on the tonic as is the case with Western music.

The use of the pentatonic scale however restricts melodic contrivance due to the limited range of the scale. In addition, the tonal nature of the Mijikenda language also restricts melody. When intonation chanfes from high to low, the singing changes with it. Every syllable within a word should receive its correct pitch which will imptint meaning on the word and phrase. The melodies must therefore be sensitive to this.

The concept of harmony is not applicable in the Mijikenda setting. Songs are sung in unison and when instrumentation is used, the notes are not played together to contribute to a harmonic end. Differences of octaves are noticeable where men and women or children sing together.

Fig 4.08

DANCE COSTUMES

Women dancers wearing lesos and mahando sisal skirts that emphasize hip movements. Ostrich feathers are used to create headgear.

Sources: Author, 21st October 2014

4.1.3 PERFORMANCE STYLE

The call and response pattern-prevalent in African music is used in Miji Kenda music. The music is made up of complex overlapping phrases which may or may not be connected. A soloist begins and the chorus responds before the soloist completes singing. The soloist again takes up his part before the chorus end their phrase causing an overlap. Singers do not always sing to written verses and set words. In many cases, the chorus responds to what the soloist sings and the soloist is at liberty to add what he pleases to the song. Usually, the chorus restates, continues or amplifies the thought expressed by the soloist.

The dynamic and improvisatory nature of Miji Kenda music performances give it a unique texture and the minds of those performing work fast to come up with new fitting content.

4.1.4 ORNAMENTATION

Ornamentation in the music is exemplified through trills and other sounds. This is usually to enhance the performance or to indicate key parts of the performance.

Dances are performed in costumes. Men wear *shuka* around their waists and a vest known as *kitambi*. Women wear mahando costumes which accentuate their hip movements.

Other ornaments and adornments, such as ostrich feathers and beads are worn by certain members of the troupe to identify them or to show their status.

It is notable that ornamentation seems to be a concept that occurs naturally and that is closely tied in with function.

Fig 4.09

KAYAMBA

The shaken idiophone, *kayamba*, being played during a musical performance.

Sources: Retrieved on 16th February 2015, from http//:www.singingwells.org/

4.1.5 INSTRUMENTATION

MIjikenda songs and dances are accompanied by musical instruments usually fashioned from materials fround around the area. These instruments are in four categories:

(i) Membranophones

Drums are the most common instruments in Mijikenda land. All dances and songs are accompanied by drums as rhythm is central to the music of the people. Drums are usually made from stretched skins or other membranes and are extremely important to the Mijikenda.

Drums are usually played in groups of two to four, though some ensembles are made up of as many as fifteen drums, played by four to six performers. The drums are often tuned to different pitches and create melodic music similar to that of xylophone ensembles.The popular drums found among the mijikenda the Mabumbumbu drums, chapuo, gonda.

(ii) Idiophones

These are the second most common instruments among the Mijikenda and are self-sounding instruments such as bells, rattles, shakers, xylophones and log drums. Most are struck or shaken but others are scraped, rubbed, plucked or stamped against the ground. They are mostly instruments of indefinite pitch but a few, like the xylophone are tuned instruments. The xylophone is known as the *kiringongo.* Other idiophones that they use are the famous *kayamba, njuga*-which are foot rattles*, ndere,* metals that are struck and *lungo* which is an *uteo*(woven bowl) containing broken glass and similar particles that is shaken to produce percussive sound.

(iii) Aerophones

Wind instruments such as reed pipes and transverse flutes are also found among the mijikenda. These are such as the chivoti and bung'o.

(iv) Chordophones

Stringed instruments are relatively few. A one stringed fiddle-the *mbeveve* is prevalent.

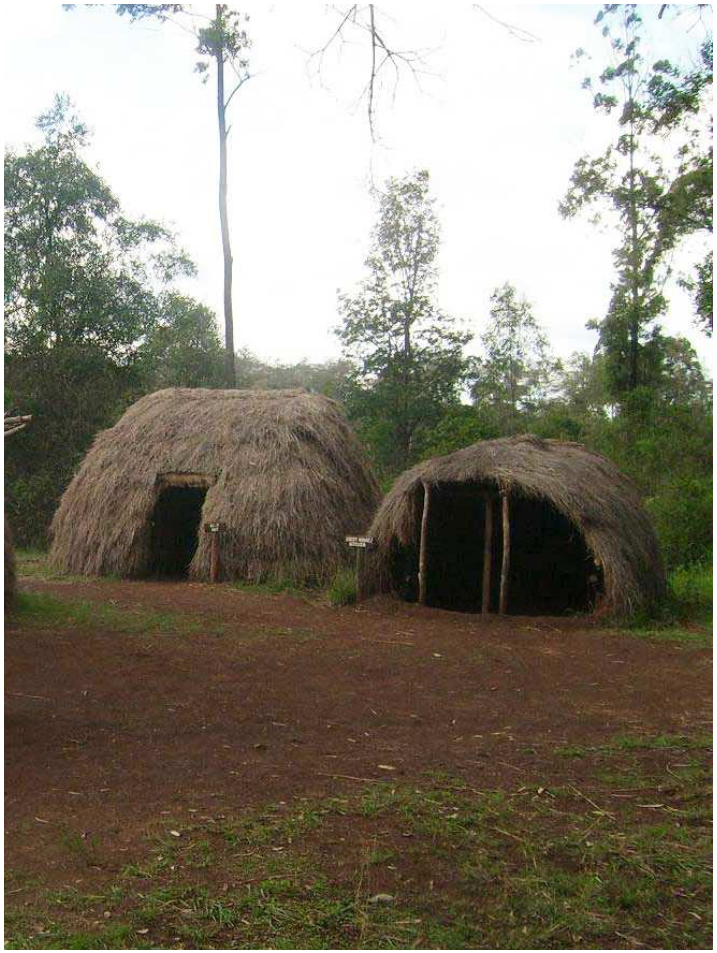


Fig 4.10

MIJIKENDA BUILT FORM

Photograph of a dwelling unit and a space for rituals within the kaya.

Sources: Author, 22nd October 2014

4.2 MIJIKENDA ARCHITECTURE

The main topography of the Kenya Coast includes a flat coastal plain edged by sandy beaches and coral cliffs as well as mangrove swamps, from which a low range of sandstone hills, rises to a maximum height of about 250 metres parallel to the coastline. From these hills there is a drop to the Nyika Plateau followed by a gradual descent to the semi-arid and flat Taru Desert . The Mijikenda Kaya forests (or Ma-Kaya in the Mijikenda plural), appear as forested hill-tops and sometimes valleys, in this landscape. They are typically found in the midst of densely populated rural farmlands dominated by coconut and cashew stands and clusters of thatched dwellings, in the homelands of the Mijikenda people.

The Mijikenda settlement is organised around the Kaya. Upon migration from Shungwaya, the Mijikenda eventually settled in the Kenyan coastal region around the 16th century AD. They established themselves in fortified villages known as Kayas. As they continued to be harassed by other groups, especially nomadic pastoralists and slave trading scouts, the defensive function of the kaya village was crucial to their survival. This was achieved by :

(i) Siting the kaya within the thick forest so that it could only be approached on narrow forest paths

(ii) Surrounding the village with a strong stockade

(iii) Burial the sacred objects or fingo within the kaya, essential to the material and spiritual well-being of the community.

The kaya forests with their clearings and sacred sites are believed to be what remains of the extensive forests and hidden villages, preserved now as ritual and spiritual sites, the surrounding land having given way to agriculture during the 19th and 20th centuries.

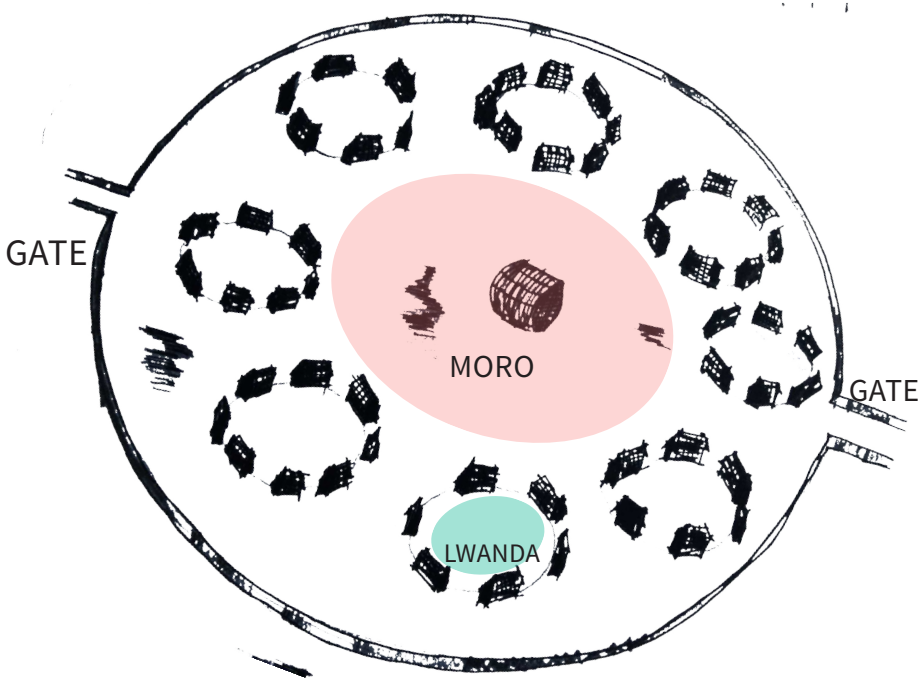


Fig 4.11

MIJIKENDA KAYA LAYOUT

The layout shows a clan settlement with the two levels of courtyards used as meeting places nad performance spaces.

Sources: Retrieved from 21st October 2014

4.2.1 SPACE PLANNING

The Kaya was composed of houses arranged in an ellipse and radiating outwards to form the village. The foremost Kaya had 9 houses representing the 9 sub tribes of the Mijikenda. The houses that were part of the largest kaya formed the first house of each sub tribe kaya. The sub tribe kaya had houses that corresponded with the number of clans within the specific sub tribe, for example, 6 clans for the Giriama translated to 6 main houses within the Giriama kaya. The homesteads then formed after the clan kaya and developed in the same elliptical shape with a courtyard at the centre within which the nyumba ya koma marked the centre point.

To enter the kitsaka or Jima (the forest), the traditional path established generations ago as the only legitimate path to the kaya-*mwara*-was used. There usually are only two such paths leading to the Kaya. The path is well-worn and compacted and nothing grows on it despite theprofusion of plants all around.

There are gates into the kaya known as mvirya marked passage into the kaya.On the outer side of the gates on one side of the path, there are historical burial grounds *makaburini*, for those who could not be buried in the central village having died outside the gates. Important leaders, healers or prophets however may have their own individual burial sites which are often considered sacred.

Within the kaya, dwelling units were arranged around an elliptical courtyard. Within the elliptical courtyard was the *moro* which was a meeting hut or booth where issues are discussed. The main house that opened into the central courtyard was the first house in the formation of another elliptical unit that was a homestead with a ritual meeting hut known as *lwanda*.

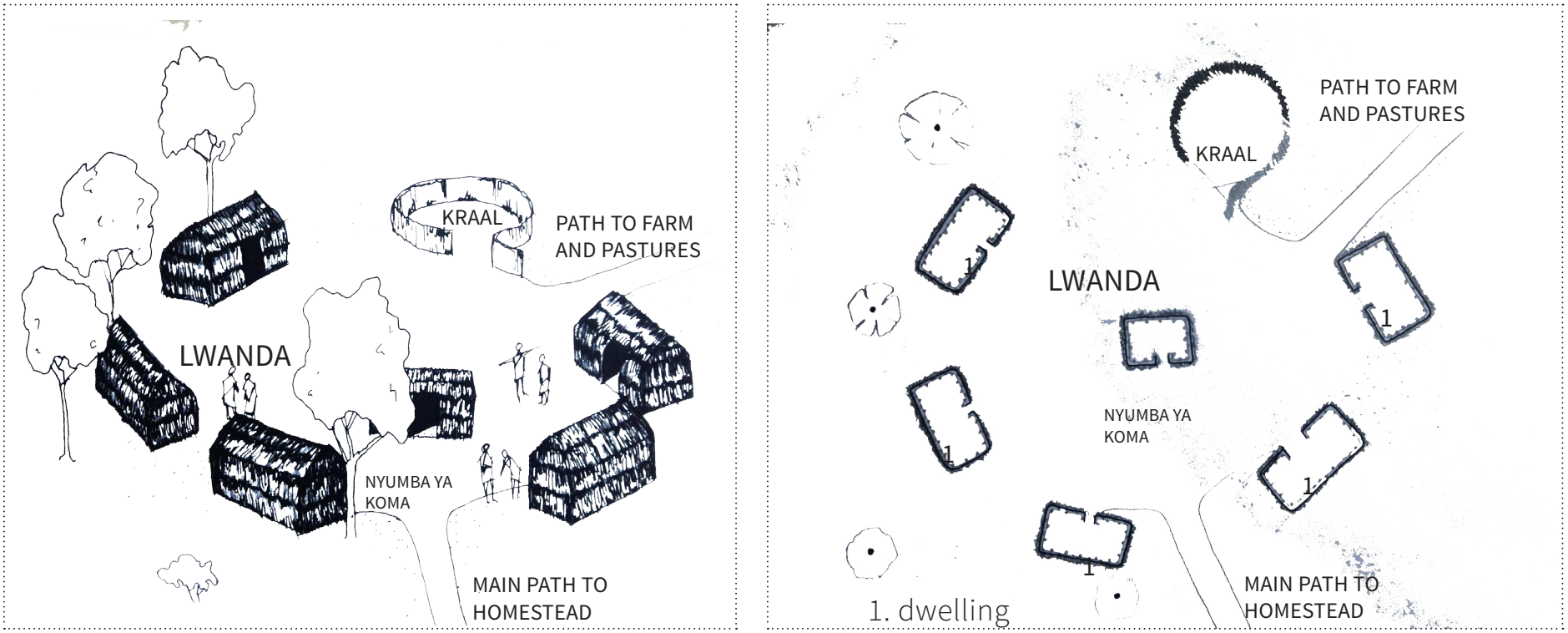


Fig 4.12

MIJIKENDA HOMESTEAD LAYOUT

A Mijikenda homestead unit with dwelling units opening up to the Lwanda and with a Nyumba ya koma at the centre and a kraal at the side.

Sources: Author modified, 15th February 2015

The Mijikenda homestead is made up of houses opening up to a common courtyard-lwanda. There is also space set aside for livestock. There are two paths to and from the homestead, one heading out towards farms and pastures. The nyumba ya koma where rituals are held and where the fingo-talisman are kept is at the centre of the courtyard.

The courtyard is used for meetings, performance and recreational activities. The dwelling units are mainly used at night only for sleeping. All other activities take place outside the house. Space is seen to be perceived as that which is outside and therefore endless and the favourable climate allowed for their activities to be carried out outdoors.

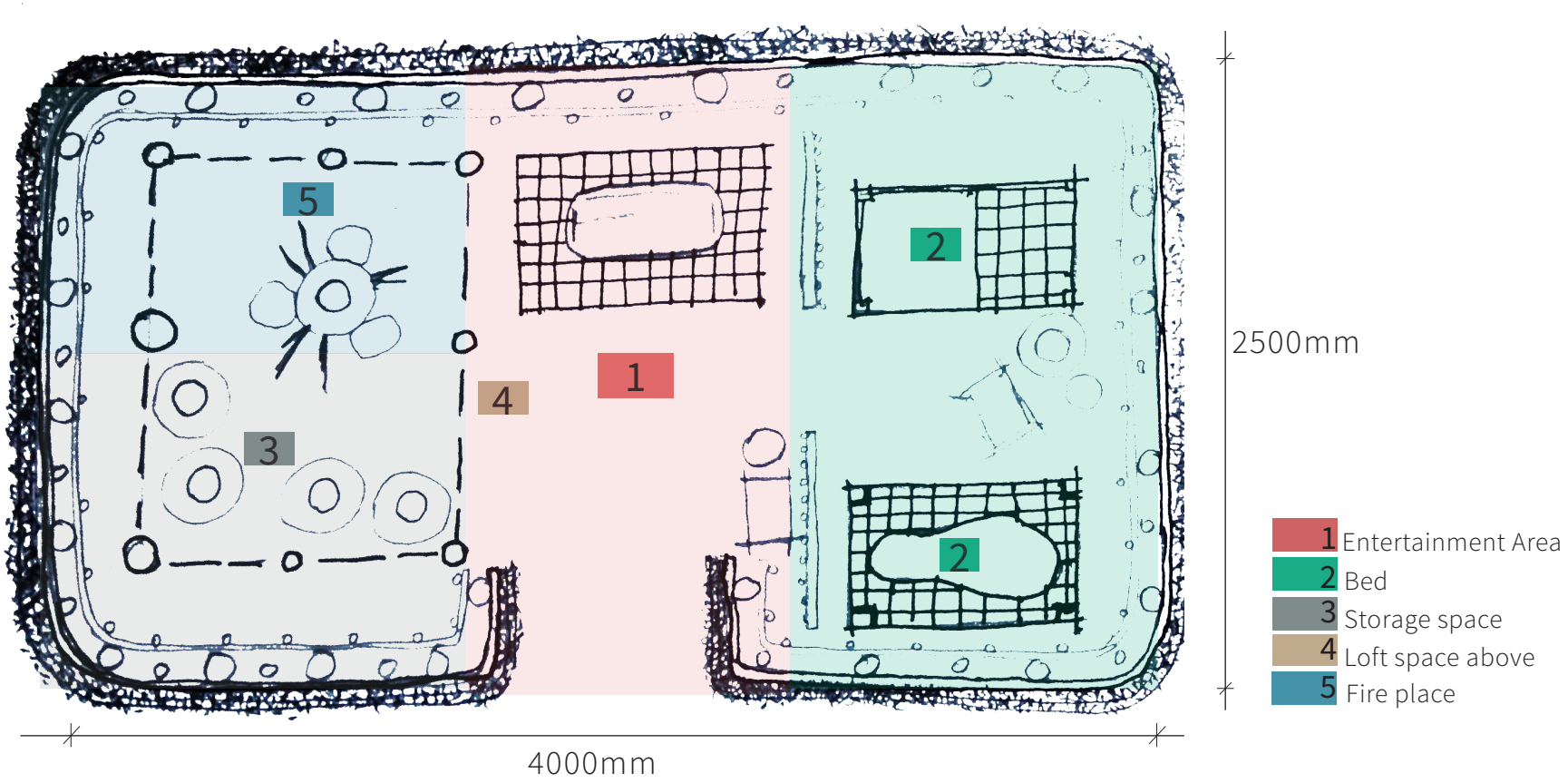


Fig 4.13

MIJIKENDA DWELLING UNIT FLOOR PLAN

A sketch of a typical Mijikenda dwelling unit.

Sources: Author modified, 15th February 2015

The plan shape was elliptical as shown. This was deemed even safer as intruders could not hide behind corners. The length of the house was 4000mm while the width was 2500mm. The sizes of houses varied and the exact plan size and height.

Within the unit, there was space for sleeping, cooking, entertainment and storage. As earlier stated, the unit was mostly used at night for sleeping. The various units were for different members of the family with one for thehead, one for the girls and boys and one for different wives in a polygamous setting.

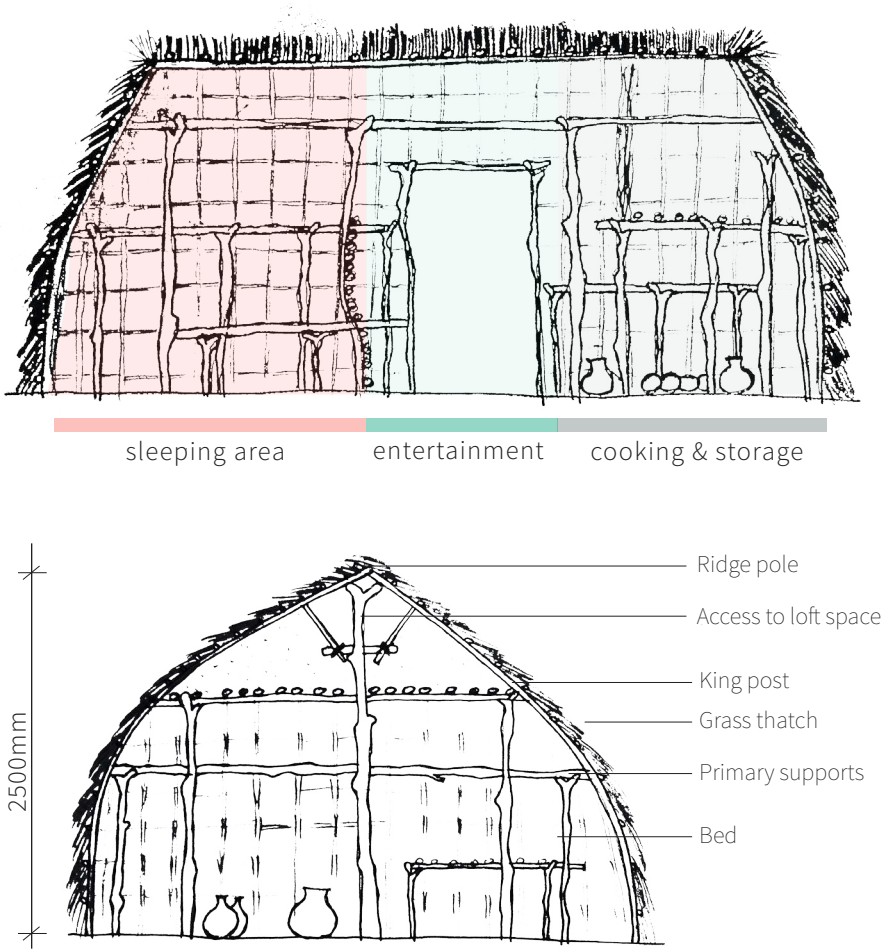


Fig 4.14

SECTIONS OF MIJIKENDA HUT

Sectional drawings of Mijikenda dwelling unit

Sources: Retrieved from 21st October 2014

4.2.2 FORMS AND MATERIALS

The Mijikenda dwelling unit is elliptical in plan and is approximately 2500mm high. It has one opening, 800mm by 1500mm wide that faced the central courtyard. The houses were not all exactly the same height and the head of the home had a hut that was taller than the rest giving a sense of hierarchy.

The form of the hut is simple with no differentiation between the roof and walls. It is made from post and lintel construction with mud walls covered in thatch all around. The covering with thatch made the settlement seem to blend in with the forest which was it's context and appears natural.

The houses are contructed from three basic materials. The first is the timber poles from trees in the forest. These are used to create a structure-post and lintel style which is the frame that supports the hut. The second material is clay that is used to plaster and fill up the spaces between the posts and create an enclosed structure. Third is grass thatch that is used all around the roof and walls as a covering giving the house the textured aesthetic that fits so well in it's surrounding forested area.

The houses in the homestead had various uses and users. There was a house for the women, one for the head of the home and for the various wives of that homestead. The houses were therefore of different sizes depending on users.

Fig 4.15

ELEVATION OF MIJIKENDA DWELLING

Front elevation of Mijikenda dwelling unit

Sources: Author,21st October 2014

4.2.3 PROPORTION IN MIJIKENDA ARCHITECTURE

The proportion of the length to width on the plan is 1:16. That of the height of the door to the width of the door 8:15 which is a minor 7th and does not correspond to harmonic proportions. That of the door height to the overall height is 3:5 which is a minor 6th. All of these ratios are inconsistent with those commonly used according to the golden ratio, the theory of harmonic proportions and, more importantly, inconsistent with ratios present in the pentatonic scale, which Mijikenda music is written in.

It can be argued therefore that the Mijikenda were not keen on a precise proportioning system. The proportions and sizes of spaces were purely determined by the function and the users and are not arranged or proportioned with an aesthetic aim in mind. The entry is such that one human can go through it at a time and the spaces inside are designed such that the space is useful for the users.

This instictive attitude towards nature is in line with the observable attitude of the Mijikenda towards aesthetics. Firstly, they took a naturalistic approach to beauty and order and seemingly did not perceive or conceive that mathematical systems of order and proportion would achieve this effect. Secondly, functionality and utilitarianism are key to their innovativeness. Everything had a use and ornament for ornament's sake did not exist in this culture. The walls and basic furniture remained bare and unadorned.

4.2.4 RHYTHM IN MIJIKENDA ARCHITECTURE

Rhythm in architecture is achieved through repitition. The Mijikenda homestead or kaya is made up of a series of houses arranged around an elliptical courtyard. The homesteads belonging to a particular clan are also arranged in an ellipse around a communal courtyard belonging to the clan. This grouping was also referred to as a kaya. Groupings of homesteads then form an elliptical shape around another communal space of different hierarchy belonging and forming the sub-tribe kaya.

This repetitive growth gives a sense of rhythm. As earlier discussed, repetition is one of the building blocks of rhythm and a major characteristic of Mijikenda music which

Fig 4.16

VIGANGO

Mijikenda talisman that were made to commemorate the dead. These were painted various colours.

Sources: Retrieved on 21st February 2015 from www.bruno-mignot.com

is also manifest in this hierarchical arrangement of houses, homesteads and clan groupings. The repetitive and polyrhythmic nature of their music is comparable to the planning of their settlement. The various homesteads and clan groupings are of various sizes and character as they have room for expansion.

The variety mix within the initial elliptical concept and repititive nature of the arrangement is similar to the rhythmic patterns in Mijikenda music. The short rhythmic phrases of unique character and metre are similar to the clusters of houses and homesteads to form the overall whole despite their not being identical.

It is important also to mention the dance formation patterns correspond to the overall shape of the Mijikenda house and the Mijikenda homestead-the ellipse. As established from literature review(Sachs, 1930), it is common for dance formations and shape of the built form to correspond.

4.2.5 TEXTURE COLOUR AND ORNAMENTATION IN MIJIKENDA ARCHITECTURE

Mijikenda houses are entirely thatched using various types of grasses. The various houses within a homestead are identified by the type of grass thatch used in construction. The houses appear similar in character though with the grass thatch only interrupted by a timber door.

The houses are seen to be bare and devoid of ornamentation. They are retained in their original form without any aesthetic additions. There is no colour applied to the houses either on the inside or outside. Colour is used in body adornment particularly in costumes for dance performances and ceremonies and in the adornment of other cultural objects such as musical instruments and vigango. The adornments usually have a specific function-identification. Ornamentation is always functional when applied and even dance costumes enhance the performance and do not simply just beautify.

The attitude towards ornamentation in the built form is somewhat different to that in their music. Their music is seen to have colourul melodies with the soloist using

Fig 4.17

PERFORMANCES IN THE KAYA

Photographs of performances during the 2014 Mijikenda cultural festival.

Sources: Author, 21st October 2014

ornamentation devices such as trills and ululations to mark various transitions and sections of the song and to pass certain messages. Their music is also upbeat and with a wide array of musical instruments being used at a go. However, when performing the music, the spontaneity and improvisatory nature of their performance suggests that they are natural and they adapt to situations as they arise There is no rigid interpretation of what is beautiful and pleasing and what most certainly is not. This is also brought out in the architecture where precision is not pursued in construction but natural, organic forms are created.

The lack of adornment and colour in their built form is inconsistent with the vibrant attitude brought out in their performances and music in general. This can be perceived differently-as most of their lives were lived out of doors, it was not important to them to attempt to beautify their dwelling units as the natural outdoors, where most of life was lived, was already captivating enough.

4.3 THE PERFORMANCE SPACE

Performances among the Mijikenda were held out in the open in the communal space between either the houses or the homesteads, depending on the level. As earlier discussed the performance could be private, a feast within a homestead, a clan feast or even an entire sub tribe ceremony.

The space within which the performances were held was called the *mhala*. The space was uncovered and outdoors with sound moving freely in the space. There were no echos and no resultant reverberation issues were raised. The outdoor location is conducive for the loud rhythmic texture of Mijikenda musical performances.

Dance formations echoed the elliptical nature of the performance space with three spaces defined during the performance. The first space is the outer realm defined by the dwellings which is where the spectators stand forming a ring round the performers. The next space is defined by the dancers who form an ellipse around the soloist. Those watching the performance are able to cross over into this space and be part of the performance. The soloist stands in the middle inviting others to join in a special dance within this space. There is no clear spatial distinction between any of the above described spaces.

Fig 4.18

ELLIPTICAL PERFORMANCE SPACE

Elliptical shape of the Mijikenda performance space

Sources: Author, 21st October 2014

The performance space is very interactive and allows free movement of the spectators into and out of the performance space. The positioning of the audience at the periphery of the performers gives the space a sence of enclosure. All the spaces in the courtyard during a performance are implied and not clearly defined suggesting flexibility.

Other spaces that are important for purposes of performance are the *chanze*, a position outside a homestead from which the *Kimungwe* dance, which was processional begun. The dancers would announce their arrival there and would await a signal to proceed.

The *chinyaka* was a rehearsal space outside the settlement in a clearing where performers would learn new dances and songs and practice them for performance. These rehearsals were usually held overnight.

4.4 SUMMARY OF DISCUSSION

The Mijikenda built form is not directly related to the music. Melody does not play a major role in the music of the Mijikenda and harmony does not feature at all. An analysis of the architecture reveals that there is no attempt to attain perfect or near perfect proportions and that proportions of their built form are based on the human body and not at all on any harmonic principles.

The rhythm in their architecture is demonstrated in their planning concept and the theme and variation approach is similar to that in the rhythmic patterns in their music. However it is not at all derived from their music. Similarly, ornamentation is not drawn from music and their perception of beauty and ornament and order is independent from that of their aesthetic appreciationof their music.

The performance space, mhala, an outdoor courtyard is seen to be conducive for the style of their music and unlike in the western setting where enclosure led to the discovery of new ways to manipulate music and harmony, did not in any way affect or develop melodic structures or harmony.

Music is seen to have in no direct way influenced their appreciation or attitude towards design as they are seen to be unrelated and distant fields. The vibrance that is portrayed in their music and performing arts does not reflect in their built form perhaps due to the general understanding of what the house was; simply shelter from the elements and other attackers in the night and not necessarily a glorified art form.

TABLE 4.03: COMPARATIVE ANALYSIS OF COMPOSITIONAL PRINCIPLES IN MIJIKENDA MUSIC AND ARCHITECTURE

	HARMONY/PROPORTION	RHYTHM	TEXTURE AND ORNAMENTATION	ACOUSTICS AND PERFORMANCE SPACE
MUSIC	Music is based on the pentatonic scale. Songs sung in unison, no harmonies or counterpoint. Music is made up of unconnected overlapping phrases. For instance, a soloist may sing a phrase and the chorus comes in rhythmically before completion of the line. Language is tonal and when singing, melody changes so as to convey the right meaning of the word according to it's tonality. Tunes are therefore specific to each dialect of the Mijikenda. The tonic is not always the beginning and ending of the work as it is in Western music.	Polyrhythm: a complex combination of different rhythms played concurrently. Many rhythms are introduced without prior notice relating to pitch or tempo. The polyrhythm is useful in communication as it indicates various sections of the song or dance. Other rhythmic patterns, such as syncopation which is the playing of a short beat before a long one is used in creation of meaning and introduction of passages. Dance is a response to the rhythmic variety and people dance when music is played.Dance movements are in response to the various rhythms.Dance formations were analysed and found to be linked to the ellipse form.	There is a wide range of instrumentation used in musical performances Some performances use an ensemble of the instruments while some focus on one instrument only. Devices such as glissando and slurs are used and were borrowed from the neighbouring Swahili tribe. Trills and ululations are also used in the music during the climax as an expressive tool.	Music was performed outside within the elliptical courtyard. The performers form an ellipse which defines another ellipse. The space between the dancers and the houses defining the courtyard is for spectators. There is no clear spatial distinction between the audience and the performers. Audience participation is key. The space defined at the centre is where the soloist usually dances, moving around the ellipse encouraging dancers to join him at the centre. The outdoor performance space works for the loud rhythmic music.
ARCHITECTURE	No definite proportioning system used. Size of kaya dependent on other factors: 1. size of clan 2. size of homestead The ratios used in construction are not based on calculation but on utility and users. The sizes of houses varied with use eg. The house for females could be larger depending on how many it was accommodating.	The general shape of the mijikenda abode is an ellipse. Both the house itself as well as the courtyard and arrangement of the kaya uses the ellipse. The Kaya Complex reveals a repetitive rhythm. The kaya's begin with the main kaya with 9 houses representing the subtribes. These houses form the main house for the next level and so on. The repetition of the elliptical arrangement creates rhythm, as it is defined in architecture. The varying number of houses in each kaya creates some variation but that remains relevant to the whole.	The Mijikenda house is entirely thatched with one type of grass. Within the kaya, different grasses are used depending on the significance of the house. The Mijikenda house is unadorned. It retains its usual grass thatch and remains uncoloured and unpainted.	Performance spaces were outdoors. No singing or playing of instruments was done indoors. The performers formed an ellipse with the soloist in the middle and the audience formed another ellipse outside that circle. These spaces had no finite boundary but the three levels of space were implied. The performance space was allowing for audience participation and the audience and performing space were read as one space.
RELATIONSHIP	There is no precise and calculated approach to harmony among the Mijikenda in either music or architecture, as songs are not harmonised and proportions in architecture are not arrived at through a proportioning system but through scaling to the users needs.	The elliptical dance formation coincides with the shape of the built form as well as the shape of the courtyard and of the larger complex showing a relationship between the two. Order emanates from repetition. The repetitive but varied rhythm of the settlements is related to the rhythm of their music by use of repetition and subtle variety that blends.	The complex rhythmic and melodic texture of Mijikenda music does not extend to their architecture. Their houses are simple and do not exemplify any mixing or variation of textures. Colour and ornamentation does not extend to architecture. In an attempt to remain at one with the environment, the huts remain plain	The outdoor performance space facilitated the performance of the loud rhythmic music without any serious acoustic challenges. The performance space works for the music being performed, which involves everyone as the audience can freely access the performing area and join in the performance.

CHAPTER 5
CASE STUDIES

5.0 INTRODUCTION

The analogies, coincidences, affinities and bonds existing between architectural and musical compositions have been expounded upon in the literature review. This chapter attempts to study closely the ways in which the contemporary architect works in integrating music and architecture. It aims to find out how projects that are explicitly declared to derive from musical pieces pursue that intent. This could be both scientific operative methods and aesthetic methods where both the practical and theoretic spheres are acceptable.

In studying these projects, a clear understanding of how to apply the principles of the music of the Mijikenda, discussed in chapter 4-or any other music will be gained. The cases will go a long way in answering the third research question.

The following cases will be studied:

- Music as method-Stretto House-Stephen Holl
- Music as inspiration-Berlin Jewish Museum- Daniel Liebeskind
- Music as image-Roberto Cantoral Cultural Centre-Broissin Architects

These works, explicitly refer to musical works of classical music as opposed to vaguer generic principles of harmony and musicality. Each of the three works takes a different approach to it's particular musical theme bring ing out a different approach to abstraction of architectural form from the vast field of music.

Fig 5.01

STRETTO HOUSE

Photograph of Stephen Holl's Stretto House.

Sources: Retrieved on 20th Februaryr 2015 from www.stephenholl.com

5.1 STRETTO HOUSE

Client: WITHHELD
Architects: STEVEN HOLL ARCHITECTS
Location: Dallas,Texas, USA
Design Architect: STEVEN HOLL (DESIGN ARCHITECT)
Project Architect: ADAM YARINSKY
Structural Consultant:DATUM ENGINEERING
Mechanical Consultant:INTERFIELD ENGINEERING
General Contractor:THOMAS S. BYRNE CONSTRUCTION
Landscape Consultant:KINGS CREEK LANDSCAPING
Date of Construction: 1989-1991
Size: 697square metres
Building Type: PRIVATE ART RESIDENCE FOR ART COLLECTORS
Initial Function: PRIVATE RESIDENCE
Current Function: PRIVATE RESIDENCE

5.1.1 BACKGROUND INFORMATION

The Stretto House was commisioned by a couple who were avid art collectors and lovers of architecture, one of them having grown up in a house designed by Frank Lloyd Wright.. They approached the architect Stephen Holl whom they gave complete freedom to design as he pleased.

The parcel of land was located next to a river feeding three ponds each contained within small concrete walls. The water flowed over the concrete walls making a constant murmuring sound.

Stephen Holl, the project architect, sought inspiration from music in designing this house. He asked one of his students who was previously a student at the prestigious Juillard School of Music about knowledge on musical works that were characterized by an overlapping of parts to mimic the site conditions. The student suggested Bela Bartok's Music for Strings, Percussion and Celesta.

The work will be discussed in detail to give a background on the structure of the music and the basics of it's compositions and the intentions behind it so as to better appreciate it's architectural translation.

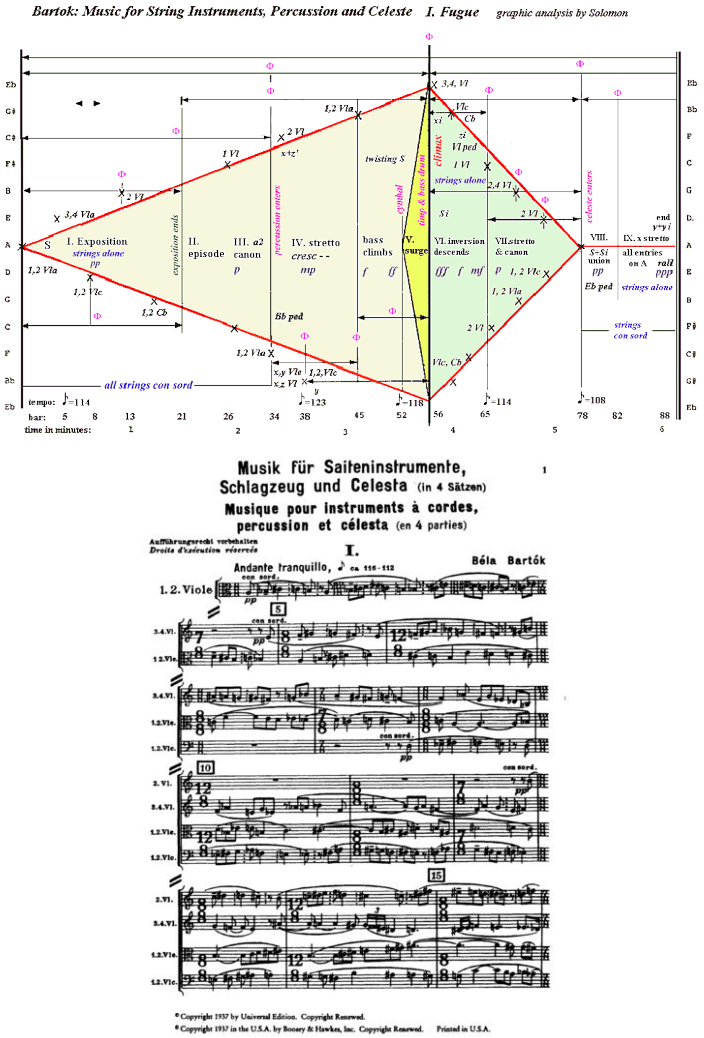


Fig 5.02

SHEET MUSIC

The sheet music for the musical work by Bartok reveals the use of the GOlden Sectionas an organising principle and the use of symmetry as a compositional determinant.

Sources: Retrieved on 20th February 2015 from www.stephenholl.com

5.1.2 MUSIC FOR STRINGS, PERCUSSION AND CELESTA

Music for strings, percussion and celesta by Bela Bartok was commissioned by the conductor Paul Sacher in commemoration of the tenth anniversary of the Basle Chamber Orchestra. It was written in 1936 and premiered on 21st January 1937 where it was played by the Basle Chamber Orchestra conducted by Sacher.

5.1.2 (a) BASIC FORM

The work is written in four movements. A movement is a large section of a musical work. The first and third movements are slow and the second and fourth are quick paced.

The first movement is a fugue. A fugue was a style used in the Baroque period in music which was characterised by counterpoint. As earlier discussed, counterpoint refers to an interweaving of parts. Its time signature changes constantly and it is written without key signature. It is based around the note A, on which the movement begins and ends. It begins on muted strings, and as the voices enter the texture thickens and the music becomes louder until the climax. Mutes are then removed, and the music becomes gradually quieter over gentle celesta arpeggios. The movement ends with the fugue subject played softly over its inversion.

5.1.2 (b) HARMONY

The harmonies in this musical work are based on the golden ratio and the fibonacci sequence. The composer was fascinated by regular structures found in narure such as snail shell spirals and the perfectly ordered rows of a pine cone. These are both examples of the Golden Ratio. In geometrical terms this rule states that a unit can be divided into two in such a way that the ratio of the greater part to the whole is the same as the ratio of the smaller part to the greater part.

In numerical terms, an irrational number of the order of 0.618 is obtained for the greater part and 0.382 for the smaller part. These proportions are exactly those observed in the concentric circles of the pine cone and the snail shell.

The composer used these proportions to determine the relative duration of different sections in his works.

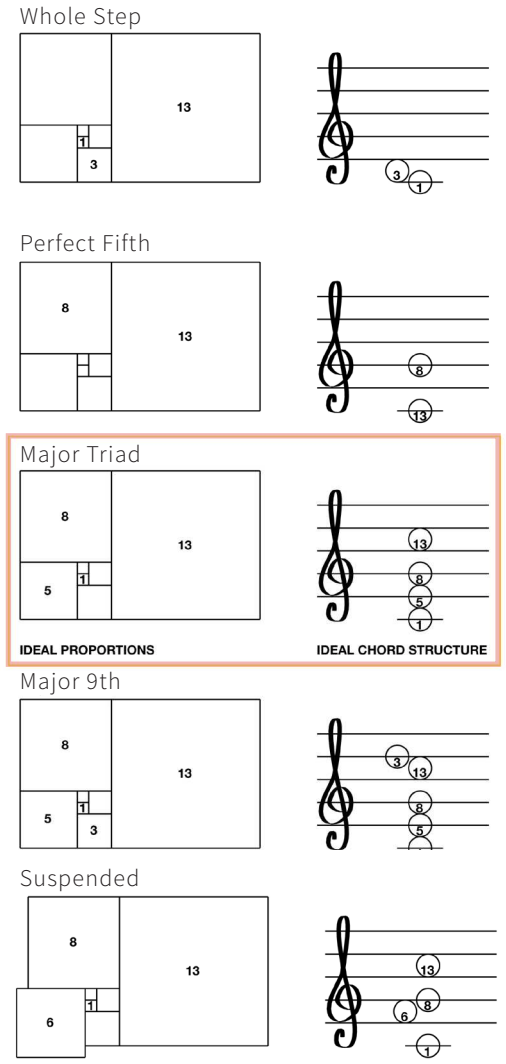


Fig 5.03

GOLDEN RATIO IN MUSIC

An illustration of the application of the golden ratio to musical intervals and harmony.

Sources: Retrieved on 20th February 2015 from www.geometryarchitecture.wordpress.com

A simple mathematical series known as the Fibonacci sequence enables us to get around the problem of the irrational number and approach teh Golden ratio with a small margin of error. The sequence is calculated by adding to a number it's immediate predecessor giving: 0,1,1,2,3,5,8,13,21,34 and so on.

The first movement is an example of construction along these lines. the fugue entries correspond to the numbers of the following bars:

Violas 1,2: Bar 1

Violas 3,4 Bar 5

Cellos 1,2 : Bar 8

Violins 2: Bar 13

Double Bass: Bar 18

Violins 1: Bar 27

The first four Entries correspond to the Fibonacci sequence. Missing are the numbers 2, 3 and 21.In bars 2 and #, the violas state the second and third phrases of the theme, clearly defined by a half rest. Bar 21 marks the end of the statement of the theme by the double basses and intitiates a short passage before the first violins enter at bar 27. This is where the transition begins, leading to the kettledrum entry at bar 34, another number in the Fibonacci sequence.

The further one advances in the Fibonacci sequence, the greater the amount of time needed by the music to reach the desired bar so as to establish an important formal moment. Therefore for practical reasons, entries in bar 18 and 27 , Bartok inserts his less significant musical moments between the major formal frontiers. This problem was solved by making further subdivisions within the major sections defined by the sequence. Thus, from bar 13, entry of the second violins to bar 21, beginning of passage, there are 8 bars. These were divided in the raio 5:3 (a Fibonacci ratio) to get the entry at bar 18 and so on.

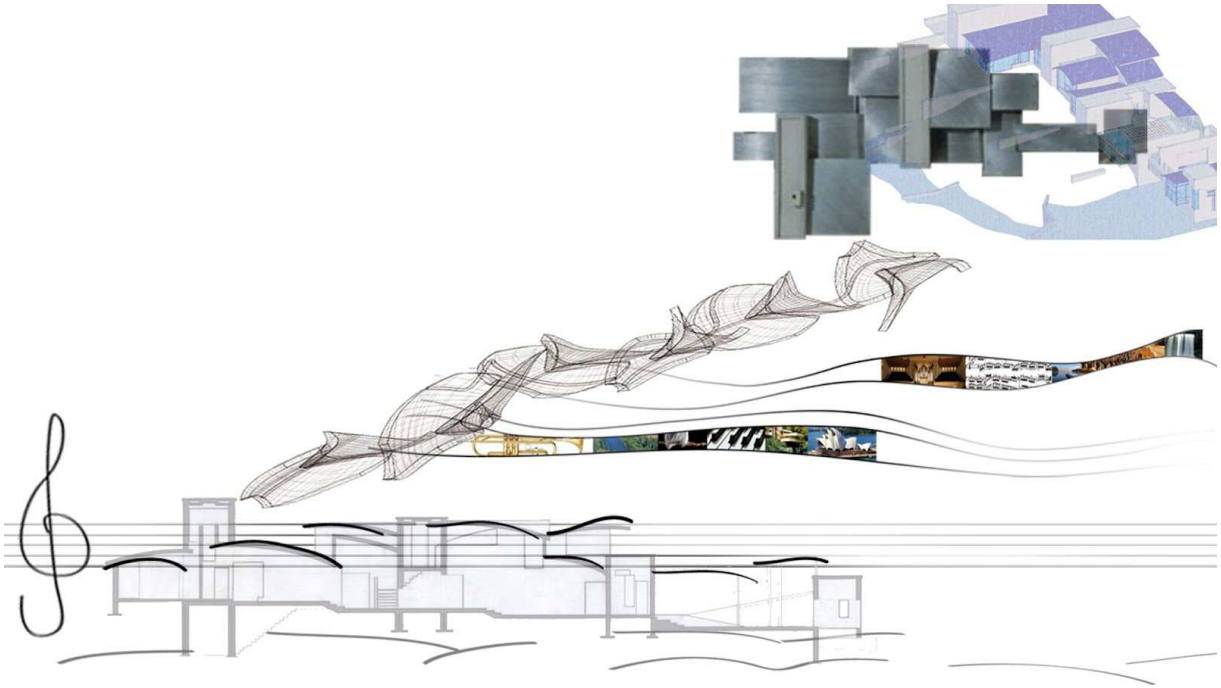


Fig 5.04

STRETTO CONCEPT

The Stretto concept in music implies an overlapping of two musical phrases in music. Due to the character of the site. the architect, Stephen Holl, chose to apply this to his design due to what he felt was an overlapping between the land and the water. The musical work he chose, Music for string, percussion and celesta is not only rich in stretto but uses more mathematical means to achieving it's end. The illustration attempts to explain graphically the ways in which the architect used stretto and what in actual sense stretto means in the musical world.

Sources: Retrieved on 20th February 2015 from www.re-readingstoriesofhouses.blogspot.com

It is important to mention that the work revolves around the note A. It has no time signature-which denotes a key in which it is played in but instead moves freely. The work is characterised by chromaticism, which as earlier discussed is movement in semitones as opposed to do the traditional keys which use the sequence T-T-ST-T-T-T-ST.

5.1.2 (c) SYMMETRY

Symmetry is used to unify this composition. The first movement, almost entirely for strings, has a structure perfect in its symmetrical conception. The first part leads up to the climax that is in bar 55(a number in the Fibonacci sequence) and from bar 56, the music is inverted. The notes played in the first part are played in reverse in the second part as illustrated. A very noticeable exact inversion of the theme occurs over the last three measures between the first and second violins. This inversion is about A, reaffirming it as the tonal center of the movement. The inversion rises and falls a tritone to E, in both voices, mimicking the overall harmonic structure of the piece.

5.1.2 (d) STRETTO CONCEPT

Stretto, is an Italian word meaning *drawn together*. In Music,the stretto concept is defined as an entry or an answer, usually used in the fugue form, that occurs before the subject is completed, overlapping with it. The subject is presented in one voice or instrument and then imitated in one or more others, before the first has finished, creating excitement.

The contrasting instrumentation of the work helps to emphasize the stretto of the musical piece.

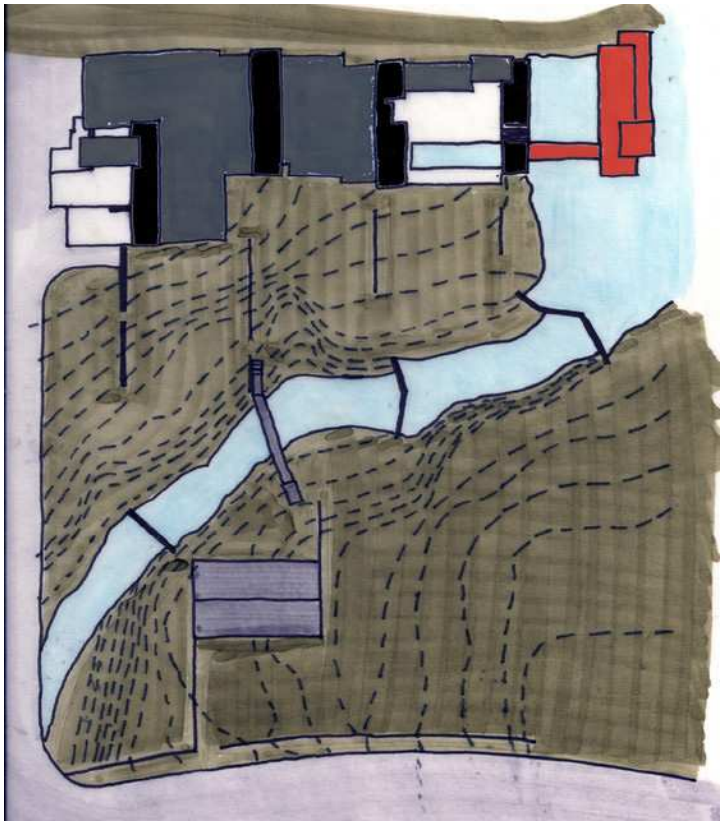


Fig 5.04

SITE PLAN

A sketch of the site plan showing the terrain and the ponds which poured into each other creating overlapping sounds.

Sources: Retrieved on 20th February 2015 from www.geometryarchitecture.wordpress.com

5.1.2 (e) TONE COLOUR

It is important to note that tone color is a major defining characteristic of 20th century music. Tone colour refers to an element of sound that allows a listener to identify the sound without referring to pitch, loudness or duration. It is what allows a sound to be identified as being produced by a specific instrument. For example, a trumpet sounds different from a violin and so on.

As its title suggests, the piece is written for string instruments (violins, violas, cellos, double basses, and harp), percussion instruments (xylophone, snare drum, cymbals, tam-tam, bass drum, and timpani) and celesta. The ensemble also includes a piano, which may be classified as either a percussion or string instrument (the celesta player also plays piano during 4-hand passages). Bartók divides the strings into two groups which he directs should be placed antiphonally on opposite sides of the stage, and he makes use of antiphonal effects particularly in the second and fourth movements. This is similar to what was earlier discussed in 2.4.1 regarding Gabrieli's work Sonata Piano e Forte. The title is slightly misleading as the celesta does not play a special role in comparison to the other tuned persussion instruments in the work-that is-piano, cymbals and timpani.

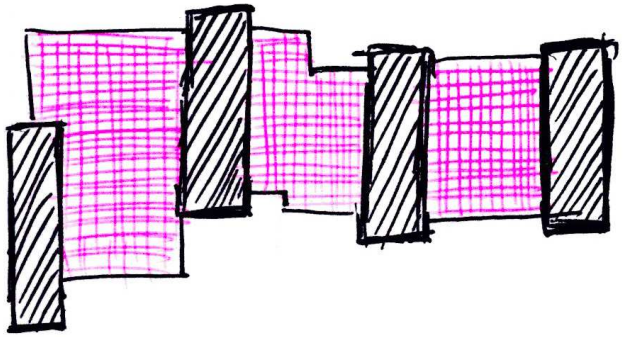
These instruments can be grouped into light (string) instruments and heavy (percussion) instruments creating tension and excitement in the work.

5.1.2 (f) RHYTHM

There is evidence of polyrhythm in the work. The time signature changes often-shifting from one to the next as is common with 20th century musical work and specifically Bela Bartok's music.

5.1.3 ARCHITECTURAL ANALYSIS OF THE STRETTO HOUSE

The Stretto House by Steven Holl was designed on the basis of two main ideas: material and Bela Bartok's Music for Strings, Percussion and Celesta. Holl maintained that it was imperative that these two concepts run parallel to each other. (Holl, 1996) The focus on materials is a personal consideration of Holl's; all of his projects place emphasis on this aspect of architecture. The articulation and selection of materials is so important to Holl that models based on materials are deYUveloped before the ideas and design



HEAVY MASONRY
"Drums"
Service areas-kitchen, library, stairs, bathrooms

LIGHT CURVILINEAR MATERIALS
"Violins"
Living areas-bedrooms, study, living room, entry

Fig 5.05

PLANNING CONCEPTS

The volumes that Stephen Holl created were frouped along certain functional lines with the masonry bits that were heavy being service areas and the lighter spaces being living areas.

Sources: Author, 23rd February 2015

concepts are settled upon. He considers materials to be significant to the design because of how they affect the character of the architecture. He feels these material selections begin to inform the ideas from the onset.

5.1.3(a) PRELIMINARY CONCEPTS AND IMPRESSIONS

In a book about the project, the architect Stephen Holl discusses the inception of the project, the client's needs, the conceptualisation and the execution of the project. He attributes the favourable outcome of the design to a special amiable relationship with the clients, who having an appreciation of architecture were able to understand the importance of well sequenced spaces, proper articulation of structure, good plays of lighting and attention to construction detailing. He holds out a belief in conceptualisation as something which derives a design, dissapears completely in the phenomena of physical reality and yet intuitively, the abundance of the idea may still be felt.

The site was chosen because of it's landscape. They were looking for a landscape which they would alter or affect minimally. The site, having the three ponds earlier mentioned, had an immediate effect on Holl and the overlapping sounds led to the development of the stretto concept.

In addition to Stretto, materiality played a large part. Concrete blocks and metal roofs, which are a material vernacular to Texas were chosen from the onset for this project. The Texan climate also necessitated the use of sun shading and allowed for plays of light and shadow.

The piece, Music for strings, percussion and celesta by Bela Bartok was selected due to it's extensve use of the stretto style whose manifestation in the musical work has been earlier discussed.

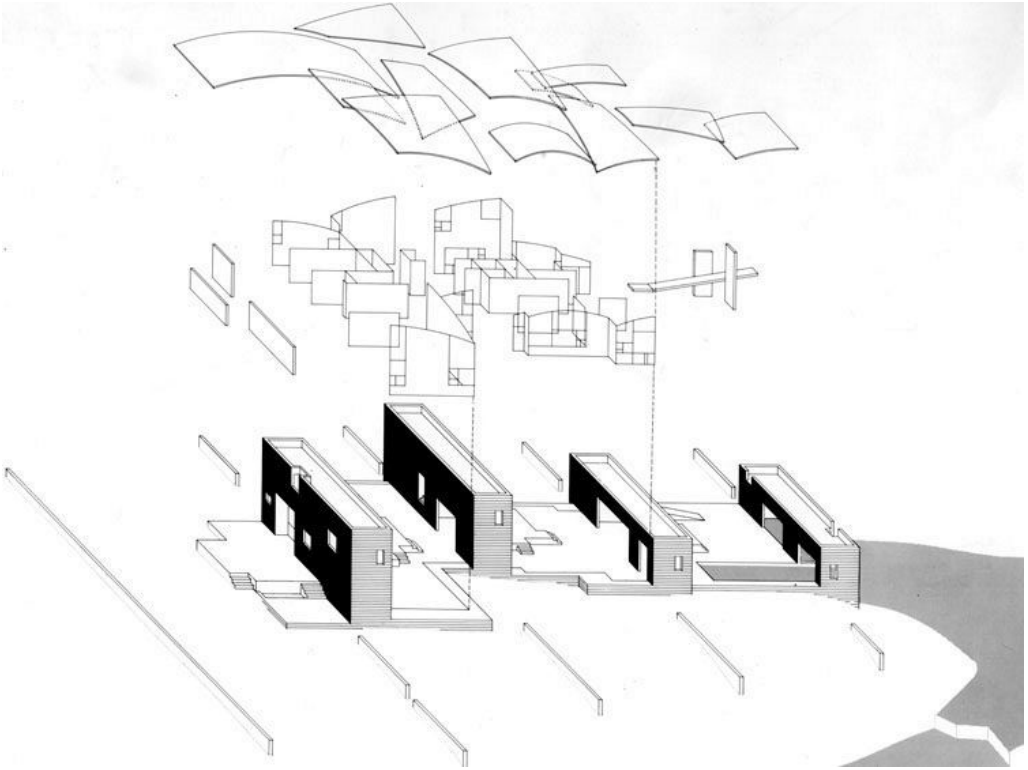


Fig 5.05

EXPLODED AXONOMETRIC

The drawing shows an exploded axonometric perspective drawing of the Stretto House. It clearly shows the heavy masonry bits which house the service spaces such as staircases and the lighter parts in between where living happens and which have glass walls to let in the views. The juxtaposition of curved roofs and heavy masonry with the curved roofs overlapping brings out the stretto concept.
The photograph shows a perspective photograph of a model illustrating the same concept.

Sources: Author, 23rd February 2015

5.1.3 (b) BASIC FORM

The house is divided into four sections, similar to the four movements of the musical work. The heavy percussive sounds are expressed through orthogonal masonry while the light string sounds are expressed through curvilinear metal. The metal roofs overlap masonry 'spatial dams' mimicking the dams on the landscape. The roofs in perspective are seen to be overlapping then spilling out over the pool court as shading.

There are two buildings on the site; the main house and a guest house.

In the main house, floor plans pull the level of one space into the next while roof planes pull space over the walls and an arched wall pulls light down from a skylight creating aqueous space.Aqueous simply means water based. Fixated with the site conditions, the architect was trying to recreate the flowing concept in the interior spaces by translating the atmosphere created by the dams. The external dams are mirrored by the orthogonal elements of the exterior creating spatial dams. A gradual fluid movement is propelled through the spatial dams by the curving roofs, which never overlap but appear to be floeing between the dams, containing the spaces below them. The idea of aqueous space aids to reinforce the initial stretto concept as the aqueous spaces produce a sense of perpetual motion enhancing the musicality of the spaces as intended.

The house is approached along a driveway bridged over the stream leading to a stone courtyard with a 'melting ice' fountain. This fountain further reinforces the aqueous theme as it gives the perception of the

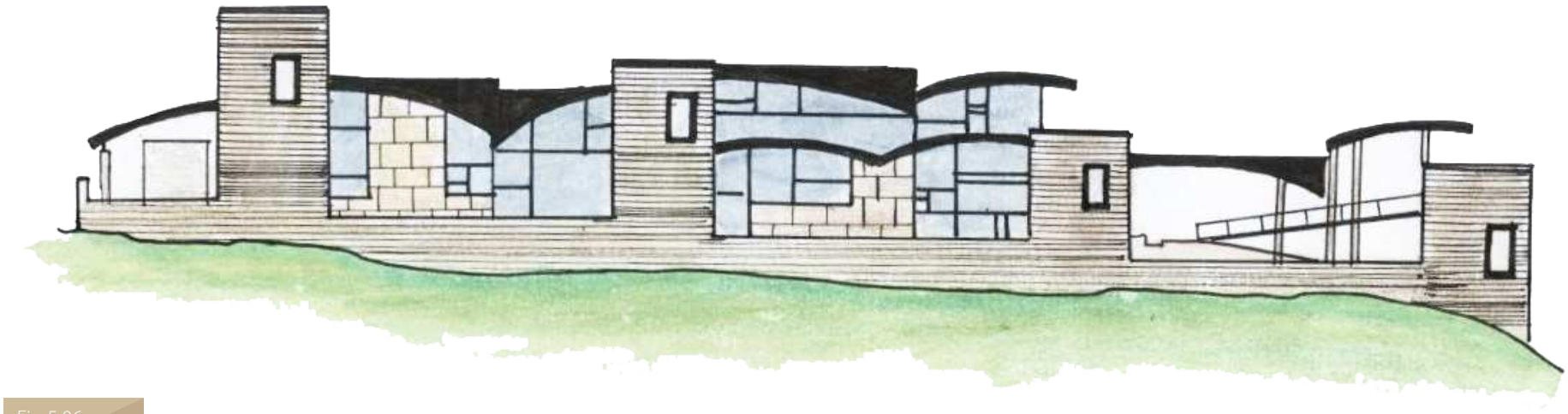


Fig 5.06

STRETTO HOUSE ELEVATION

Elevation showing various materials used on the stretto house facade.

Sources: Author modified, 23rd February 2015

masonry dams restraining water within the house. This helps to give the sense that if the masonry walls were removed, then similar to an actual dam water would actually escape and the building would lose it's space. A view through the main entry at this point reveals the overlapping spaces in the house. The gardens can also be seen from the major rooms.

The roofs are both concave and convex. To fully understand the roof conditions, the team made a model and mocked up a full size coping detail in order to fully understand the roof consitions. The roofs are only seven inches thick in accordance with the heavy/light concept. The roof structure was made from standard six inch steel pipes that were bent by computer driven magnetic-induction technology. When a long space was necessary, the wall thickness of the pipe was increased internally so that the roof thickness remained the same. These pipes, later referred to as noodles, were erected and welded with fish-mouth joing and braced in steel pockets within the masonry walls.

The interiors are designed as a series of overlapping spaces further reinforcing the fluidity and stretto concepts which the house is named after. The last room in the sequence, at the north edge of the house is completely flooded by the ponds and has no pragmatic function. The water mirrors the walls leading to an impression of the room size being double what it actually is. There are baclonies facing this room and bridges over it, making it a tranquil and relaxing space. It becomes the centre of two sequences of space, one from the landscape and one from the aqueous space of the house.(Holl,1996)

Fig 5.07

MATERIALITY

Photograph showing the realisation of Stephen Holl's design particularly the juxtaposition of heavy masonry and light curvilinear forms that is similar to the contrast between percussion and light strings in the musical work.

Sources: Retrieved on 23rd February 2015 from www.stephenholl.com

5.1.3(c) MATERIALITY

The materials, as spoken of earlier, aim to bring out the contrasting tone colour brought out in the musical work. The strings, which play almost throughout the musical work maintain the fluidity of the work. The heavier percussion instruments give a discontinuous element that passes a message and enhances certain parts.

Similarly, the architect, very keen on materiality in design, identified materials and textures that clearly bring out the heavy/light theme that is the heart of the musical work. His ideas are represented in the following equation:

Material x Sound = Material x Light

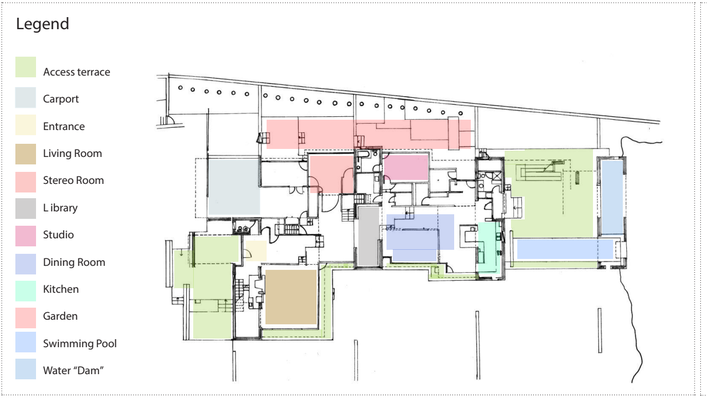
The Texan vernacular facilitated the execution of this. Orthogonal masses made out of poured concrete and concrete blocks represent the percussion instruments while the liquid elements are represented by metal frames and roofing, glass cast in fluid shapes and slumped glass. The use of liquid terrazzo in addition to these other fluid shapes is in line with the spatial concept.

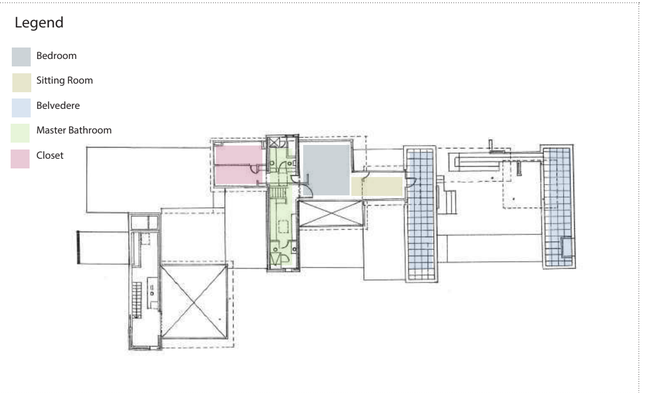
The spatial dams are ground-space block double-wall construction where columns were poured into the spaces where structurally necessary. The blocks were trimmed in Texas limestone. The exterior materials were hand-sanded aluminium and acid-reddened brass that yields an organic patina on the metal areas.

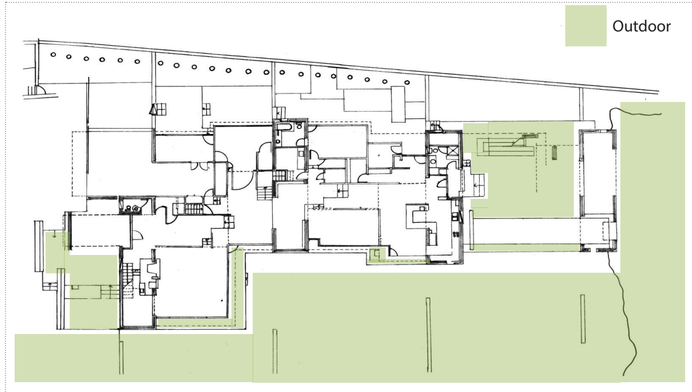
Interior finishes included one of a kind woven wool carpets depicting musical scores on top of the black stained concrete floors. Bespoke curved glass light fixtures are used to enhance certain areas of the house.

The furniture has been designed parallel to a musical theme with quarter note, counterpoint and half note tables. Kitchen cabinet handles based on the the heavy/light orthogonal/curvilinear concepts.

FIGURE 5.08-5.12STRETTO HOUSE PLANNING ANALYSIS







5.1.3 (d) PLANNING CONCEPTS

The plan is completely orthogonal and the section is curvilinear in the main house while in the guest house, the plan is curvilinear while the section is orthogonal. In implementing Bartok's symmetry, the architect mirrored the guest house in reverse of the main house. The climax, which is the note A in the work is represented as the flooded space in the main house.

There is an obvious progression and rhythm through the site. The plan modules shift back and slightly forward as the house slopes gradually downward from the limestone-paved front terrace at the southwest corner to the other open court at the northwest end. As the building progresses, it is obvious through it's elevation that it is developing, flanking the east bank of the river and initial dams, the house flows downward into a culmination at the rear courtyard.

5.1.3(e) HARMONY AND PROPORTION

Throughout the exterior and interior designs, the Golden section is used to fine tune the proportions.

A first division in anthropometrical measures, (expressed in the foot/inch system), of the areas within the blocks of walls, is simply repeated in the voids and solids on both the ground and upper floors, and recalls the measures 21+13 feet that are typical of the Fibonacci series. A timbered internal division of the solids and voids of the main façade is easily deduced by the golden drafting process. It is also possible to see a more general harmonic disposition of the glass walls composed of rectangular windows.

The flowing spatial sequence was designed in a series of overlapping perspectives. The proportions of these overlapping parts were determined using the golden section. This gave the interior spaces a sense of order, familiarity and harmony.

The Golden section has also been used in the design of features such as the windows and the furniture in the house. The windows are segmented into a perfect golden rectangle. The continuous use of the Golden Section helps to present the house as a singular entity, giving cohesion to all the elements contained within. Each additional component feels at ease and is designed and positioned using the rules of the Golden Section.

Fig 5.09

FURNISHINGS

The architect tried to tie in the musical theme with everything including the furnishing, both hard and soft.

Sources: Retrieved on 23rd February 2015 from www.stephenholl.com

5.1.4 SUMMARY

The musical piece, Music for Strings, Percussion and Celesta, by Bela Bartok uses stretto extensively to define it's character tempo and composition. In addition, the work has used unusual proportioning and organising features such as the Golden Section and symmetry in the composition. This has given this work, and a lot of the composer's other works, general acclaim from listeners and critics alike.

Similarly, Stephen Holl used many architectural and musical techniques to transform all the predominant features of the music into his building. This gives the design order, strength and continuity. All parts of the design merge creating a singular experience within the architecture. The intertwining of space, light, geometry, material and detail complement each other and the building is seen to be a whole, with the musical concept unifying all the parts.

This building is memorable as a seminal piece of architecture but also serves to highlight the blurred links present in music and architecture. Holl allows the occupant to view music through architecture and uses the musical theme to heighten sensorial reactions to the architecture.

It is seen that in spite of the strong bonds existing between the two fields, that is geometry and mathematics, other bonds can be created when trying to connect the fundamental nature of the two fields and this is through material/texture, light and rhythm.

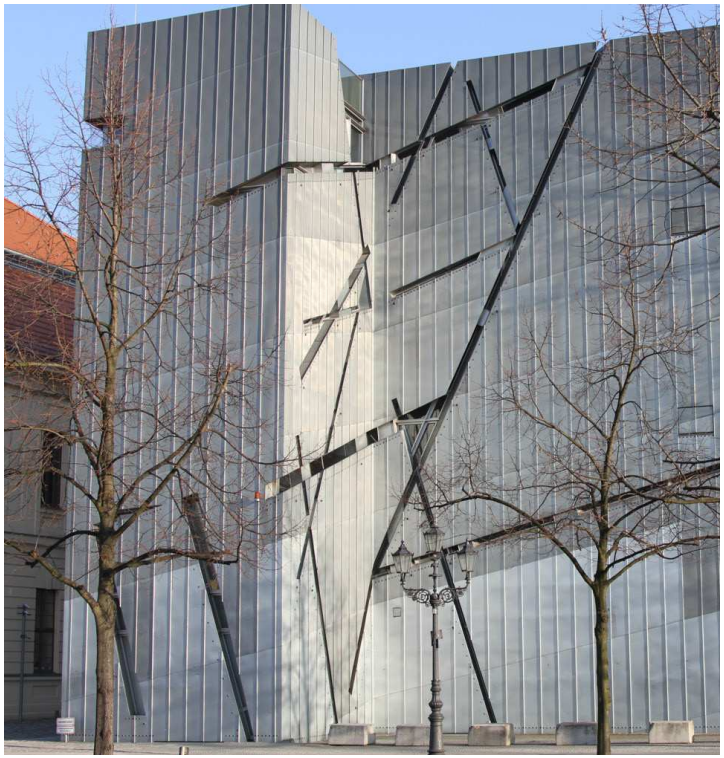


Fig 5.10

BERLIN JEWISH MUSEUM ELEVATION

The Berlin Jewish Museum, by Daniel Libeskind, was designed using the musical work Moses und Aron as a philosophical guide.

Sources: Retrieved on 23rd February 2015 from www.andberlin.com

5.2 BERLIN JEWISH MUSEUM

Client: STIFTUNG JUEDISCHES MUSEUM BERLIN
Architects: DANIEL LIBESKIND
Location: BERLIN
Structural Consultant: GSE TRAGWERKPLANER, BERLIN IGW
Mechanical Consultant: KLIMASYSTEMTECHNIK, BERLIN
Date of Construction: 1988-1999
Size: 15,500 SQM
Building Type: MUSEUM
Initial Function: MUSEUM
Current Function: MUSEUM

5.2.1 BACKGROUND INFORMATION

The Berlin Jewish Museum was commisioned in 1988 following several years of deliberation on the implications of development of a Jewish Museum in Berlin. Jews had been living in Germany from the 4th century BC but following the Holocaust that occured between 1941 and 1945, approximately six million Jews had been murdered in an attempt to ensure Germany was pure and only contained Germans. Being the centre of the German government at the time, Berlin is where the Holocaust was planned and executed. The memorial museum was intended to bridge rifts and to represent this important, albeit dark aspect of it's history. A brief was finally developed in 1988 and an architectural competition launched.

The foundation for the design of the Jewish Museum Design was formed around three ideas. Firstly, it would be impossible to understand the history of Berlin without understanding the cultural, intellectual and economic contribution of the Jews. Secondly, it was necessary to physically and spiritually integrate the meaning of the Holocaust to the consciousness and memory of Berlin. Lastly, only through the acknowledgement and incorporation of the erasure and void of Jewish life in Berlin could Berlin's history have a human future.

Fig 5.11

STAR OF DAVID

In addition ot music, teh form making of the Berlin Jewish Museum was the star of David, a cultural symbol relevant to the Jews.

Sources: Retrieved on 23rd February 2015 from www.andberlin.com

Daniel Libeskind, the project architect won the competition and this project served as his very first commission after 17 years of theorising and teaching at the Cranbrook Academy. Being a Jew himself, the son of two Holocaust survivors from Poland, the project was of sentimental value to him.Having lost most of his family in the Holocaust. this was a building that he was implicated in from the beginning and not one that he had to invent or research. It is important to note that the architect is an accomplished musician and accordion player.

The architect explicitly outlines his influences for the project. The first is the invisible and irrationally connected star which shines with absent light of individual address. The second is the cutoff of Act 2 of Moses and Aaron which culminates with the non-musical fulfillment of the word. The third is the everpresent dimension of the deported and missing Berliners and the fourth is Walter Benjamin's urban apocalypse along the One Way Street.

5.2.2 MOSES AND ARON

We will examine in greater detail how the architect was able to draw inspiration from the opera and use it to inform his design.

5.2.2(a) INTRODUCTION

Moses and Aron is an opera composed by the Jewish-German composer Arnold Schönberg in 1932. The opera was first written as a play in 1926 titled The Biblical Way. The play developed into the Moses and Aron oratorio in 1928 and eventually became an opera in 1932. The opera has 3 acts with the last act being unfinished. The composer did intend to finish the opera but had not written a conclusion for the word that Moses was to speak.

An opera, according to the Oxford Dictionary of Music, is drama set to music to be sung with instrumental accompaniment by singers usually in costume. The music in an opera is integral to the telling of the story and not incidental as in a musical play. An oratorio was a predecessor of the opera which was developed in the 16th century. It was a sacred story-usually a biblical story-set to music as in an opera and performed in the church without scenery or costume. Schonberg changed the play to an oratorio and then to an opera in order to fully utilise his abilities as a composer and improve his

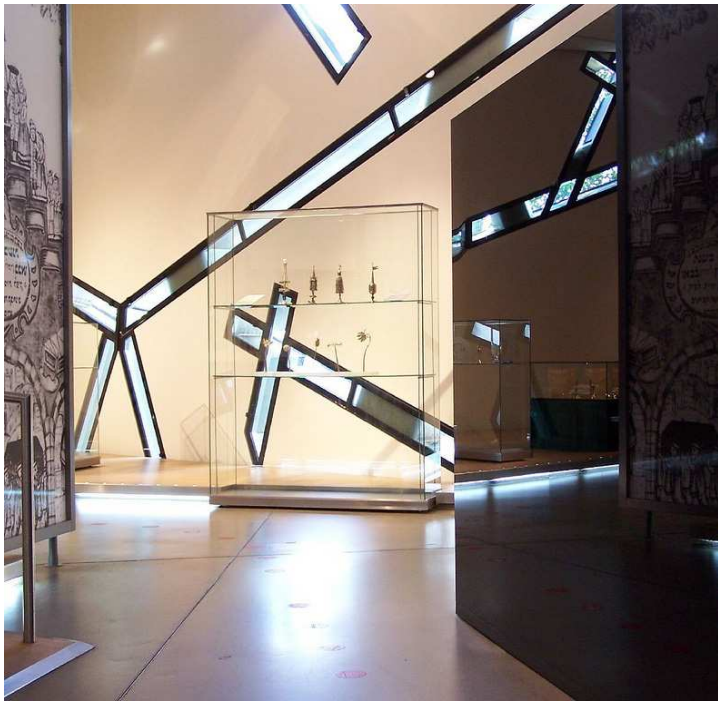


Fig 5.12

GALLERY OF THE MISSING

"Gallery of the Missing" reminds visitors of the idea and character of "that which no longer exists"refering symbolically to what has been lost.

Sources: Retrieved on 23rd February 2015 from www.andberlin.com

ability to express the themes that were central to his composition.

It is important to note that Arnold Schonberg was one of the greater modernist composers of the 20th century. He widely used the 12 tone system and was known for the development of the twelve tone system. The twelve tone system abandons traditional harmony and tonality. The musical notes used in a composition were no longer organised by a key but instead were independent and unrelated. Schonberg's twelve tone musical scale of the 1920s arranged all twelve notes in an abstract, mathematical pattern. This atonality (lack of key) was widely resisted by the audiences at the time, as they were used to tonal music leading to riots (such as the 1913 riot upon the premiere of Igor Stravinsky's Le Sacre du Printemps). This composition style only won acceptance after the first world war.

Due to its incomplete status, the opera was not performed during the composer's life. The first public performance of the music was on 2nd July 1951, 11 days before the death of the composer.

5.2.2(b) STYLE: SERIALISM AND MODERNISM

Serialism was a 20th century revolution in composition where composers sought to replace traditional rules and conventions. Serialism united the arts, which had become separated with no realisation of their common deatures. It soon became a 'philosophy of life' and spread even to architecture. This came about because musical developments had come almost to a standstill, woth only superficial developments and no real technical changes. Composers such as Schonberg therefore attempted to construct their own musical language representing their own era and condition. Serialism gave merit to the technical aspects of music creating a more truthful and efficient aesthetic.Schonberg considered music to have developed with unnecessary ornamentational elements, hindering it's evolution and instead favoured simplicity in music. He gave emohasis to the technique and structure of composing and his work did not utilize any harmony. "This is because Schonberd...[believed], how a composition sounds, [had] no importance".

At the time of the development of Serialism, Hapsburg, Viena was a cultural centre. Most cultural leaders, musicians, sculptors, architects and philosophers were closely

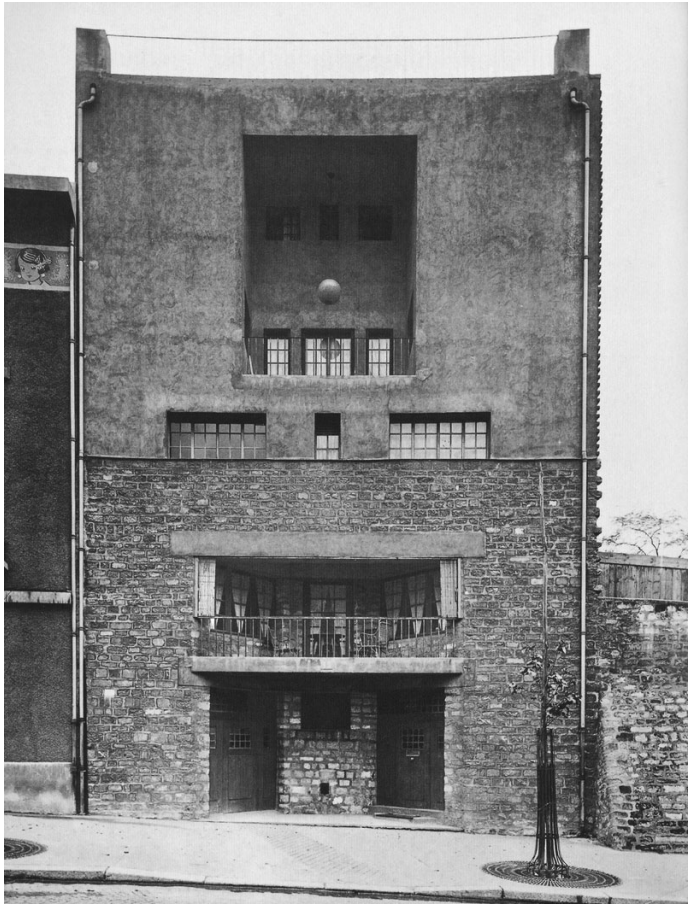


Fig 5.13

TRISTAN TZARA HOUSE

This building by Adolf Loos, an architect that was a contemporary of Schonberg, shows the beginnings of modernism and departure from ornament that was shunned by the Nazi leadership at the time as a Jewish aesthetic.

Sources: Retrieved on 23rd February 2015 from www.photobucket.com

acquainted and shared ideas and philosophies. The development of these ideas and philosophy in Hapsburg, Vienna was closely related to the critique of language and society by Karl Kraus. Most intellectuals used the Kraus influence in their related fields, for Loos this was architecture and design and for Schonberg it was music.

The arts at the time therefore had a parallel influence on each other. As Schonberg developed serialism, with it's minimalist aesthetic and emphasis on technicality, Adolf Loos pursued similar principles and philosophies in architecture. He was an important pioneer of the Modernist movement in Europe. In his 1913 essay, *Ornament and Crime,* he held out that the architect should follow the plumber as his model, and not the sculptor. Loos considered form purely based on aesthetics unnecessary and wanted to banish non-functional elements from architecture believing that the creation of something rational and efficient will inherently result in the creation of something beautiful.

The work of Loos and Schonberg is reresentative of the philosophies and ideas of Hapsburg Vienna in the early twetieth century. Architecture without ornamentation is mirrored in the atonal music of Schonberg. This was a critique of the period, attacking aesthetics and not accepting the norm. The influence of the two on each other ideally exemplifies the thought of their culture and a beneficial use of musical theory within architectural theory and design.

These similar thoughts influenced Daniel Libeskind in his design and he was able to create a serial code that he implemented in the creation of the form of the Berlin Jewish Museum. The work shows a clear avoidance of symettry and repetition comparable with Serialism and the conscious turning away from automatically accepted features.

5.2.2(c) JEWISH IDENTITY IN MOSES AND ARON

The opera was written in response to the growing anti-Jewish movements and a deeply personal expression of his own Jewish identity crisis. This had been brought about by a face-to-face encounter with an anti-semitic group in Mattsee, Salzburg where he was forced to leave a resort upon being identified as Jewish despite being a Protestant convert. This encounter had an impact on his creativity as the sense of placelessness and lack of belonging led him to delve further into his Jewish roots. In a letter to a

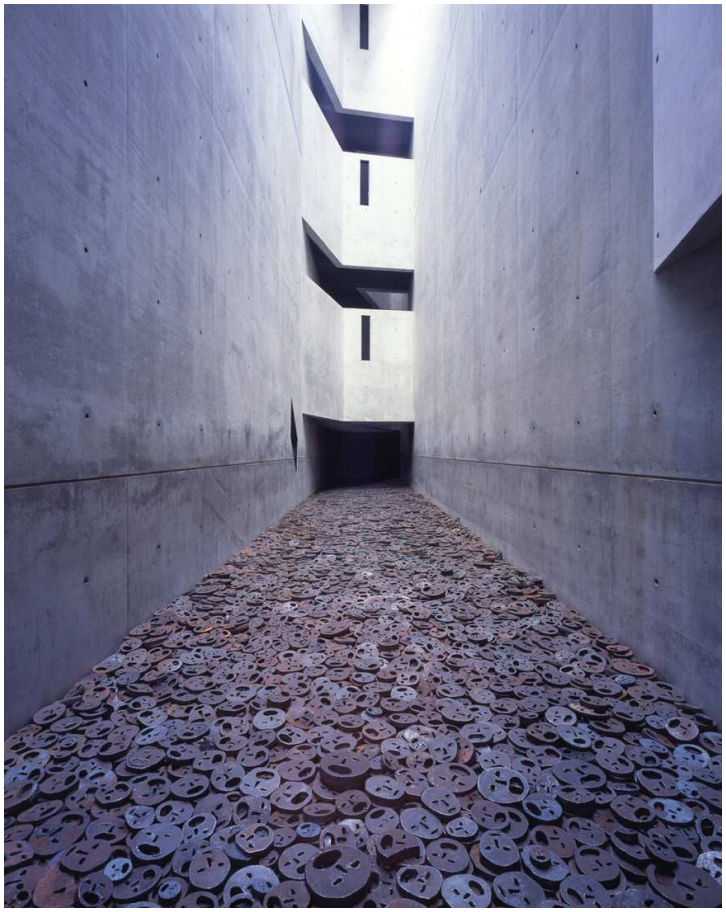


Fig 5.14

THE MEMORY VOID

Libeskind tried to mimic the Jewish journey and experience in this museum by attempting to leave an effect on the museum visitor by creating a feeling of being lost and of lacking a sense of belonging. The pictured space known as The Memory Void, Fallen leaves commemorates all those that were lost in the holocaust.

Sources: Retrieved on 23rd February 2015 from www.andberlin.com

friend, Wassily Kandinsky who had invited him to join the Bauhaus, he writes *"I have at last learnt the lesson that has been forced upon me this year, and I shall never forget it. It is that I am not a German, not a European, indeed perhaps scarcely even a human being (at least, the Europeans prefer the worst of their race to me), but that I am a Jew."*

This awareness of his identity led him to strongly pursue Jewish related themes in an attempt to advocate for Judaism and the freedom of Jews. The opera Moses and Aron is one such example where the composer attempted to visit this theme of placelessness among the Jews by making direct references to the intial exodus story.

The opera consists of a dialogue between Aron and Moses, whereby Aron is the "voice", the mouthpiece of the people of Israel, and Moses the one who understands that there is nothing to show to the people. Aron wishes to tell the people that they will be led into the Promised Land, and Moses feels unable to find any image to explain God's revelation – including the musical image, in Schönberg's case. The discussion between Moses and Aron ends with Aron disappearing gradually into the background and the choir singing: "Almighty, you are stronger than Egypt's gods", at which point they all depart and Moses stands on the stage and attempts to sing the following: "Unimaginable God! Unutterable thought with many meanings! Do you permit this interpretation? May Aron, my mouth, make this image? Thus have I made myself an image, as false as an image can be! Thus am I beaten! Thus, everything I thought was madness and cannot and may not be spoken!" All this is sung. The last line, "Oh word, you word that I lack", is no longer sung but actually only spoken. At the end of the opera we can understand the word, because there is no music. We can understand what is said in the opera, because the word is isolated, so to speak, and expressed in a completely unmusical manner. This is the end of the opera as Schönberg composed it. The second act is also the end of the record.

Only the first two acts were ever composed. The point is not only that he lacked the inspiration, so to speak, to complete the third act, but also that the entire musical structure had ground to a halt and that there was consequently no longer any way he could continue with the opera in the same vein. This interested me, as I had always found it remarkable that a genius – this outstanding intellect and great composer – had been unable to complete the third act.

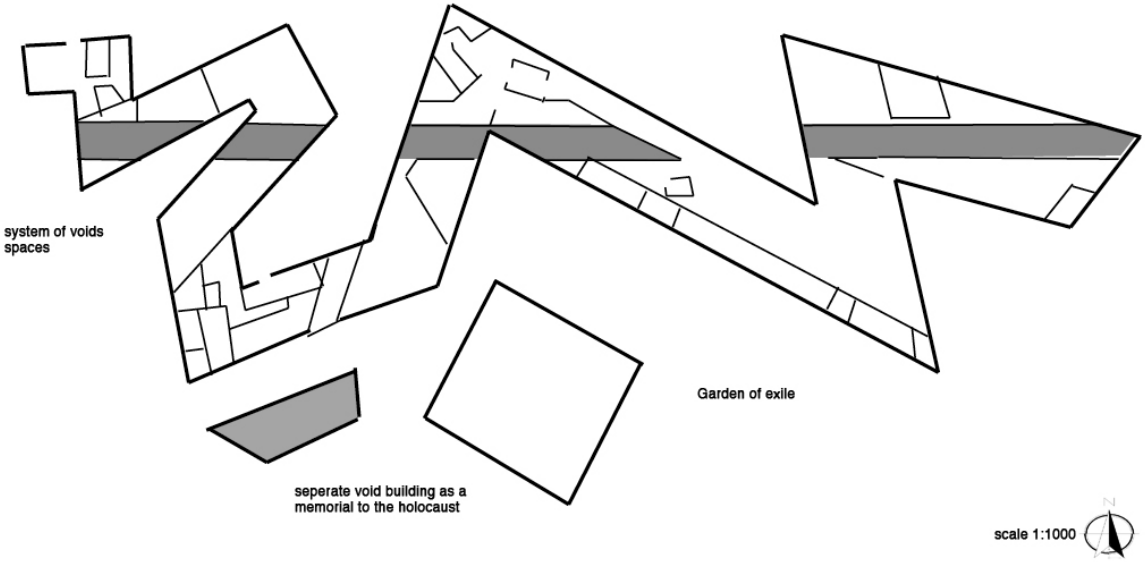


Fig 5.15

BETWEEN THE LINES

The project is built upon two lines of thinking, organization and relationship. One is a straight line, but broken into many fragments, the other is a tortuous line, but continuing indefinitely. These two lines develop architecturally and programmatically through a limited but definite dialogue. At the points of intersection of the lines are voids.

Sources: Retrieved on 23rd February 2015 from www.andberlin.com

It is important to note that at the time of it's composition, there was a severe attack by the Nazi government on the non-representational outlook of Judaism arts and the anti-semitic movement sought to cleanse German arts from association with this minimalistic, functional approach.

Similarly, the museum, in commemoration of this tragic period in Jewish history would have to represent and recall the struggles of the Jews of Berlin in that period and would need to directly address their identity question. The project draws inspiration from this work that was attempting to address the identity crisis of the Jews. Despite the difference in time, the messages that both the song and the project aimed to portray was similar.

5.2.3 BERLIN JEWISH MUSEUM

As earlier stated, the museum was commissioned in an attempt to acknowledge the atrocities that the Jewish community in Berlin had faced and incorporate it in the city's history. The museum explicitly presents and integrates the repercussions of the Holocaust.

Right from the onset, it was clear that this is a project that would need deep roots in symbolism. The author cited his four influences that were engrained in Jewish tradition and condition and he was able to integrate all these ideas and tie them together to create a building that was able to successcully represent what had happened to the Jews.

The Jewish Museum is officially known as the "Extension of the Berlin Museum with the Jewish Museum Department", but Libeskind refers to it as "Between the Lines." Libeskind explains "…it is a project about two lines of thinking, organization and relationship. One is a straight line, but broken into many fragments, the other is a tortuous line, but continuing indefinitely. These two lines develop architecturally and programmatically through a limited but definite dialogue."

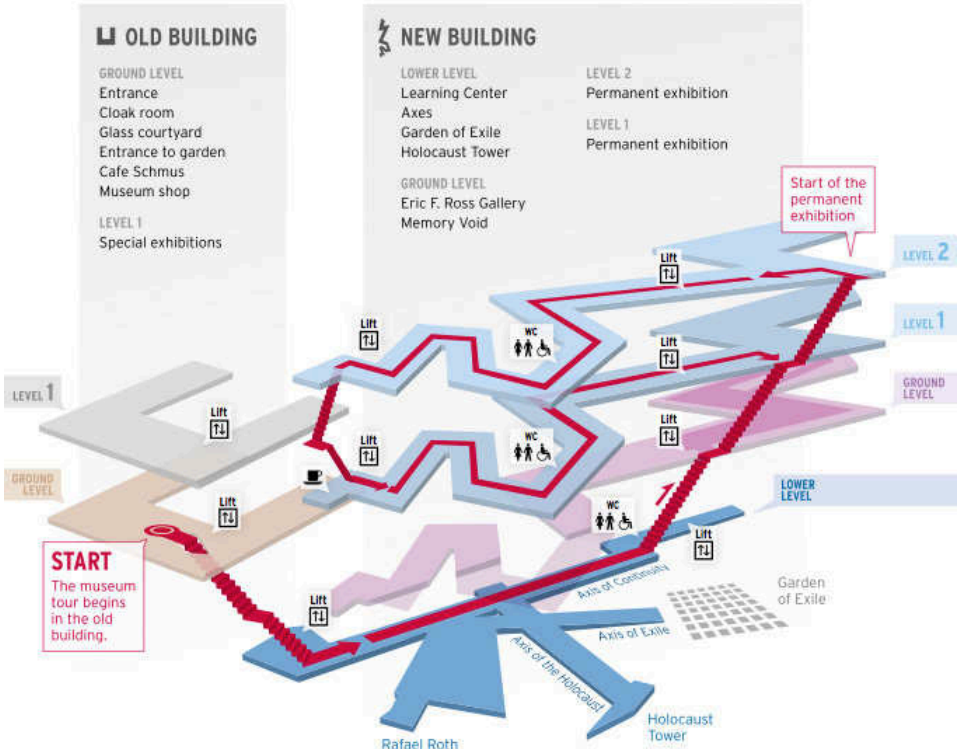


Fig 5.16

MUSEUM LAYOUT

The illustration shows the layour of museum from the entry in the old building which begins the journey through the history of the Jews. All aspects of the journey are symbolic even the concealed start within the old building.

Sources: Retrieved on 23rd February 2015 from www.andberlin.com

The museum is built around the concept of the void. The broken Star of David, or lightening bolt shape of the building is interrupted by structures that Libeskind calls "voids". These voids represent the loss of the Jewish presence and culture in Berlin as a result of the Holocaust. Libeskind elaborates, "The void is one of the organizing features of the building…it is the cut through German history, Jewish history. It is the extermination of Jews and the deportation of Jews not only from this city but from Germany and from Europe. So that is the central but not very apparent line which organizes all of the seven spaces which stand around it in the zigzagging form of the building." The void represents the erasure of Jewish history.

A grand Baroque structure, the old Supreme Court building, serves as the entrance to the Museum. A void has been cut into the old building through all of its floors, and it is through this physical embodiment of nothingness that visitors can access the new extension with its exhibits of Jewish culture and heritage. This is just one example of the simple way that Libeskind represents through the architectural form the inextricable link between Berlin's past, represented in this case by the Baroque building, and the history of the Jews in Berlin.

The architectural plan of the Jewish Museum is conceived around a four-fold theme. First, as a way of linking the Jewish tradition with the history of Berlin, Libeskind plotted the addresses of famous Jewish artists, composers and poets of the city such as Henrich von Kleist, Arnold Schoenberg, Paul Celan and Walter Benjamin. This "irrational matrix" resembles a broken star and is the basis of the "zig-zag" shape. The second dimension reflects the loss of music; specifically Schoenberg's unfinished opera Moses and Aaron, which was composed in the neighborhood of the Museum. Libeskind mirrors the end of sound in the proportions and structure of the void.

The third aspect involves missing Jewish Berliners. Prior to starting the project Libeskind found a book called Gedenkbuch that lists

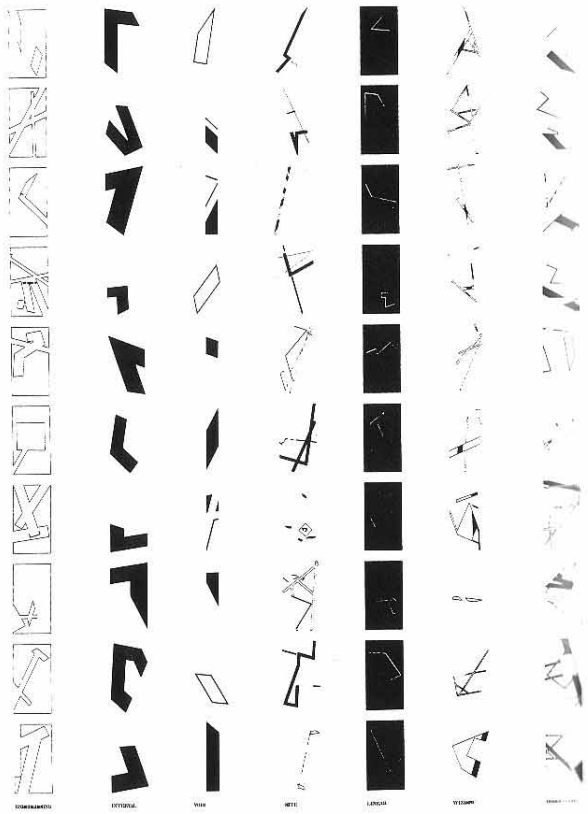


Fig 5.17

SERIAL CODE

The above is a serial code that was used by the architect in the design of the building. The serial code is abstracted in line with the serialism philosophy used also in the opera Moses und Aron.

Sources: Retrieved on 23rd February 2015 from www.andberlin.com

the names, birth dates, dates of deportation, and places of murder of those deported from Berlin. He looked for the names of all of the Berliners and where they had died. Finally, in the fourth dimension of the project Libeskind used a guidebook to Berlin, "Einbahnstrasse" that describes the one way streets, and the 60 stops along the map of Berlin. He drew the distorted Star of David along these stops to organize the buildings upon the matrix of Berlin.

5.2.4 MUSIC AS INSPIRATION FOR THE BERLIN JEWISH MUSEUM

The architect's past experience as a music led him to some experimentation on this front. In 1986, Daniel Libeskind did some studies known as Chamber Works. Chamber works often refer to music pieces performed for relatively small audiences in small rooms or chambers by smaller groups of musicians such as quartets, quintets or chamber choruses of up to 12 voices.

In the Berlin Jewish Museum, Libeskind uses music as a guiding design philosophy. Music is an idea that unites his other ideas and imbues symbolism in the work. The musical piece that he chose, being of a similar theme to his building was able to inspire him to create something along the same line of thinking.

Similarly, the philosophy of serialism, as advocated by Arnold Schonberg, was used in the design of the museum. A serial code was devised from which the form and planning of the building was constructed.

5.2.5 SUMMARY

Music can serve as philosophical inspiration for architectural form. In this project, Daniel Libeskind, an accomplished musician himself, looked to Arnold Schonberg's 1932 opera, Moses and Aron, an expression of the Jewish identity crisis at the time for inspiration.

The opera was never completed as the composer was unable to find a musical expression. Daniel Libeskind felt he could express this final act of the opera through architecture. This was by tackling the underlying theme of the work, the struggle of the Jews, the search for the promised land and for a sense of belonging.

Fig 5.18

GARDEN OF EXILE

The garden of exile aims to symbolically remind one of the disorientation that exile brings. 49 columns are filled with earth in which willow oaks grow. Forty-eight of the columns contain the earth of Berlin and stand for 1948 and the formation of the state of Israel. The central and 49th pillar is filled with earth from Jerusalem and stands for Berlin itself'.

Sources: Retrieved on 23rd February 2015 from www.andberlin.com

Daniel Libeskind's method of abstrscting from music included applying serialism, which was a method of composition devised by Arnold Schonberg himself. The forms used in the design of the Jewish Museum were created through serial thinking and a serial code was created for the building. Serialism was a style of composition in which a structural 'series' of notes were selected and governed the total development of the composition. The interpretation of this in architecture, would be the development of a code or language, that would inform the entire development of the built form.

Clear parallels in the thinking of the writer of this work, Arnold Schonberg, and Adolf Loos, a modernist pioneer are noted. Each of them represents the thought of leading intellectuals of their time and culture and showing a beneficial use of musical theory within architectural theory.

5.2.6 LESSONS LEARNT

The first lesson learnt from the creation of the Berlin Jewish Museum is that music can be used as an effective metaphor in the creation of buildings with symbolism. The reference to the opera as one of the guiding lights in the design was simply a beginning. Understanding that the song conveyed a message relevant to what he hoped to evoke was a starting point.

The understanding of methods used by musical composers in bringing out their themes and messages will help architects who are inspired by philosophies in music. In this case, the understanding of serialism as it was used in the opera Moses and Aron helped Daniel Libeskind organise his thoughts on the matter and devise a code that would help him imbue the design with the symbolism it required.

Music serves as inspiration when it is broken down and better understood before translation. In this case, the architect affirms that he did read the libretto and tried to understand what the composer sought to bring out. He was also able to understand the composer's shortcomings by looking at the score and the exact point at which he stopped writing the work.

Fig 5.19

CONDUCTOR'S MOVEMENTS

Drawing of a musical performance in which a conductor is giving instructions to the group. The architect abstracted architectural form from a combination of the 5 lines of the staff as well as from a conductor's movements during a performance.

Sources: Retrieved on 20th Februaryr 2015 from www.photobucket.com

5.3 ROBERTO CANTORAL CULTURAL CENTRE

Architects: BROISSIN ARCHITECTS
Location: Coyoacán México DF, Mexico

Design Architect: Gerardo Broissin (DESIGN ARCHITECT)
Structural Consultant:ARMANDO SERRALDE
Acoustic Consultant:OMAR SAAD
Date of Construction: 2012
Size: 9287square metres
Building Type: CONCERT HALL
Initial Function: CONCERT HALL
Current Function: CONCERT HALL

5.3.1 BACKGROUND INFORMATION

Roberto Cantoral García was a Mexican composer, singer and songwriter. He was known for composing a string of hit Mexican songs, including "El Triste", "Al Final", "La Barca" and "El Reloj". In 2012, Sociedad de Autores y Compositores de México commissioned the construction of this concert hall in honour of one of Mexico's greatest musicians.

The architect wanted to create a haven for music and musicians and decided to seek inspiration from the musical world so as to u=imbue the building with the symbolism and meaning it called for.

In using music as an image, the architect uses visual communication tools that are known to architects and combines them with his inspiration method. In this case we are able to see effective demonstration of abstraction from musical images.

Fig 5.20

FRONT ELEVATION

Photograph of the front elevation of the Roberto Cantoral Cultural Centre. The form is abstracted from the five lines of a musical staff and further altered by abstracting from the movements of a conductor's baton.

Sources: Retrieved on 20th February 2015 from www.archdaily.com

5.3.2 MUSIC AS IMAGE

A conductor is the leader and guide of a musical performance. He is responsible for understanding the music and cueing in performers as well as correcting anything that goes wrong during the performance. He provides the tempo and guides the players on the beat and metronome that they will play in.

Inspired by the movement of a conductor´s baton, the building design is composed of five concrete roofs moving up and down in harmony to give shape, space and light to the project. Each roof represents a musical staff´s line, always straight, constant and parallel.

The lines composing the façade move up and down as branches move in the wind, letting the sunlight pass through, creating a fantastical parade of shadows. Step by step, the visitor discovers the project as he walks through the access square with a relaxed mind, just observing everything around him, feeling how the concert hall is more than just steel and concrete, it is an invitation to reflection, to feel the harmony inside and outside and to discover the wonderful and magic world of music.

5.3.3 SUMMARY

Broissin's approach to form making abstracts from the musical world in an indirect way as it takes a commonly occuring form in music-the staff and uses yet another image, a conductor's movements to give the initial image character. The result is a contemporary building that delights the senses.

This is different from the other two cases studied where internalisation of structure and meaning is necessary for abstraction. In this case, one only needs to select an image identified with music and realise it through the usual principles of design and abstraction to give the building meaning.

In considering music as the image for design, it is important to abstract form and not simply to mimic the images that present. Broissin was able to successfully abstract from perhaps the most common musical image, the staff and enrich it using yet another musical image, the movements a conductor makes to further give this familiar image character and meaning.

TABLE 5.01: SUMMARY OF APPROACHES TO ABSTRACTION OF ARCHITECTURAL FROM FROM MUSIC

	CASE	HARMONY/PROPORTION	RHYTHM	TEXTURE AND ORNAMENTATION
METHOD	 STRETTO HOUSE STEPHEN HOLL ARCHITECTS	Strict adherence to the harmony used in the musical work. Analyse harmonic pattern and tonality and use proportions in music to determine proportions in architecture. Demonstrated in Stretto house through application of the golden ratio that is applied in the musical work by Bartok-Music for strings, percussion and celesta.	Adherence to patterns in the musical work. If polyrhythmic, variety of volumes/shapes/textures to be applied increases. Abstraction of rhythm in this method is not tied to the time concept of rhythm in music and could extend to repetition of other characteristics of the musical work such as symmettry or hierarchy through successive notes. Demonstrated in stretto house through repetition of sections to coincide with the movements of the work as well as in the application of symmettry and stretto that is used in the musical work.	This is applied to the materiality and surface treatment of the building with strict reference to the musical work. This will depend on the instrumentation of the movement and the nature of the parts. Demonstrated in the case study through use of different materials to bring out the contrast achieved in the musical work through heavy instruments(percussion) and light (strings). They are represented in the work by heavy masonry sections and light glass and curvilinear metal sections.
INSPIRATION	 BERLIN JEWISH MUSEUM DANIEL LIBESKIND	The architect is at liberty to determine proportions based on the message they want to bring out as a result of the philosophy or messages they have picked out from the music. In the museum, Libeskind plays with scale and proportion to create various sensations and emotions in those experiencing the museum that communicate the dejection of the Jews. Some spaces feel constricted and others too large to bring out various feelings such as loneliness and lack of a home.	Rhythm in a composition inspired by music in this way is achieved through a clever play of design elements on the part of the architect. This depends on the message that the architect wants to send. In this work, Daniel Libeskind achieves a symbolic sense of rhythm using two lines abstracted from the star of David. One of these lines is a zig zag, bringing out the difficult path the Jews had been on and one was straight. It is in fully understanding the message he wanted to pass that he was able to come up with an appropriate means to bring out rhythm.	The materials and ornamentation to be used will be dependent on the message to be passed and the context of the building. Daniel Libeskind uses metal on his facade with slit windows which further comunicates the difficult plight of the Jews and the hardship they faced. Music as inspiration is the most difficult means of abstraction as the music only serves to clarify a message and intention.
IMAGE	 ROBERTO CANTORAL CULTURAL CENTRE BROISSIN ARCHITECTS	Proportional relationships in the architecture are based on the image being abstracted from. In the particular case, the lines of the staff are equally spaced. In application of the conductor's baton movements, the lines are moved apart at certain points and resume the distance at others. The critical dimension remained the initial distance set as the distance between the lines of the staff.	Rhythm is also dependent on the image being abstracted from. In this case, rhythm is added to the initial staff image by introducing movement through another image-the conductor's baton. The otherwise stationary 'staff lines' are given movement by abstracting the lines of movement of the baton and moving hte staff lines in that way.	Texture is again dependent on the image to be abstracted from. The materials and ornaments are chosen based on what will bring out the image and the form best. In this case the lines are contrasted from the rest of the building using colour. and material. The lines are solid and between them are glass walls allowing light and air into the building.

CHAPTER 6

CONCLUSIONS AND RECOMMENDATIONS

6.0 INTRODUCTION

The aim of this thesis was to understand clearly the relationship between music and architecture, which has in recent times become deemphasised, and how to apply this understanding to the creation of culturally relevant and symbolic architecture. This was done by a close examination of commonly occuring principles between the two fields and their implications on each other. Upon establishment of these principles, a study of Mijikenda music and built form was carried out in a bid to understand the attitude towards these similarly occuring principles in either field within the local setting so as to enable eventual abstraction from it, as has been done many times in the Western setting. Lastly, contemporary application of music to architecture was analysed in a bid to understand the various methods through which these principles can be understood and a source of architectural concepts and inform form making. The following are the conclusions that were drawn.

6.1 CONCLUSIONS

6.1.1 THE RELATIONSHIP BETWEEN MUSIC AND ARCHITECTURE

From the research findings, it can be concluded that music and architecture, being both compositional arts have a real and present relationship, albeit indirect. The relationship is hinged on certain compositional principles and is in constant flux and at various points in history certain aspects of the relationship have been more important than others. However, the principles shared all remain relevant and have potential for reinterpretation and new perspectives on their translation into architectural form.

However, the famous quote, that *"architecture is frozen music"* becomes redundant for this study. It was found that the commonly occuring theories in music and architecture require translation into the visual form before becoming available to architecture. This is because when music is taken out of context it loses it's coherency and meaning. This leads to the conclusion that a clear understanding of the music one wishes to abstract from and its compositional devices is necessary in attempting to translate concepts in music to the visual form.

The understanding and subsequent application of music to architectural form is a subjective process and dependent on the designer or perceiver. There are various permutations and options depending on the attitude and disposition of the architect that is engaging in the process. However, for meaningful abstraction, and to avoid direct mimesis that may create meaningless architecture, deeper interrogation into the spirit of the musical work, including any underlying attitudes and philosophies, is essential. Creation of symbolic architecture requires a deep understanding of the key values, metaphors and memories to be expressed, as well as an understanding of how these are communicated visually.

6.1.2 MIJIKENDA MUSIC AND ARCHITECTURE

The Mijikenda are seen to have made no correlation between the two fields. The principles applied in the creation of their music manifest weakly in their built form, only as a distant rational understanding of rhythm and order, with polyrhythms, theme and variations being central to their musical creativity but a sharp intuitive sense to those principles. Their attitude towards the creation and performance of music, for which there is no word, is not as a creative discipline but as part of life. Their approach to architecture is similar. It also brings out that the Mijikenda did not view the built form as their main area of existence but instead understood space as endless, what is outside. The indoor space is not treated with a sense of importance and no major ceremonies or activities took place indoors. The outdoor is made to blend in with the forests where they settled.

The appreciation of music and architecture by the Mijikenda is not to be based on precision of ratios but instead from a natural inclination to function and to 'what feels right', thus the spontaneity and polyrhythm of their performances and the variable adaptation of their houses. The attitude towards harmony is not an artificial one, where sounds need to be in perfect concord and rhythms are timed to coincide using a single metre. They instead perceive harmony with the universe as a less regular concept with a sense that patterns occuring in nature are not regular or symmetrical but that rhythms in nature are varied and different and still harmonious at the end of the day. Their organic elliptical forms, not attempting to seek precision of a grid or rectilinear form, which does not exist in nature only reinforces this attitude to living that manifests in their musical and material culture.

Music is a community affair and uniting the members of the Mijikenda community. The performance space is therefore a space belonging to the community. The performance space which has no real boundary or separation between the audience and performers, reveals the inclusive nature of Mijikenda musical performance. Spaces for performance facilitate the participation and inclusion of everyone. It also is concluded that the performance space, in this case out of doors, influences the music that is performed there which in this case, the loud rhythmic drumming is made possible by the out of doors performance venue.

The understanding of the Mijikenda principles of composition, which are unique, provides numerous possibilites for architectural conceptualisation. Mijikenda music remains largely undiscovered and unexplored as a source of inspiration for architecture. The structure and stylistic devices employed in the music as well as the philosophies behind them, as documented provide a rich starting point for architectural projects. In a time when the identity question in Africa is widely discussed, turning to a rich source of cultural inspiration such as music will greatly enrich creativity.

6.1.3 ABSTRACTION OF MUSIC TO ARCHITECTURAL FORM

The cases studies were approached from three different points of view from which abstraction from musical sources can take place. The conclusions are as follows:

6.1.3(a)MUSIC AS METHOD

From the study of Holl's Stretto house we are able to understand the application of the more structural and technical parts of music to architecture. Using music as method involves picking a specific musical work and using it as an organising principle. This involves understanding and noting the patterns on which it is composed as well as the concepts behind the creation of the particular musical work. and finding architectural equivalents. Careful application of this results in meaningful architecture with a clear theme running throughout.

6.1.3(b)MUSIC AS INSPIRATION

In designing buildings with music, it is important to understand keenly the cultural context that you are designing in. The Berlin Jewish Museum uses a musical work steeped in symbolism and meaning and keenly describing the emotional, physical and psychological situation that the Jews were in in the early 20th century. In understanding the spirit and philosophy of this work, Daniel Libeskind is able to create an architecture inspired by the philosophy of the musical work, by the meaning and method, yet not based on it.

This being the vaguer and more difficult method from which to draw inspiration, it requires deep understanding of the messages being communicated in the music and then the finding of an architectural language to express the same.

6.1.3(a)MUSIC AS IMAGE

Perhaps the most direct method of abstraction from music is using music as an image. This involves drawing inspiration from images relating to the musical world and rethinking them to create great architecture as is seen from the form of the Roberto Cantoral Cultural Centre.

From all the case studies, it is clear that a deep understanding and appreciation of the cultural context of the architectural project is the first important step. This clarifies what music you should apply and what aspect of the music to apply in order to achieve a certain effect be it symbolism or a sense of place.

It is important to analyse and pick out the key principles and concepts in the musical work to be applied to a project in order to abstract from it successfully. To create meaningful forms from music, one must build a strong organisation principle from it and this can only be done upon understanding how the music itself is organised and the philosophy behind it's composition.

To achieve the effect that music has on the senses, it is important that in abstracting from music, a less literal and a more practical approach should be taken. The ways in which architecture delights the senses-that is space making, form creation and selection of materials must be examined critically using the music as a reference point. The careful combination of volumes and selection of finishes as opposed to the imitation of forms found in music will lead to a more succesful abstraction upon abstraction. A literal approach must at all costs be avoided as the imitation of familiar forms does not in any way create architecture that is relatable-perhaps it creates only forms that are recognisable.

New methods for the translation of music and architecture are available using computeried algorithm softwares such as Grasshopper. This could assist with design depending on the direction one wishes to take in design. Hoewever, the forms produced are often unreadable architecturally.

6.3 RECOMMENDATIONS

There is potential for application of Mijikenda music and compositional principles in the design of regionalistic architecture. Architects should look into the possibilities and attempt to understand not just Mijikenda music but all music as a source of cultural concepts.

The introduction of an inter-disciplinary method at the early stages of design education, where one gets a varied feel of compositional principles and various ways that they can be applied for different results will greatly enhance creativity and maximise the potential for understanding architectural problems and seeing them in a different light.

A deeper interrogation of cultural aspects and values, symbols and metaphors , in this case music, will facillitate meaningful abstraction and possibly result in creation of architecture that is relatable.

Performance spaces should be designed specifically and with the users in mind. The inclusivity and participatory nature of the African performance should be considered in design of music performance venues. One should also keep in mind that the performance space will affect the music that is produced there are careful consideration of acoustics should be taken when designing. The way that rooms sound is as important as how they look, especialy for music performance venues where the acoustics directly affect the sound and appreciation of the music.

There is room for further study in the analysis of other forms of African music, as Africa is ethnically diverse, including modern music authenitcally from Africa. This would ideally include a breakdown of the form and exploration of it's compositional principles and aesthetics.

There is also room for testing of this thesis through design as a research method in attempting to further explain and demonstrate the possibilties that exist upon the debunking of compositional principles in African music as well as aesthetic philosophies.

BIBLIOGRAPHY
PUBLISHED WORKS

CHEDD. G *Sound :* Aldus Press (1970)
KAMIEN R. *Music An Appreciation*: McGraw HIll (2004)
ANTONIADES A. *The Poetics of Architecture* : Wiley (1990)
MAHMOUD R. *Architecture: Music, City and Culture* : Lambert (2009)
RASMUSSEN S. *Experiencing Architecture* : MIT Press (1959)
CHING F. Architecture: *Form, Space and Order* : Wiley (1996)
SCHMIDT-JONES C. *Understanding Basic Music Theory* : RICE UNI. (2007)
THADDEUS-JONES G. *Music Theory* : Harper Perennial (1974)
WITTKOWER R. *Architectural Principles in the Age of Humanism*: (1952)
BLESSER & SALTER *Spaces Speak, Are you Listening?* : MIT Press (2007)
BAGENAL *Planning for Good Acoustics* : Methuen London (1931)
LUTZ J. *Resonance, Essays on the Intersection of Music and Architecture*, Culicidae Architectural Press (2007)
SENOGA ZAKE G. *Folk Music of Kenya* : Uzima Publishing Co. Nairobi (1987)
KWABENA NKETIA *The Music of Africa :* Norton (1974)
AGAWU K. *African Rhythms: A Northern Ewe Perspective* : Cambridge University Press (1995)

JOURNALS AND PUBLICATIONS

LIBESKIND D The Walls are Alive : The Guardian
JENCKS C. Architecture Becomes Music Architectural Journal (June 2013)
CESARE J. Theory of Visual Space in Music

THESES

NJOGU G. *Music in Architecture* :University of Nairobi (2000)
MASESE G. *Music and Architecture* : University of Nairobi(1998)

WEBSITES AND BLOGS

www.archdaily.com
www.stephenholl.com
www.storiesofhouses.blogspot.com
www.andberlin.com