

From the Beginning of Aesthetic Theories of Art to Iannis Xenakis Mathematical Theories (The Inseparable Relationship between Music and Architecture)

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Abstract

The definition of aesthetic and the evaluation of relationships between the atmosphere of music and architecture in past and modern time has always been of significant arguments in art arenas; in a way that in all eras there has been two major approaches toward the evaluation between music and architecture: a. schema approach b. conceptual approach. The main issue that this research has mainly discussed about is the atmosphere issue which is the most significant and most obvious aspect of the link between these two arts which is the cause of a deep relationship between the two topic from past to modern time. The purpose of this research which is done with the method of library studies and the assessment of thinkers in this topic is to enlighten the rules hidden in the two arts of music and architecture; and on the way for understanding the conditions of inspiration of artists from nature and mathematics to create their art works, the hypothesis of the great musician and architect, Iannis Xenakis, are used. The result of this research announce that there has been always a deep conceptual relationship between music and architecture from the time before modernism till now and these two arts have been always carrying united contexts.

Keywords: music, architecture, aesthetic, atmosphere, mathematics, Iannis Xenakis

INTRUCTION

Human being has always been trying in different ways to interpret his beliefs and ideals to others in different formats during the historical periods. Music, poems, paintings, architecture and sculpture are announced as various ways of expressing their awareness, feelings and enthusiasm. Goethe noticed the architecture as frozen music and his claims arouse many discontent. Some believed that this brilliant idea is not even better than calling the architecture as reserved music, there

are many scholars on the relationship between architecture and music and many researchers have been done scholars on this issue; these approaches find their roots in the classic Greece, Pythagoras and Plato are the pioneers who have theories on the elegance as a systematic structure. Apparently music and architecture seem to be so far from each other but as an abstract

approach they have many common points with this explanation that the main element of music is sound and the main elements of architecture are building materials and; music is also a kind of architecture which happens in the motion of time. The artist is always in an irrefragible relation with his environment through seeing and observing, hearing and touching and other senses and through these channels achieves uncountable knowledge and sense comprehensions; and as much as these associations are plenteous, the circle of his thoughts and ideas and his artistic imaginations are vaster. One of the important subjects in the art territory is the «theory of information⁴» and in fact is a theory about transitions of symbols. This theory is a clear example of the school of process which recognizes the communications as conveyance of messages not only exchange of meanings; with these definitions the approach towards music as a branch of art that can be measured and understood, is a very long discussion. One of the persons who has done serious researches about the inner relationship between music and architecture in modern era was Iannis Xenakis who was the student of the Le Corbusier. Thoughts and mathematics in music composition is written in the famous book by Xenakis named “Formulized music” which he explains his motivation, philosophy and technique for composing music based on accidental dependents in mathematics And also he wrote another book in 1976 named «music and architecture» that he discussed about the connection between the two creative domains, the music and architecture. This book is a collection of Xenakis’s scholars which consist of his theories. In this book he represents a new theory about building a transcendent music city which includes three sections: music, architecture, music of architecture.

AESTHETICS IN ART

One of the first questions in aesthetics that comes to mind is that why beauty looks beautiful? In response, several possible definitions have been raised:

- I. **The Information Theory :** Information theory which is known as communication mathematical theory described with features like super-general ambit, a fundamental and principled approach toward problems and issues and the results come with it. In weavers¹⁷ view, this theory is so general that could be

used written language, musical notes, oral words, pictures and many other signs of communication. The word communication has been used in a very general sense to include the every other manners in which one mind affects the other. The goal of communication is an attempt to influence the destination's conduct, is defined by the general definition of conduct [1].

- II. **Representation theory:** art is the collection of works that have a certain proportion of their components upon which arouse aesthetic feeling in sensitive critics. Rodger Frye and Clive Bell are the founders of this theory in the beginning of the 20th century.
- III. **Idealism theory:** art is the collection of ideas or emotions of the artist's mind which are transmitted to other people as modifications.
- IV. **Institutional theory:** art is a collection of man-made art that has been found by its artistic people. Based on the information theory the perception of beauty captures the aesthetic information of human emotions. According to that, a message induce beauty when it has enough information port, and its aesthetic content is more than the perception of the mind. In this case the receiver is forced to create a schema, thus the mind forces itself to focus on higher perceptual levels. In fact satisfaction of the aesthetic sense is achieved when the mind succeeded in discovering a relative order in a series of irregular and turbulent provocations. Sophisticated messages can't be understood directly. In this case, the amount of information should be reduced by schema formation method [2].

CONCEPTUAL APPROACH IN THE TERRITORY OF MUSIC AND ARCHITECTURE

The researches about the conceptual approach are not as much as schema approach but in some cases there has been some words as hints in some researches like: the creation of concepts in music and architecture, the united language of music and architecture in conveying the concept and other cases which these evaluations have not been comprehensive and no example is not presented for understanding them. The evaluation in this essay is under the category of this approach; because first of all comparing to the other two approaches, the conceptual approach includes more universality and is concerning about the deeper layers of the unity between these two arts and the other issue is that from among other approaches told before, the conceptual unity is the only relationship that its existence is evident. In this approach the most significant factor is the matter of atmosphere. An architecture atmosphere is similar to a musical track which is created by human and with the direct interference of him and by the time of his presence in that atmosphere, the track is ready to be played. The architecture atmosphere just like music will find the ability to compose different types of music like jolly, heart seizing, arranged and rhythmic songs or on the other hand annoying none rhythmic, strident and meaningless music and this ability is dependent on the modality of the creation of the parts and angles or the

situation of the position of atmosphere sectors which are in communication with each other [3]. There is a technical term in music art called sound scape which declares the major sound perspective which equals to the term landscape that means scenery in visual arts and architecture. If you look at an ideal architecture atmosphere in a general way, you will find out different parts are in contact from various angles and in other words they help the adornment of complex; in music such happening can be seen either. So as a result music and architecture both own a united factor in leaving us in a different emotional atmosphere comparing to what we usually live in [4].

The definition of architecture atmosphere

The term atmosphere in architecture has no exact and union definition in a way that this term could be considered as one of the most problematic and most important terms among architecture technical terms [5]. Although the term atmosphere in architecture has a broad and chaotic meaning, on the other hand among all definitions presented of this term two inseparable elements have always been argued; first concrete issue and second heuristic issue, in some of these definitions the existence of the first element, concrete issue, and the atmosphere which has embraced human, is pointed out and; like the definitions that consider architecture as the art of organizing the atmosphere or the inheritor of atmosphere concepts [6]. Norberg Schulz thinks that the extract and essence of atmosphere is shown as the work of art through architecture. thinks that the architecture is the art of modality of atmosphere usage; from his point of view atmosphere is the reason which causes people accumulation or their separation [7]. In other definitions the element of concrete issues and human existence in the atmosphere is discussed. Le Corbusier says that the architecture atmosphere must be felt by walking; this means he believes that the atmosphere cannot be felt by watching maps and he emphasizes the human role in comprehension of atmosphere [8]. from this point of view there is a steady interaction between beholder and atmosphere and an organized scale connects these two elements to each other [9]. Adding to these two views, there is a third approach which contains the two views told before and includes the sufficient universality. When the term atmosphere is used as meaning for terms like quality, declaration or atmosphere effect, they nearly mean the atmosphere in this part of essay and the main attention is paid to contradiction between architecture and human. In other word atmosphere in this case of meaning is a kind of comprehension and in any comprehension two main elements are involved: (penetrated or concrete issue) and (sentient or comprehensive issue) [5]. This type of approach toward architecture's atmosphere is close to a theory called the theory of being atmosphere presented by Martin Heidegger. This theory relying on a phenomenological view and by crossing out the division of concrete world and comprehension world is shown and more than anything emphasizes on the atmosphere shaped of human existence. The same like Heidegger's phenomenological approaches it could be said that the atmosphere is neither concrete nor comprehensive but it is exactly on the boarder of these two elements. Atmosphere is a purgatory between reality and mentality [10].

The definition of musical atmosphere

There are two approaches in definition of musical atmosphere: some consider music as the art of absolute aural designing and they do not believe in the atmosphere floating in music and some other consider it as a combinational art that demonstrates the meanings through words or concrete images [11]. recent researches have proved that the second approach is more accurate which means that the factor of atmosphere possession existing in music is not occurred accidentally but it is composed by accurate designing of the composer [12]. By accepting the view point of second approach the musical atmosphere could be defined as: the atmosphere is one of the essential bases in musical experiences. Musical atmosphere is not a type of atmosphere categorized under the concrete atmospheres category which are considerable by visual, physical or geometrical power; musical atmosphere is a type of visualization atmosphere. A fluid atmosphere which moves and changes without going to a definite destination though it is stopped in the same origin that it was. But in any case all these factors are the characteristics of an atmosphere that is comprehended by all our senses not only the aural sense [13].

The relationship between the atmosphere of music and architecture

in the assessment done on this issue it was resulted that: first in different eras, premodernism and after that there has been always a conceptual relationship between music and architecture and both were representing same meanings in a way that these two branches of art in every era were in communication based on the particular definition and necessities coordinated to that specific era. Based on the

information on the Table 1, in renaissance, human is the core of both arts and its effect in architecture is prioritized in the form of central atmosphere which gives the best perspective to human and also is preferred in music in the form of lyrical music for the sake of making use out of human voice. In Baroque era the sense of motion and activity in architecture and the use of echelon dynamic is added to music atmosphere. In Rococo era the designs are shown in an extravagant way in the atmosphere of the two arts in a way that in architecture atmosphere intemperance in designing details of the atmosphere and in music the use of instrumental and lyrical music at the same time and extravagant using of decorative notes are seen. In classic era, the principles of ancient era are revived and once more the core arguments are coordination and moderation. In romantic era in creation of both atmosphere the personal taste of the artist is obviously contributed. In modern era the both arts atmospheres are liberated from the accustomed principles and new systems are presented in the production atmosphere of music and architecture; and finally in postmodern era new concepts like multi atmosphere, no atmosphere implicit atmosphere, no boarder atmosphere and etc. are presented in music and architecture. What is obvious is that these two arts have always been in a in a close communication; so from pre modern time up to now there has been a continuous conceptual relationship between music and architecture and in each era both arts has been conveying same concepts. The other result is that in pre modern eras, in specific periods in both arts, there has been a main and same central concept; but from modern time up to now because of the reasons to be told hereunder we face with the lack of a particular context and instead of that we see multi context artworks. Modernism caused changes in the common structure of music and architecture and centrality of a concept replaced with inexistence of a coral concept and multi conceptuality[14].

Table1: The Comparative Evaluation of the Conceptual Relationship Between Music And Architecture Atmosphere From Before Modernism And After That [By: Writers].

Relation between Architectural and Musical Atmosphere	Music Atmosphere	Architectural Atmosphere	Historical periods
Focus on human being and his interpretation of atmosphere	Advantage of vocal music to instrumental music, Relation between music and Language, Representing emotion in a Common manner. Adding dimension to music by polyphonic structure.	Invention of perspective, Attention to the role of human in creating the atmosphere based on mathematics. Using platonic masses because it is easy to understand by human mind. Using proportion of human body in creating the atmosphere, Priority of central atmosphere to straight one.	Renaissance period
Focus on drove of mobility and move in atmosphere	Spread of rhythmic dynamism in atmosphere, emphasizing on more motion in creating atmosphere, using rhythmic motion technique in composition songs. Using rhythm in speech, using conflict in creating atmosphere.	Soul of movement in atmosphere, using of contradiction in creating atmosphere, using charm in fancy world. Priority of straight atmosphere to central atmosphere. Using of oval form because of its dynamism. Using of exaggeration tricks. Creating of asymmetric atmosphere.	Baroque period

<p>Focus on using decoration in atmosphere</p>	<p>Using different melody lines and varied audio layers. Using clever notes and decoration in composing songs. Merge the asymmetrical atmospheres in musical atmosphere.</p>	<p>Delicacy art in art manner, creating atmosphere based on demonstrative art, using extravagance in decoration, extravagance use of combinational color, making more concentration and pause in atmosphere by extravagance in creating details of atmosphere.</p>	<p>Rococo period</p>
<p>Focus on using ancient patterns in atmosphere</p>	<p>Using particular lines, distinct structure in creating atmosphere, attention to the simple harmony, homolographic and balanced quality, using a particular form like sonat in composing songs.</p>	<p>Revive of ancient classical manner, enthusiasm of dignity and soothing moderation. Originality of atmosphere in following of classical art principles. Simplicity, clarification and reference to ancient atmosphere principles. Using particular principles in creating architectural atmosphere</p>	<p>Classical period</p>
<p>Focus on emotions and source of artist's inspiration</p>	<p>Unexampled emphasizing on personal genre, creating atmospheres coming from the emotions of the writer, time of emotion and special atmospheres.</p>	<p>Using emotional excitement and feeling in creating atmosphere, importance of source of inspiration of the artist and his mental interpretations. Igniting emotion and excitement, make ambiguity.</p>	<p>Romantic period</p>
<p>Lack of particular center and different conceptions</p>	<p>New tendencies and audio vocabulary because of industrial revolution, change in the manner of relation of music with audience, revolution in elements which defining atmosphere, lack of need for physical presence.</p>	<p>Changing in meaning of atmosphere after industrial revolution, evolution in the elements of atmosphere, decadence in quality of architectural atmosphere</p>	<p>Modern period</p>
<p>Lack of particular center and different conceptions</p>	<p>Lack of particular boundaries for music, using different sounds in creating musical atmospheres, new technics in composing songs, appearance of new manners, appearance of digital and electronic music</p>	<p>Experience of creating atmosphere without the presence of the object, develop of unreal atmospheres, creating atmospheres with special geometric features, vanishing the boundaries and bordersentering of software atmospheres</p>	<p>Post-modern period</p>

HARMONIC RATIOS IN ARCHITECTURE AND MUSIC

The musical rations happen beautifully in music, the rations that conclude to an appropriation (Figure1). Appropriation is sometimes in the visual form and in some other cases is in audible form. Also some things has been told about olfaction and tactile¹¹; accordingly all branches of art have a pinpoint and that is the point that is prearranged with our heart's geometry. When we move from one, that is the monotheistic essence of world, toward the multiplicity, we face with two and three in the first stage. Also in architecture we deal with the light frequencies which define length, width and height and when these three factors come to most reduced form, you can feel the beauty and these appropriations are seen in many fabulous architectural works. The marvelous point in these appropriations is that they exist in human body, bird's anatomy, trees and all sections of nature as they exist in golden ratio [15].

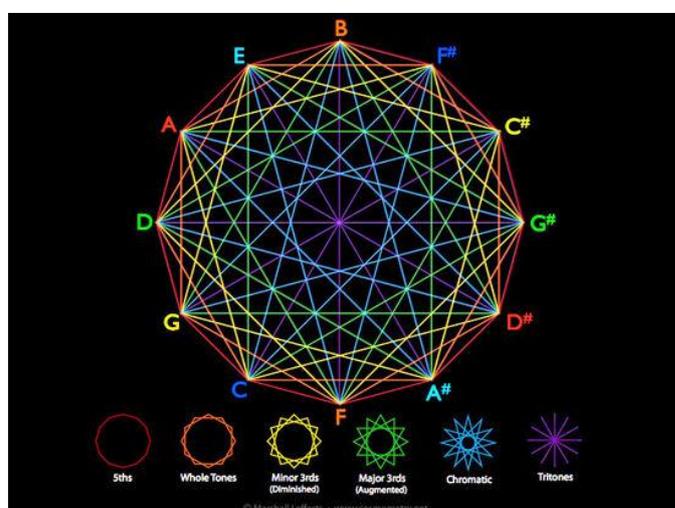


Figure1: Music is a system of relationships, these being the harmonic intervals between notes and the combination of these intervals to create melodies and harmonies [16].

RHYTHM AND ANACTION IN ARCHITECTURE AND MUSIC

Rhythm is the systematic and harmonic repetition of lines, shapes, forms and colors and consist of the fundamental repetition theory that is considered as a delicacy for organization of forms and spaces in architecture. Almost all types of buildings are constructed of elements which are normally repeated. The masts and pillars are repeated to build up the repeated ports and space frames. The doors and the windows frequently drill the building’s surface to provide the ports for air and light passage and the view for people and landscapes. The repetition of spaces often happens to supply the frequent or similar functional needs in the building program. The simplest repetition style is the line style that consist of many parts. Anyway in order to categorize the parts in the repetition style, there should not be necessarily mere similarities between them, they may have one similar factor with one common denominator and; and at the same time they can be individually unique and be a member of a unit family [17]. Generally rhythm is divided into four visual rhythms:

Steady Repetition: in this type of rhythm, one picture is repeated steadily and frequently. This rhythm results in a spontaneous movement and reaction and leads the spectator’s attention to itself; but because of lack of diversity it has negative consequences and after a short period it will be boring and tiresome (Figure2).



Figure 2: Repetition an architectural element or the music notes steadily and frequently [By: Writers].

Alternative Repetition: in this type of rhythm, a visual element is repeated but with its alternative changes it concludes to a diversity in a way that it makes an expectation of repetition for audiences (Figure3).



Figure 3: makes an expectation of repetition for audiences, Both in architecture and in music [By: Writers].

Evolutionary repetition: in this type of rhythm a picture or an element starts from a specific posture and progressively reaches a new posture through some changes in a way that it follows a growth and evolution during the transformation (Figure4).



Figure 4: Induction the sense of growth and evolution in evolutionary repetition [By: Writers].

Sinuosity Repetition: this type of rhythm which is mainly based on curve movement of surfaces and lines and also contains a kind of alternation is a perfect example of visual rhythm. (Figure5).

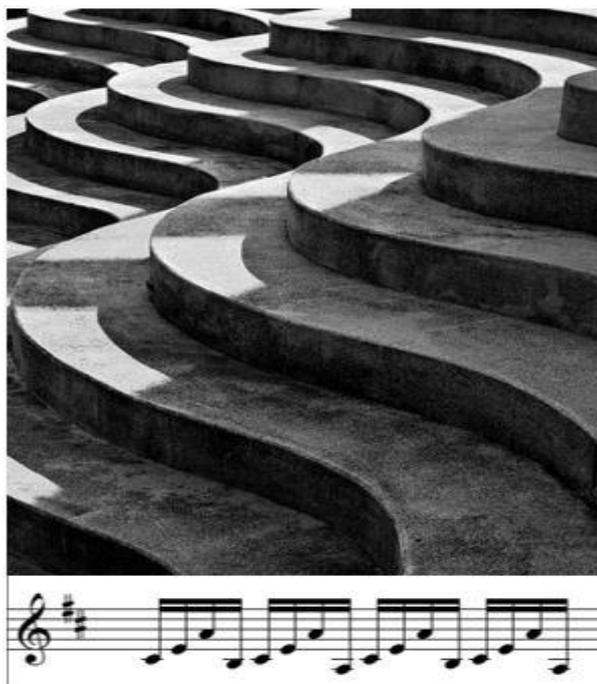


Figure 5: Create a Fluid visual rhythm of Sinuosity Repetition. [By: Writers].

Inaction or definition Of Station: has a practical aspect in architecture. Footpases, circles and city nodes are the examples of practical schemas of that. Sometimes it is possible to make a cause of station and with constructing a factor or an element in the architecture atmosphere and attract the visitor to that station cause (Figure6) [15].



Figure6: The stairs symbol of silence in architecture and pause in music notes [By: Writers].

THE RELATION OF MUSIC AND ARCHITECTURE WITH GEOMETRY MATHEMATICS

Common people believe that works of music are lovely and beautiful when they follow particular principles; the principles which the knowledge of physics measured the technical aspect industrial music based on the sensibility of human ears and soul [18]. It is also true about architecture. Plato and Pythagoras were the first people who represented theories of architecture to prove the internal relationship of mathematics, geometry and music and finally, architecture has based hypothesis and has expanded them in a way that they finally result in announcement of the rhythmic and cosmic ratios[19].

Geometry and numbers are the secrets of life, all life and world have their special geometric form. The basis of all art branches and normal behaviors is a ratio and we reach this ratio through geometry and numbers. In Music all notes are derived from the numbers 2 and 3 that is called LAMBDA list that this ratio in architecture is called the GOLDEN RATIO (Figure7).

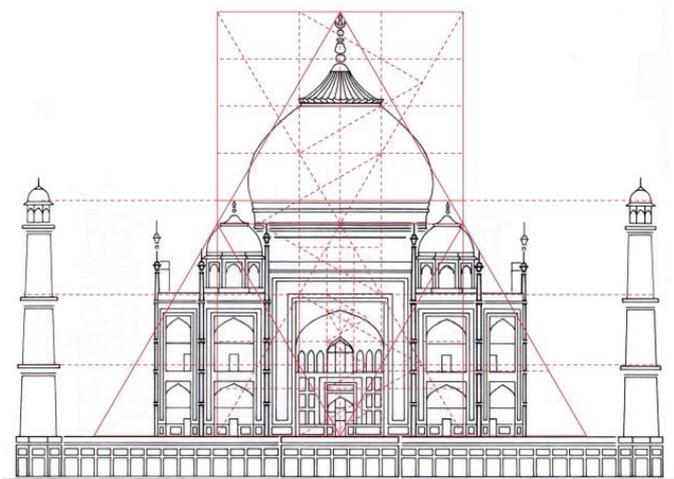


Figure 7: The serene harmony of compositions such as that of the Taj Mahal is achieved by a carefully calibrated system of geometrical relationships [20].

The accuracy and correctness of geometric instruments have always been more trustworthy than the abstraction of numbers and equations. As a result, humans have always been more attracted to geometry rather than mathematics [21].

INNIS XENAKIS AND HIS METHOD OF INSPIRATION FROM NATURE AND MATHEMATICS

He turned to an eminent person in world through composing music. Acoustic and electro-acoustic and his multimedia tracks are examples of his art works. He could be called as the pioneer of creating the digital music. Xenakis was trying to prove the consolidation theory through witting music notes based on probability theory calculations that exactly fits its place, despite other types of music that this process was only shown during the performance and each performance could be different from another. In the Philips booth he used an electronic track called

«metastasis» which was the peak of cooperation between music and architecture; he used the same constructing technique of note writing by using simple symbols of Fibonacci's architecture, he could write this track. [22].

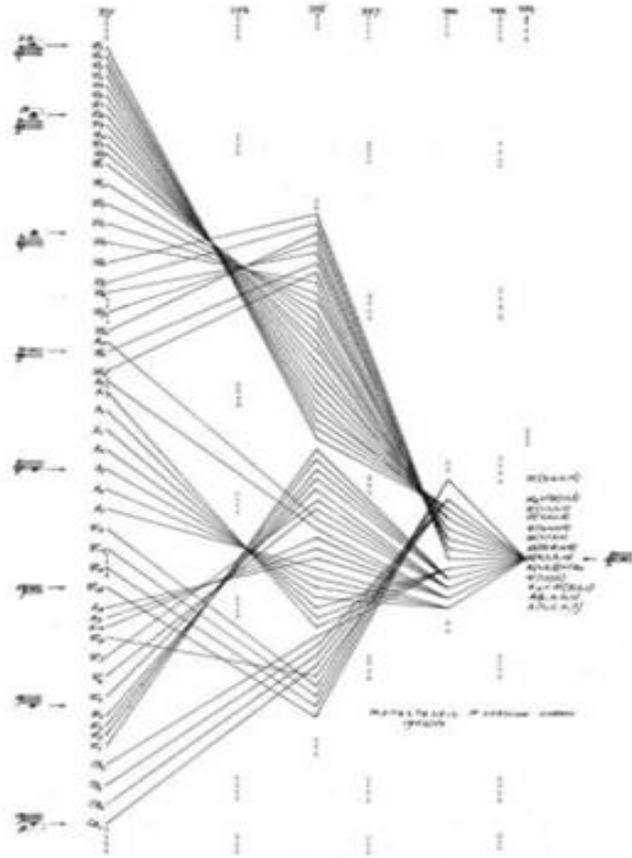


Figure 8: The Metastasis Partitur [23].

Xenakis entered any event that he wanted into the circle of music and architecture with the observation to nature; for instance he used transmission and dispersion of gas and the sound of smash of rain on the ground. About the metastasis track the issue was not the rain sound but it was rain fractal that indirectly did these and he wrote these in a way that they would not be accidentally. After composition and calculation of rain sound, Xenakis could obtain the time issue through formula calculation in music with an accurate arrangement in between the disarrangement of environment; in the way that in his scholar's consequences, he faced with Poisson process. Xenakis calculated different parameters of music with Poisson process, dynamic, modulation, color and time resulting in accidentally consequences (Figure9) [24].

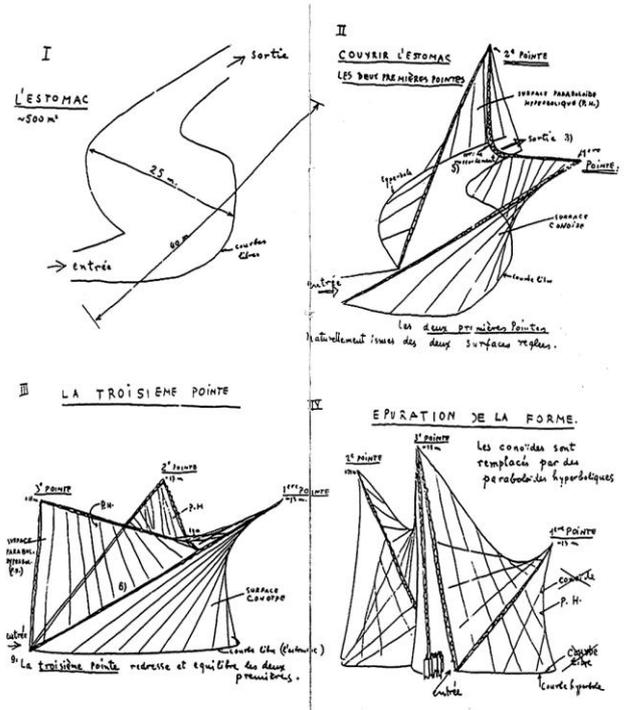


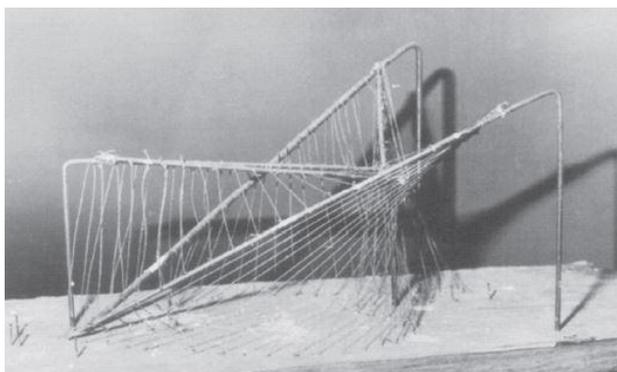
Figure 9 : Xenakis Drawing of Le Corbusier's Stomach plan [25].

When we look at Xenakis's approach toward this connection between music and architecture, we can see that mathematics, and more specifically, proportional relations play an inseparable role. Regarding these relations, Xenakis said:

“I think it is possible to feel mathematics. Let's take a very simple example, the problem of proportion. When you have two intervals of time, a long and a short one, you may proportion them so that the long one may be double that of the short one. The proportion is something that you can feel. You have to feel proportions in music, in architecture, in art wherever you use them or manipulate them. You cannot imagine them. And the same is true for larger, more complex theories. Of course, there are things that you don't care to feel. For instance, the solution of the second degree equation” [26].

PHILIPS PAVILION

Between the years 1947-1960, Xenakis had the honor of cooperation with the great modern architect, Le Corbusier. He designed the respected work, Philips pavilion, with the cooperation of Le Corbusier for the Brussels' exhibition. (1958) specialized way of note writing is affected in one of his most popular tracks, Metastasis. For the first time he entered the modular geometry in his music and composition which was the favorite of Le Corbusier by composing the metastasis track (Figure10).



He assumed the axis length(x) as the duration of performance and the ordinate length as the treble sounds of orchestra and by making use of this curve like architecture wrote his notes on these two lengths which was affected from Le Corbusier and showed string glissandos (Figure11). Notions exactly specify the role of instruments during the performance despite the art works of other composers [27]. This track from Xenakis had a great influence on many composers after him.

Figure 10: Le Corbusier and Iannis Xenakis, Philips Pavilion (1956-1958). Wire model of the first scheme with suggestion of the straight lines that compose the ruled surfaces [27].

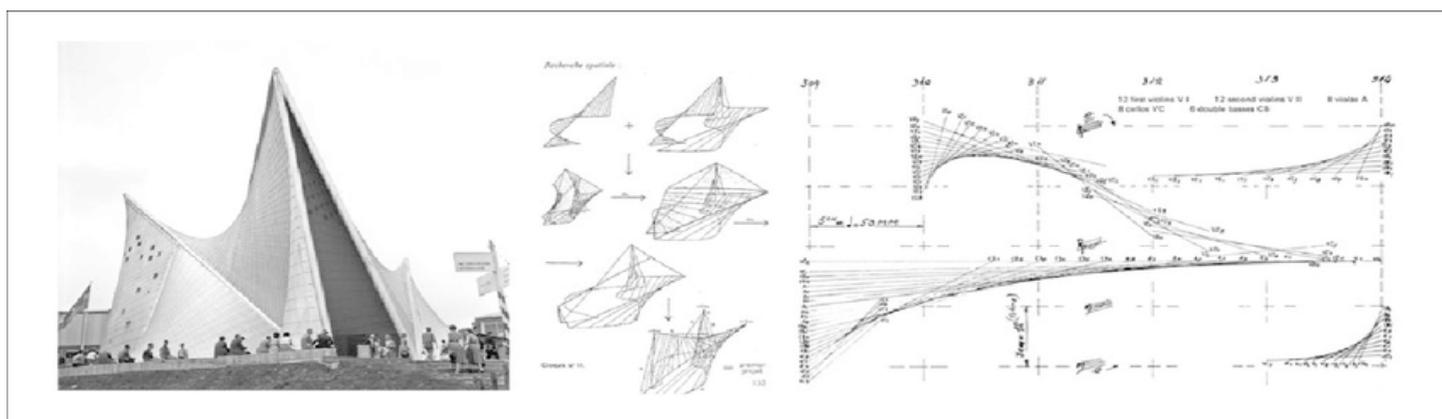


Figure 11: The process of forming Philips Pavilion from the Diagram of glissandi Metastasis through the modular geometry of Le Corbusier [28].

As a conclusion: It can be said that Xenakis has lifted the ancient Pythagorean idea of numerical proportions as a structural bond between architecture and music to a more general level by applying mathematical and scientific ‘models’ in both arts. The Modular and the paradigm of the ruled surfaces are but two examples amongst many, and in fact the only models of an architectural nature. Although such a method might appear exotic, mystifying or mannerist, Xenakis’ application of scientific paradigms has always been pragmatic. His interest was not in the technically ‘correct’ translation of such models into music or architecture but in their expressive potential. The introduction of mathematical concepts and scientific formulas in music and art served in the first place as a generator of creativity and a means to discover new sonorities or architectural forms [27]. He declares in his book, music and architecture, the impression of geometry science in adaption of these two arts and he gives some examples of transmission of music to architecture in his own works and other architects. The interesting point here is that he claims in the last part of his book that the relationship between music and architecture is an implicit and virtual not an explicit relation [14].

CONCLUSION

From past to present time there has been a continuous and deep conceptual relationship between music and architecture. Whereas the recognition of the modality of atmosphere creation in both arts and best recognition of aesthetic issues in art and understanding inner concepts made by past artists can help modern artists with this definition that the beautiful art work is something that can present the largest amount of discipline with least amount of signs. But beauty cannot only be acquired from discipline and principles but it is the result of two contradictory features that both are important the same each other. A successful art is an art that creates a mutual dialogue between mind and the mental challenges and creates reflections out of them. This relationship is often resulted out of incomplete analysis of effective powers. A combination which is thoroughly arranged and united is a boring combination. A successful artist is a person who can induce the feeling of discipline and correlation and at the same time interferes unexpected themes in his artwork. The main role of music is to impress the soul through the center of emotions and feelings. Music is a specific type of energy that is formed in the artist’s mind and the artist or composer epitomize that when forming the artwork. As a result the form of music and its effects in a special way is dependent to composer but he is in a close

relationship with the musician, musical instrument, spectator and environment. Environment includes two parts; place and atmosphere. The architect expands his thought basis through listening to the music of environment (understanding the atmosphere) which is in communication with human soul and God given consciousness in a way that he can epitomize the environment music in the form of architecture and combination of perimeters and shapes. Hence an architect should first understand the environment music of the plan and then based on that, build up his architecture. As a result, comprehension of music directly effects on creation of an artwork. It is not unexpected in a time duration that an architect can be a professional music auditor. Based on this idea the different eras before and after modernism can be evaluated in future studies separately and extensively and with a comparative evaluation about the atmosphere of these two arts in east and evaluation of architecture atmosphere and the music atmosphere in eras that have been told, can be utilized in future research.

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