Gregorian Echoes: Neumatic Notation as a Possible Graphic Inspiration for the Architecture of Xenakis

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Abstract. The text explores the transfers between music and architecture observed in Iannis Xenakis, and the fundamental role that the graphic representation of notions or concepts plays in this transfer. Specifically, it focuses on how Xenakis may have been inspired by neumatic notation (a system of symbols formerly used to link melodic line to text) as a graphic resource to establish the elevations of various projects. The research takes a look at several examples where this parallelism can be found. Some of them are from the early period when the Greek architect collaborated with Le Corbusier, like the nursery school in *l'Unité d'Habitation* in Rezé-lès-Nantes; Others, like the vacation house in Amorgos, are more recent.

Keywords: Music · Architecture · Xenakis · Neuma

1 Introduction

Iannis Xenakis' (1922–2001) musical training began at home. His mother provided him with his first instrument, a flute, and encouraged him to listen to music of various genres on the radio (Kanach 2009). After her death, his fondness for music continued during his years in Greece, as Xenakis stated in an autobiographical note: "one day I heard Beethoven's Fifth Symphony, which struck me like an Apocalypse" (Montassier 1980, p. 217). But it was not until his adolescence that he developed his musical ability by studying counterpoint, harmony, and orchestration. During his youth, he was also interested in philosophy and ancient literature, as well as other scientific branches such as mathematics, physics, and astronomy (Kanach 2009).

In 1940 he began studying engineering at the Polytechnic School of Athens, graduating in 1947. Xenakis had planned to continue his training in the United States, but he first went to Paris. He stayed there longer than expected (Montassier 1980). Shortly before leaving the Greek capital, the same year of his graduation, Xenakis had managed to resume his musical studies, and when he was in Paris he enrolled in the music conservatory there. He received lessons from important figures such as Bounlanger and Honneger (Kanach 2009, p. 20). Despite his enthusiasm, the fact that he had not previously acquired sufficient practice either as a composer or as a performer, caused the

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rejection of his mentors. However, Olivier Messiaen, one of the most innovative figures of this conservatory (Frampton 2001, p. 145), encouraged Xenakis to continue his education advising him not to return to traditional studies, but to continue listening to music and composing (Kanach 2009, p. 20). Between 1953 and 1955 Xenakis composed *Metastaseis*, and it was his first important orchestral work (Xenakis 1967).

Despite this support and his determination to train as a musician, Xenakis did not abandon engineering. His recently obtained degree allowed him to apply for a position in Le Corbusier's studio on Rue de Sèvres (1947–1959), as "an engineer who became a musician and is now working as an architect" (Le Corbusier 1955, p. 326).

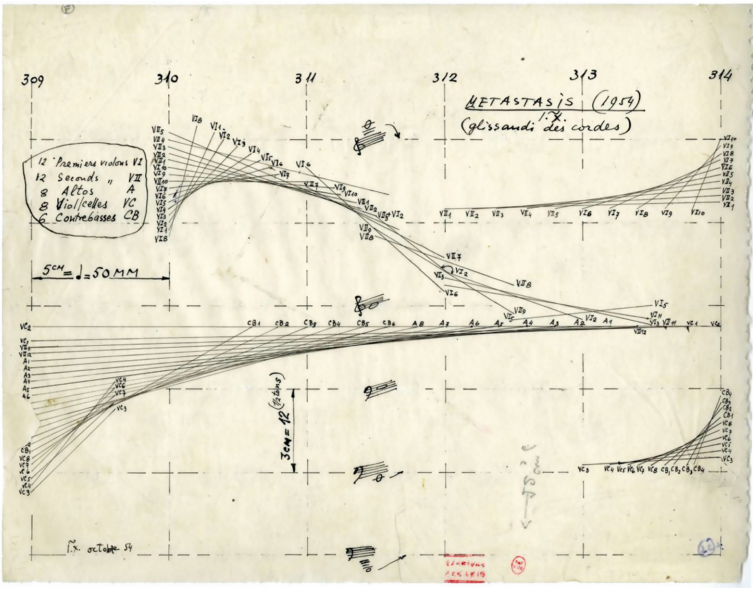

Fig. 1. Xenakis, I., study for Metastaseis glissandos, complete scheme of hyperbolic paraboloid formation by all voices, 1954 (Kanach 2009, p. 145).

Once there, he began to work making calculations, but gradually received permission to explore the more creative side of architecture (Matossian 1981). His musical training was present in his creative process, and it set him apart from the other architects of the time. Although this process was personal, he shared it with Le Corbusier, in whose studio he collaborated on works as diverse as *l'Unité d'Habitation* de Rezé-lès-Nantes (1950–1954), the *Convent of La Tourette* (1953–1961), and the *Philips Pavilion* (1956–1958). During these years, Le Corbusier organized his collaborators into four categories: draftsmen (*calqueurs*), designers (*dessinateurs*), planners (*projeteurs*) and execution managers (*chefs d'execution*). The latter were the ones who assumed full responsibility for the development of the projects. Xenakis was appointed *chef d'execution* for the Convent in 1954 (Virseda 2014, p. 481).

However, after disagreements arose in the course of designing the *Philips Pavilion*, Xenakis chose to continue his career alone (Solomos 1996, p. 24), rejecting Le Corbusier's offer to become the head of the Atelier (Kanach 2009). Music became increasingly important in his life, which would prevent him from dedicating all the time and attention that, in his own opinion, the architectural profession demanded.

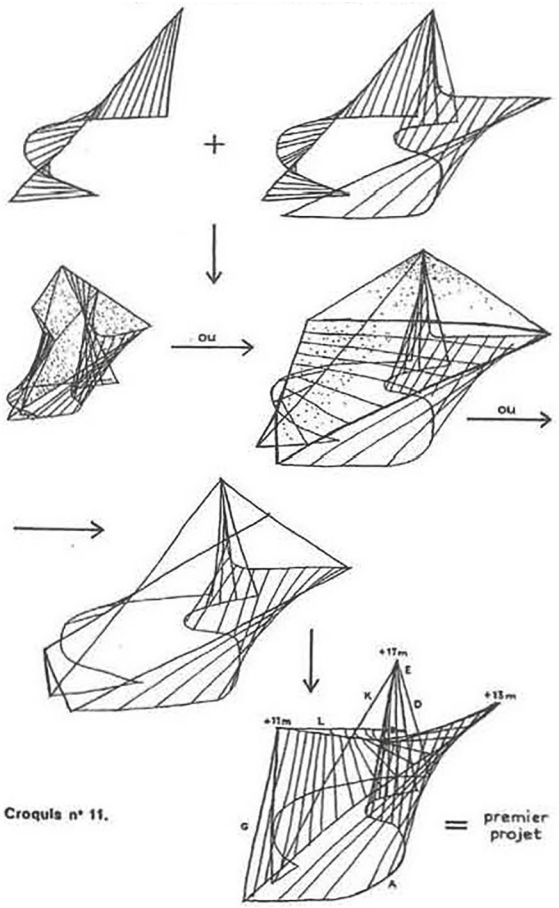

Fig. 2. Xenakis, I., steps in the development of the first design of the *Philips Pavilion*, 1956 (Kanach 2009, p. 172).

Despite his plans to devote himself exclusively to music (Kanach 2009), Xenakis developed a series of smaller projects that he called *politopos* ("various" (polis) "spaces" (topos)). This was a new design concept that approached the Wagnerian idea of *gesamtkunstwerk*, or total work of art (Özcan 2013). In the 1960s and 1970s, he also carried out several housing projects (Kanach 2009, pp. 426–427). He continued with this activity until the end of his days, and never ceased in his efforts to transfer forms and ideas between the arts.

With all this in mind, the main purpose of this text is to delve into how graphic re-presentation became one of the main tools that allowed Xenakis to make these conceptual transfers between music and architecture. Or how these tools allow us to make such transversal approaches to his work. The connections he established between the *Fibonacci* series and the rhythms of the undulating panels of the *Convent*, or the *Metastaseis* glissandos and the ruled surfaces of the *Philips Pavilion*, have been extensively studied (Solomos 1996; Frampton 2001; Boesiger 1999). However, this paper focuses on a relatively unexplored avenue, that of relating the neumatic notation of Gregorian music (Burkholder and Grout 2005) to some of Xenakis' design proposals.

2 State of the Art

Some transfers between architecture and music in Xenakis' creative process have been revealed by the author himself (Xenakis 1963), as shown in the famous sketch published in 1954 (Figs. 1 and 2). In this drawing, the distribution of voices in the last bars of *Metastaseis* (Xenakis 1967) is transformed into the hyperbolic paraboloids of the pavilion roof through graphic analogies Xenakis observed between the score of the musical composition and the project's plans (Martínez 2009; Solomos 1996). In addition, Xenakis translated Le Corbusier's wish for the pavilion's floor plan to resemble a bottle or a stomach (Fig. 3), with an entrance and an exit of similar size, into another musical analogy (Treib 1996). In this case, it corresponded to the beginning and end of *Metastaseis*, where all 61 instrumentalists begin and end playing G note (Roca 2021).

Fig. 3. Preliminary sketch by Le Corbusier for the Philips Pavilion (Kanach 2009, p. 172).

Around 1976, Xenakis was commissioned to design a small pavilion to be installed near the *Georges-Pompidou Art Center* (Kanach 2009). The proposal, which he called *Diatope*, combined the idea of hyperbolic paraboloids, tested in the *Philips Pavilion* (Le Corbusier 1958), and the experience acquired in the *Polytopes* (Quiroga 2015), where he tried to combine as many concepts from different artistic disciplines as possible. Light, sound and architecture were blended in this type of projects (Harley 2004; Rastoin 1978). In the *Diatope*, he also added ideas gathered after reading various philosophical and scientific texts (Kiourtsoglou 2017; Roca 2021).

Another connection already pointed out between music and architecture in Xenakis' work is embodied in the sketch made for the elevation of the *Convent of La Tourette* (Xenakis 1987). Once again, the graphic language allowed this conceptual transfer. The fading of some shading resulted in the separation where the mullions of the stained glass windows were placed (Fig. 4). Xenakis later turned to this idea, when designing *the*

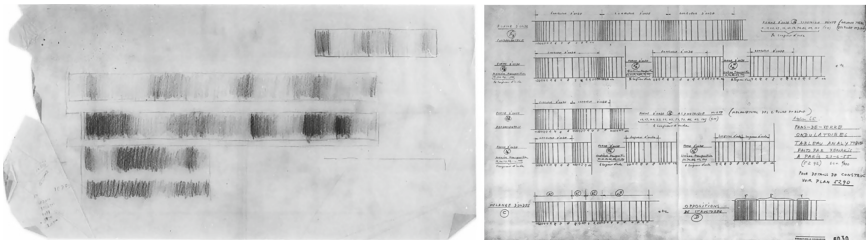

Fig. 4. (left) Xenakis, I., Rhythmic scoring of the wavy glass panels for the *Convent de la Tourette*, ca. 1955 (Kanach, 2009, p.77); (right) Xenakis, I., table with progressions of rectangles with increasing widths, based on the Fibonacci series, 1955 (Kanach 2009, p.72)

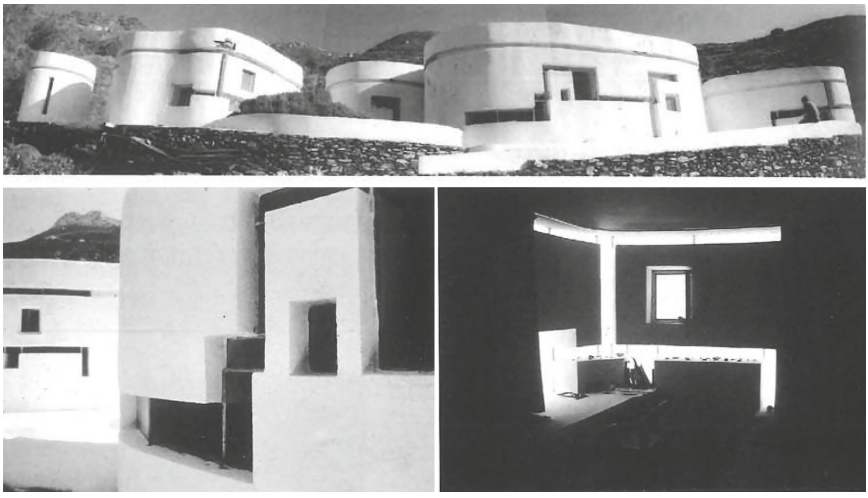

Fig. 5. Xenakis, I., photographs of François-Bernard Mâche's vacation home, 1966–1977 (Kanach 2009, pp. 250–251).

House of Culture in Firminy and in his project for a house for Mâkhi Xenakis (Sterken 2007).

In this context, and after the analysis of several authors (Harley 2004; Kanach 2009; Sterken 2007; Solomos 1996), we find a somewhat less studied linkage, suggesting the similarity between *neumatic* notation and other features present in some of Xenakis' architectural works, such as *François-Bernard Mâche's vacation home in Amorgos* (1966–77) (Fig. 5)*, René Schneider's sheepfold in Corsica* (1974–76), and *the residence project for Karen and Roger Reynolds in Borrego Springs* (1984–92).

This link can be seen in the elevations of the nursery school of the *Unité d'Habitation de Rezé-lès-Nantes* (Fig. 9) and also in a hidden part of the *Convent of La Tourette*, in the coffer covering the stairs that connect the living area to the roof (Fig. 6) (Kanach 2009).

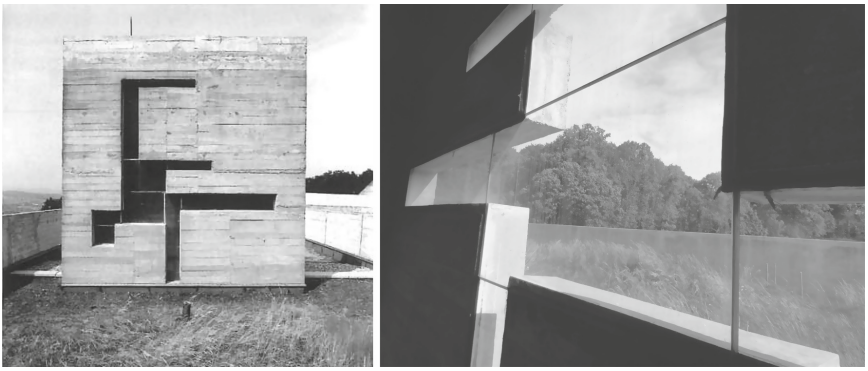

Fig. 6. (Left). Exterior view of the rooftop coffered staircase of the church of the *Convent of La Tourette* (Kanach 2009, p. 9); (right) interior view (own elaboration).

This gesture is not prevalent in the monastery itself nor in later works on which Xenakis collaborated with Le Corbusier, so it seems to remain in a state of latency until the Greek architect built the aforementioned dwellings.

3 Deciphering the Principles of Neumatic Notation to Decode a Graphic Transfer

Neumatic notation was mainly used between the ninth and thirteenth centuries to transcribe sounds to the text of a musical composition before baroque notation, which still survives today, became widespread. The term *neuma* comes from the Greek πνεῦμα and alludes to the spirit, breath and respiration (Morales 2018).

This notation method has certain limitations when transcribing music since it did not graphically specify the duration of the notes and, consequently, neither the rhythm nor the tempo of the composition could be read. The graphs specified the number of sounds and the way they corresponded to the lyrics and tones of the melody, but they could not be deciphered if the melody was not previously known (Morales 2018).

The neumas corresponded, imperfectly, to the low and high *accents* of the Latin words in the text and represented melodic turns of phrase. The imprecision of this system led to a certain degree of improvisation and inaccuracies, and it relied to a great extent on the musician's memory (Michels 1982; Pajares 2014).

Initially, the neumas did not have any line of reference, but little by little, copyists began to draw a horizontal line on the parchment corresponding to a particular note (Fig. 7). The lack of precision was thereby reduced as all the neumas were positioned in relation to that line (Burkholder and Grout 2005).

Later, Guido of Arezzo perfected musical writing with the *tetragram*, the most direct precedent of today's *pentagram* (Hoppin 2000).

The graphic representation of these neumas can be described as a set of small pen strokes that appeared next to the words and progressively evolved into a square notation (Fig. 8). There was no fixed system of neumatic writing since the script changed from

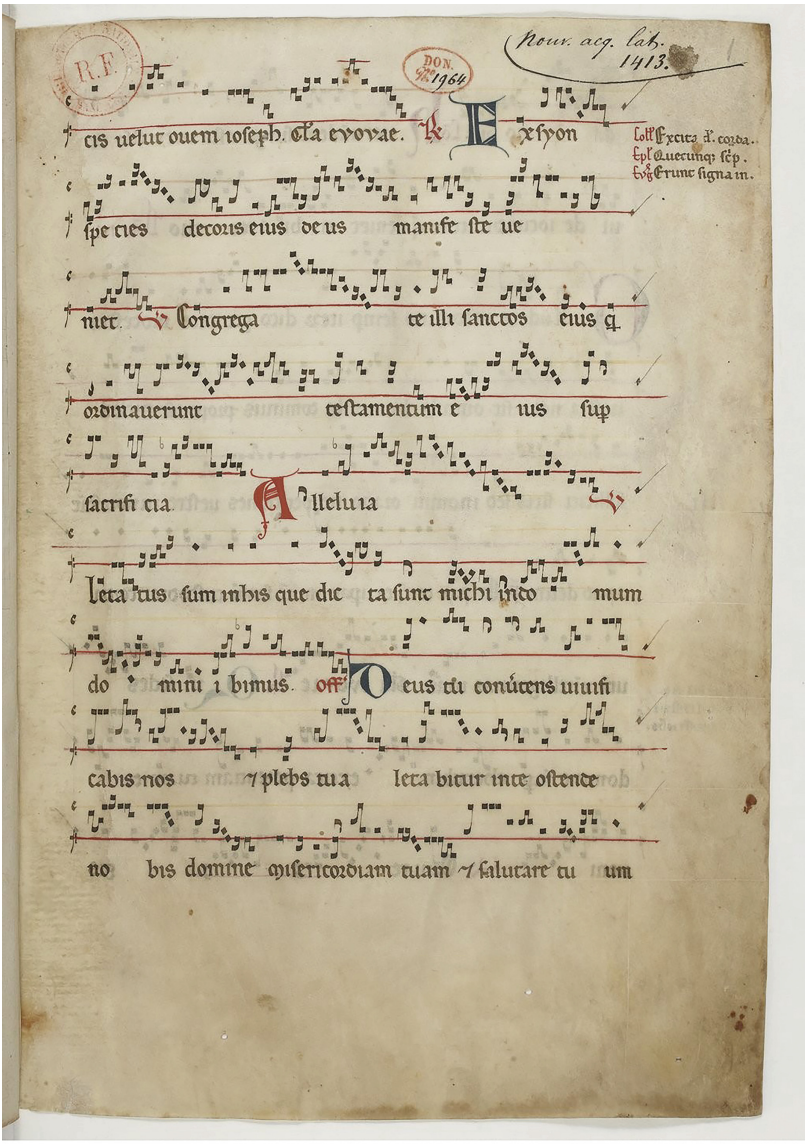

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Fig. 7. Cistercian Gradual S. XII (Paris BnF, NAL 1413, fol. v.8, retrieved from https://gallica.bnf.fr/ark:/12148/btv1b8432455v/f11.item)

EXAMPLE E. TABLE OF NEUMES

NEUME NAME	9TH TO 10TH CENTURIES	11TH TO 13 CENTURIES	IN MODERN NOTATION
Virga			
Punctum			
Podatus (Pes)			
Clivis			
Scandicus			
Climacus			
Torculus			
Porrectus			
Scandicus flexus			
Porrectus flexus			
Torculus resupinos			
Pes subpunctis			

Fig. 8. Types of neumas according to their geometry (from www.auladelenguajemusical.wordpress.com)

one region or country to another during the same period. We can even find variants of the same sign in a single manuscript (Morales 2018, p. 22).

4 Graphic Documents for a Conceptual Transfer

Xenakis probably came across compositions written with these graphics while training as a musician, as they were often illustrated in books on musical history. Furthermore, Messiaen, his mentor, had already composed a study entitled *Neumes Rythmiques* (Messiaen 1949) in which he attributed duration and sound intensity to neumatic symbols (Messiaen 1994). Most likely Xenakis could have resorted to these images or Messiaen's experiences consciously or unconsciously to try out new transfers between music and architecture.

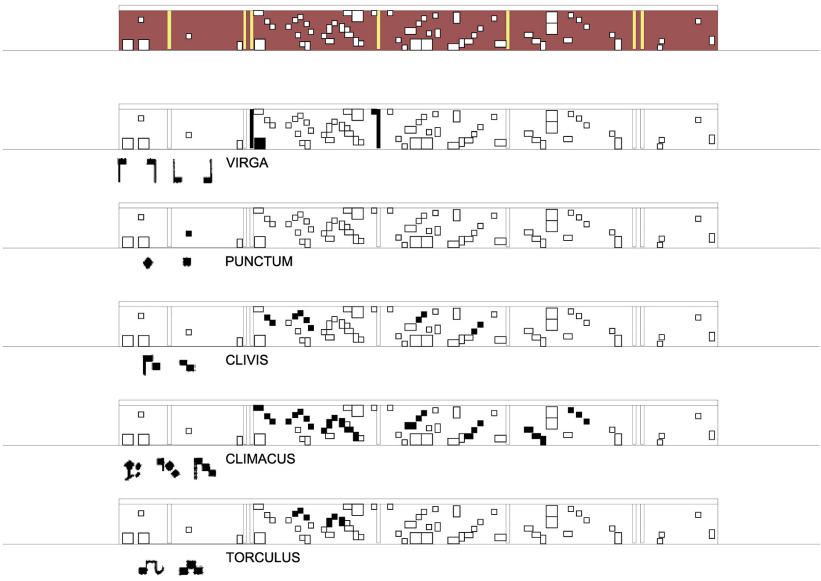

Fig. 9. Fig. 9 (top) West elevation of the nursery school of the *Unité d'Habitation* de Rezé-lès-Nantes (own elaboration from the Fondation Le Corbusier, file no. 1755); (bottom) series of drawings showing the analogies between the pneumatic language and the arrangement of the openings in the same elevation (own elaboration).

Proof of this can be found in the sketches Xenakis drew for the façade of the nursery of the Nantes *Unité d'Habitation.* In sketch FLC1755, certain parallels can be established between some of the most common positions of the neuma and the location of the openings in that part of the building (Figs. 9 and 10).

Thus, the geometries drawn by Xenakis in this sketch can be described as a supeimposition of neumatic notation motifs, such as the *punctum* (which is a specific position of a pitch in a composition, of short duration), the *virga*, (a *punctum* of longer duration), the *clivis* (two notes linked with a tonal descent), the *climacus* (neuma of descending three notes), and the *torculus* (neuma of three sounds where the central one is sharper than the rest) (Morales 2018). As a whole, the proportions, spacing, and relative position of the openings of this façade clearly evoke these scores.

The vagueness of this notation could be one more reason for Xenakis to continually develop these initial explorations until they became the final design of the façade. As they also appear in the façade of the nursery of the *Unité d'Habitation de Firminy*, they become a reocurring theme in these spaces used for children's education and recreation.

5 An Elevation as a Trace of Habits

Later works by Xenakis, such as *François-Bernard Mâche's Vacation House* (1966–1977), *René Schneider's Corsica Cottage* (1974–1976), and the *Reynolds House* at Borrego Springs (1984–1992), share a remarkable feature that is especially visible in their elevations.

Fig. 10. Exterior and interior photographs of the east elevation of the nursery school in the *Unité d'Habitation de Rezé-lès-Nantes* (own production).

In these buildings, broken orthogonal lines unfold on curved walls from floor to ceiling and from one end to the other. They are drawings of great geometric abstraction which, when seen developed on the plan, refer to a legible sequence where several lines of reference can be traced (Fig. 11).

The *Vacation House for Fraçois Bernard Mâche* in Amorgos consists of three rooms (four in the initial version of the project, dated 22 March 1966), each of which constitutes a part of the whole (Figs. 11 and 12). Mâche claims that the design of the façade openings is a play on the owner's initials (especially the letter F for François Bernard-Mâche, see Fig. 12). Also there is a 40 cm-wide skylight that is like a path that divides the rooms, and that seems to be an evolution of the light projected in the *Convent of La Tourette* (Kanach

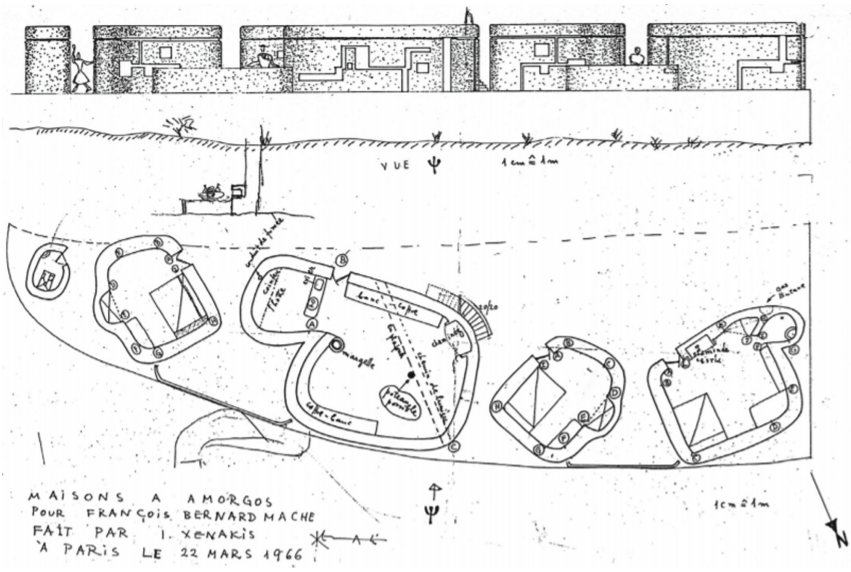

Fig. 11. Xenakis, I., elevation and floor plan of a *House for François Bernard-Mâche* in Amorgos, 1966 (Kanach 2009, p. 248)

2009). But once again the design of the openings recalls the graphics of the neumatics. The neumatic vein seems to make up a group of enigmatic calligraphic games.

The graphic documentation of the initial project, the numerous photographs of the interior of the main room of the house, and some current research work (Kanach 2009; Kalfa and Papavasileiou 2015), allow us to specify a diagram of the morphology, position

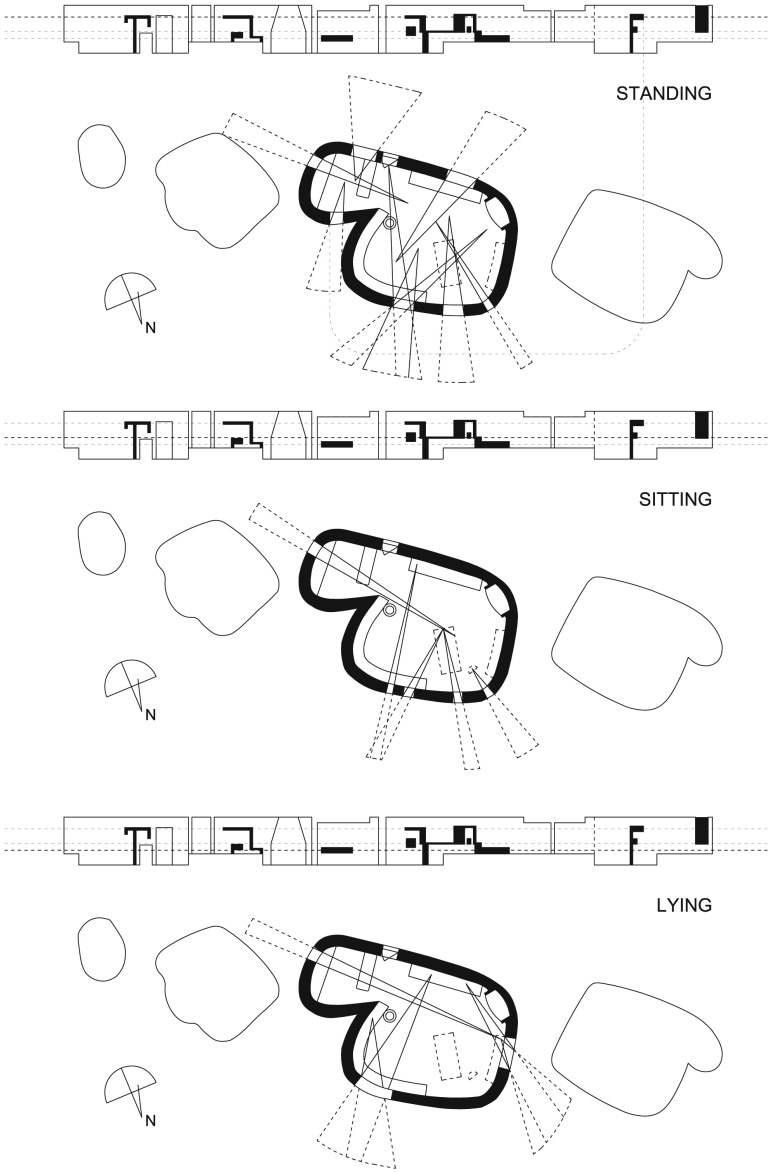

Fig. 12. Diagrams of the visual relations from inside the main room to the distant landscape, depending on the eye level: unfolded interior elevation (own elaboration).

and height of the openings in relation to the furniture, establishing three possible positions for the inhabitant: reclining, sitting and standing (Fig. 12).

If we focus on the visual relations between the interior and the distant landscape (the mountain to the south and the sea to the north), we see the enormous versatility that neumatic schemes provide: the landscape framed by vertically proportioned openings, the landscape seen at eye level by a person reclining on the built-in benches, or horizontal openings at the eye level of a moving person.

The arrangement and height of the openings in the interior spaces seem to register the position of the inhabitant's eyes in relation to the exterior, to the landscape, or to the light coming from outside. Moments when the inhabitant is seated or reclining correspond to larger, lower openings (moments of pause). The inhabitant's movements around the space correspond to elevated, horizontally slanted openings at eye level. The fact that the floor plan of the rooms has rounded corners helps to reinforce this sense of continuity and lack of dividing lines. It suggests a more indeterminate tempo (similar to Gregorian chants), marked by the life of the house's inhabitant.

6 Conclusions

We have described the context in which Iannis Xenakis' creative activity developed, characterized by a constant transfer between different artistic disciplines and focusing on the way graphic representation can be used as a tool for these transfers between music and architecture.

After reviewing the conceptual transfers between the discipline of music and architecture based on the graphic language in the *Philips Pavilion*, the *Convent of La Tourette* and the *Diatope* polytope, the study identifies a possible correspondence between neumatic writing in music and the design and organization of the openings in the façades of several of Xenakis' architectural projects. This correspondence is not specified by Xenakis in his texts, so it could be focus of further research. We have been able to verify that in 1949, Xenakis' mentor Messiaen, worked with these concepts in his musical piece entitled *Neumes Rythmiques*. Besides, it is possible to provide arguments based on the relationships between existing graphic documents and our own drawings. In any case, identifying this analogy can serve as a tool for analysis or to generate creative or compositional arguments linking architectural and musical graphic expression.

A review of the elevations of the nursery school of *Nantes Unité d'Habitation* and the *House in Amorgos* suggests that the geometry of the neuma was a source of inspiration (consciously or unconsciously) for Xenakis since his earliest designs. However, we can recognize an evolution in the way of handling this geometry from Nantes to Amorgos. If it is easy to identify the different types of neumas in the nursery school, the final design in the house has undergone so many variations that it is difficult to relate to the original neumas.

On the other hand, in the elevations of the nursery school, the arrangement of the neumas gives rise to an apparently more random organization of openings which, although it qualifies the interior space, does not establish a direct connection with specific functions of the space. In the house, however, the openings seem to be linked to furniture and possible interior functions. It could be said that, when a façade of this type is inhabited

by a domestic program, where the relations of proximity are stronger, this freedom is specified, finding arguments to be determined in its design. Here Xenakis employed the language of neumas with greater freedom (but in a more literal way, from a formal point of view) in the nursery school than in the reduced domestic space, where he shows a greater commitment to its function. Nevertheless, the result still shares this calligraphic character, with the presence of *punctus*, *clivis,* and *torculus*, as well as some new linear connecting elements, especially those of horizontal development.

Apart from the purely graphic analogy, the study has provoked other analogies. We speak about the indeterminacy of neumatic writing with respect to rhythm and the freedom with which the openings are arranged. The inexact *tempo* of the inhabitants of the house, the routines altered by the particular circumstances of each day but with a cyclical beginning and end, as well as the transit of sunlight throughout the day, can be related to the variability of the inexact transcriptions of neumatic writing. Neumatic notation and musical interpretation, as well as façade drawings and the way of inhabiting the house, are in some ways similar.

If in the *Convent of La Tourette*, Xenakis transfers problems of musical rhythm to architecture, and in the *Philips Pavilion* the issue is to move from one point to another without interrupting continuity, the elevations reflect a lack of definition or freedom of interpretation, either by the interpreter or the user.

The graphic documents, placed next to each other, accentuate this parallelism.

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