



Identifying Architectural Affiliation Forms of the Campus University of Blida 1, "Saâd Dahleb", (Arch. Walter Netsch; 1981– 1989)

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Abstract

During the mid-20th century, Walter Andrew Netsch, an American architect, introduced a groundbreaking conceptual method called the Theory of Fields. This approach focused on networks and the manipulation of geometric frames. One of his several undertakings included the construction of the University of Blida in Algeria during the early 1980s.

This article is focused mainly on a geometric analysis of the main sections of the building's structure. Its objective is to identify the numerous mathematical relationships, geometric transformations, and other components that regulate the project in its entirety. Therefore, it appears that the University of Blida includes several concepts outlined in the architect's innovative approach to architectural composition, which incorporates components of traditional architecture.

Advanced geometric practice has shaped a mathematical structure that serves as the university's compass. The latter is derived from a scholarly collection of square combinations that use ratios of 1/2 and 1/5 and a geometrical framework based on the series of Fibonacci numbers.

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Keywords

Architectural Approach; Field theory; Mathematic nexus architecture; Architectural and Aesthetics Features; Casbah of Algiers Architecture.

1. Introduction

Located in the commune of Oued Yaich in the wilaya of Blida (Algeria), the "Saâd Dahlab" University was designed at the end of the 20th century by the American agency S.O.M (Skidmore, Owing & Merrill), while the Structuralist movement tended to assert itself throughout the world. Following its independence in 1962, the country underwent a major reconstruction phase that opened up a new field of experimentation for many architectural agencies and offices (Chaulet, C. & Chaulet, P.,2012). Walter Andrew Netsch, the architect in charge of the project, was recognized for his groundbreaking Field Theory design method in the mid-20th century.

The latter is based on a combinatorial process that, from a basic pattern resulting from the superposition of a square and a square oriented at 45° , allows to generate an infinity of geometric grids, extensible to infinity. (Jones, 1990) The architectural composition of a building is based on these frames, which provide a continuous and homogeneous proportion system that can be expanded infinitely. Aiming to schedule an architectural design and allowing it, in theory, to evolve and adapt over time, the approach developed by Netsch seems to join the thought of the Structuralist movement of which it incorporates some major notions: «growth», «articulation of the built mass» and «the part and the whole» (Lüchinger, 1981).

The Blida university's conception in Algeria was based on geometric and mathematical laws that govern the various parts and the whole (Netsch, 1980). In light of this observation, it is essential to question the geometric transformations and mathematical relations that enabled the campus plans to be created. This article attempts to identify the mathematical foundations that lead to the forms of “Saâd Dahlab” University of Blida. The primary objective is thus to highlight the laws (field) that made it possible to generate the various plans, namely the mass plan of the university, the plan of pavilion 26 and the structure of an architectural unit (earthenware tile), and to understand the process by which the Theory of Fields was applied. (See figure 1)

Admitting that having been designed by the architect Walter Netsch, the University of Blida, presents the application of several principles relating to structuralism and starting from the postulate that the basic pattern, at the origin of the field and managing the structure of the ground plane (infinite growth mesh), from the building to the earthenware tile, is the combination of a square and its rotation at 45° , the work developed in this essay is a qualitative study by experimentation, based essentially on a geometric analysis of the different planes (Blum,1997).



Figure 1. External view on some blocks of Blida University 1. “Saâd Dahleb” (photo. © authors)

The University of Blida was conceived in Algeria following this same *modus operandi*, a series of questions arose from which we then discovered our general problematic.

Thus, our issue is articulated through two main questions:

1. What are the mathematical principles that underlie the structures of “Saâd Dahlab” of Blida University?
2. What were the methods employed to incorporate the architectural characteristics of the Casbah of Algiers into the project's design principles?

The main objectives of our study are:

1. Acknowledge how the Field Theory was applied to our case study.
2. Collaborate in the production of historical knowledge on the works of the architect Netsch.

3. Identify the forms of architectural and aesthetic reinterpretation from the heritage of the Casbah of Algiers, which served the Netsch project.

2. The Methodology

The Field Theory approach to architectural design is based on a complex combinatorial process that typically begins with a basic geometric figure like the square. The basic pattern is created by superimposing a square and one that is oriented at 45° , starting with this regular quadrangle. The pattern obtained is then repeated indefinitely according to various axes and directions. The creation of a grid from the same basic unit can be done in this new geometric game, which is regulated by measurement reports (Massu, 1997). The architect defines moiré patterns by overlapping two or more grids. As follows: « A lattice is when you rotate a sheet that has these forms and then you put another sheet over and you draw it all over again. In fact, you draw it a third time ». (Bruegmann et al., 2008, p.75).

The final step is to superimpose the obtained mesh network on the first sketch of the project. The mesh's continuous and homogeneous proportion system enables the establishment of relationships between the parts of the plan and the whole. This conceptual approach ensures dimensional consistency at different scales, between different buildings, and between different elements of the building thanks to the multiplication or division of the initial module. (SOM, 2015) & (SOM, 2016). (See Figure 2).

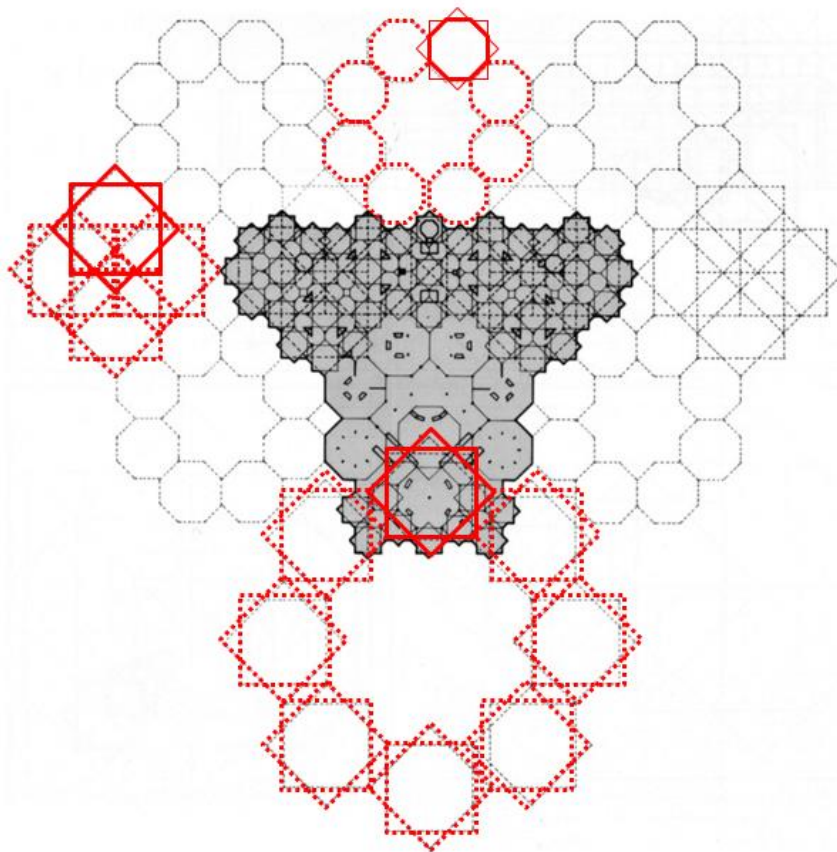


Figure 2. The behavioral sciences buildings at the University of Illinois campus in Chicago. (SOM, 2015), Plan handled by the authors.

3. The Analysis and Interpretation of the Results

3.1. The System for Determining the Block Configuration Proportions

At the level of the ground plan of the University of Blida 1, it is possible to note that all the pavilions, composing the three original faculties, proceed from the assembly of the same unit module – or block – repeated 02, 03 or 04 times; probably according to the needs and requirements of the program. The analysis of the graphic file of Pavilion 26 – the current department of dentistry of the Faculty of Medicine, and former Institute of Agriculture- allowed us to identify the various proportional relationships governing the main elements structuring the Block. (See figure 3)

The analysis performed on our case study, Pavillon 26, in 2018 indicated that the original architectural features, which have remained intact since its construction in 1982, were preserved and that no significant alterations had been made to its structure.

A block, constitutes in plan a square of side measuring 22.5 meters (measurement between axes), punctuated on its perimeter by various protruding bodies, and subdivided according to a main frame of 7.5m x 7.5 m (7.5 m = 1u) and a secondary frame of 3.75 m x 3.75 m (3.75 m = 1/2 u) strengthening the former, particularly at the level of foundations. The triangle shapes that welcome the service spaces (staircase and sanitary) are incorporated into the main frame's continuity. The diagonal of a square with 7.5 m sides is the same as their respective hypotenuse. The polygons have rounded edges that correspond to a section of a circle measuring 1.5 m (1/5 u) and which is located 3.75m from the outer edge of the perimeter wall. In conclusion, the semi-circular elements that receive the different pipes also show a half-circle that is $R = 1.5$ m. The Blocks that make up the Pavilions are governed by order ratios of 1/2 and 1/5.

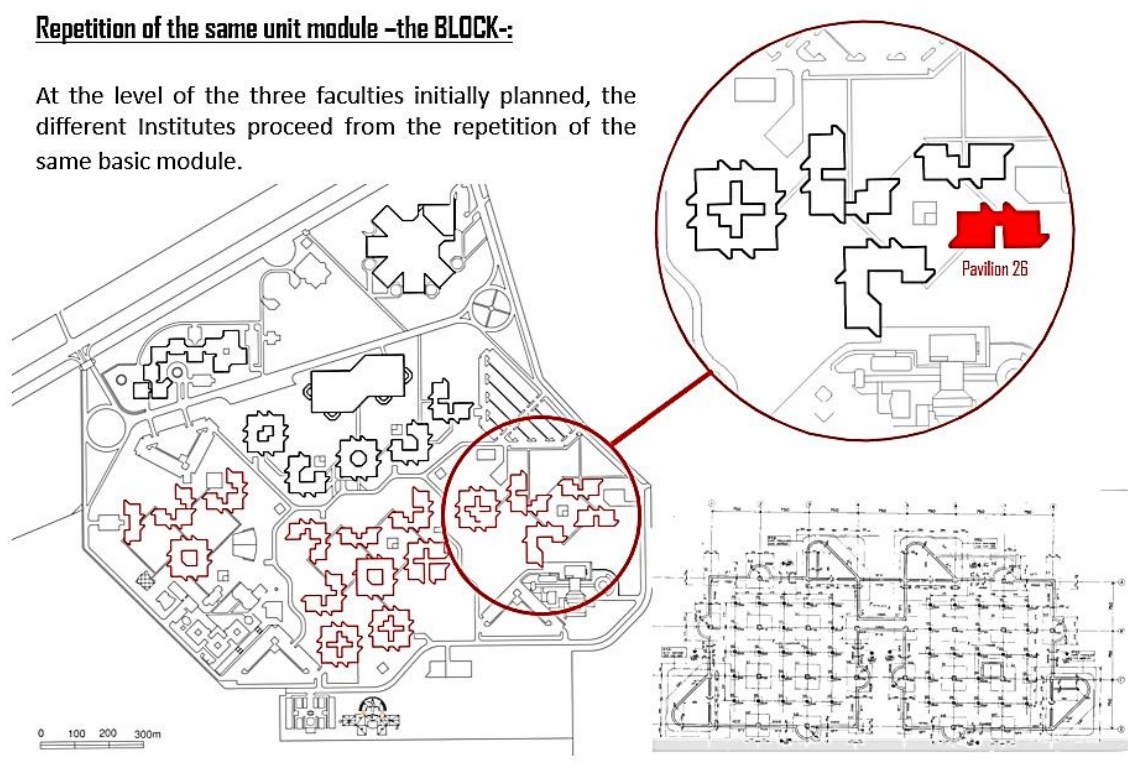


Figure 3. The genesis of the geometric shape of block (Pavillon) 26. (Chennaoui. Y, & Akeblersane. I, 2024)

3. 2. System of Proportions Governing the Organization of Pavilions within the Various Faculties.

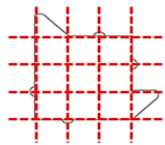
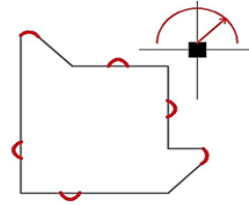
Rotating the same block from a center and successively at angles of 90° , 180° , and 270° , allows the different pavilions to be generated and up to buildings formed of 4 modules, adopting an introverted configuration; oriented around a central core taking the form of an inner courtyard served by kinds of alleys or covered passage.

The various institutes and pathways within each faculty are organized in a radio concentric scheme that occupies three successive rings, starting from these central pavilions. The centres of the pavilions and paths describing the same circle draw a series of nested squares, each following a geometric sequence of expression: $C_n = (1/2) \times C_{n+1}$; such that, taken in descending order, each side of quadrilateral (C_n), is deduced by multiplying the previous (C_{n+1}) by the ratio (1/2). The institutes are organized according to a radioconcentric scheme, which is represented by a series of nested squares that are governed by ratios of the order of 1 / 2. (See figure 4).

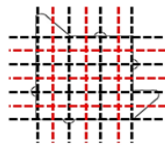
Proportion system governing the BLOCK configuration :

The Blocks constituting the pavilions are governed by order reports:

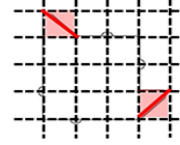
$\frac{1}{2}$; $\frac{1}{5}$ and 3.



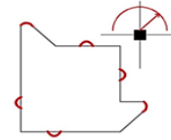
7.5 m 1 u



3.75 m $\frac{1}{2}$ u



3.75 m $\frac{1}{2}$ u
1.50 m $\frac{1}{5}$ u

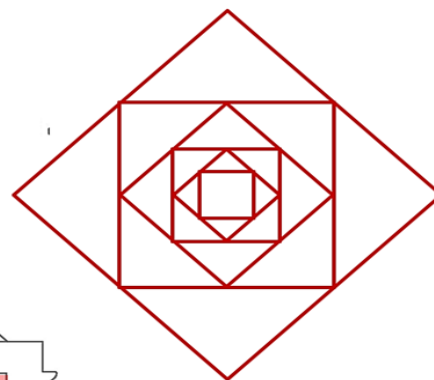


1.50 m $\frac{1}{5}$ u

System of proportions governing the organization of pavilions within the various faculties :

At the level of each faculty, the institutes are organized according to a radioconcentric scheme, drawing a series of nested squares governed by ratios of order of:

$\frac{1}{\sqrt{2}}$



$C_n = (\frac{1}{\sqrt{2}}) \times C_{n+1}$

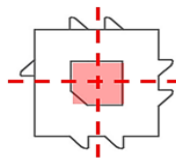
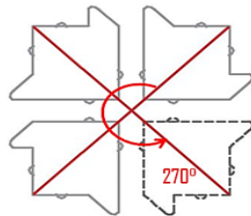


Figure 4. System of proportions governing the organization of blocks (pavillons) within the various faculties.

(Chennaoui, Y., & Akeblersane, I, 2024).

3.3. System of Proportions Governing the Composition of Earthenware Tiles

At the University level, the outdoor spaces are decorated with earthenware tile decors featuring geometric patterns and arranging mainly according to 02 compositions: a first taking a nearlyprismatic, as well as a second based on a quadrangular pattern that we will try to analyze here. Each of the two configurations rests on the same base tile constituting a side square measuring approximately 14 cm (1 u), subdivided into a series of triangles whose proportions are in scale ratios (1; 1; 2) and (1; 2; $\sqrt{5}$)

The rotation of the unit tile generates a helix pattern in the second composition, which is enhanced by the choice and application of four shades. The composition is comprised of nested squares that are interwoven based on mathematical and geometric proportional relationships. A square side equal to 2u is defined by the arrangement of the four tiles in the pattern. A second square rotated at 45° and with side 2 u is inserted within the preceding expression established upstream: $C_n = (\frac{1}{2}) \times C_{n+1}$. A third square, on the side 2 5 u (or (1/ 5) on the side of the first square) is then generated by the intersection of four segments connecting each of the vertices of the initial square to the side opposite it. In the end, the quadrilateral with sides 4 and 5 u is a quadrilateral that is visually divided by white triangles.

The decorations in earthenware tiles at the outer spaces of the faculty are based on patterns governed by ratios of proportions of order: 1/ 2 and 1/ 5. (See figure 5).

System of proportions governing the composition of earthenware tiles:

The decorations in earthenware tiles in the outer spaces of the faculty are based on patterns governed by ratios of proportions of order:

1/2/1/5

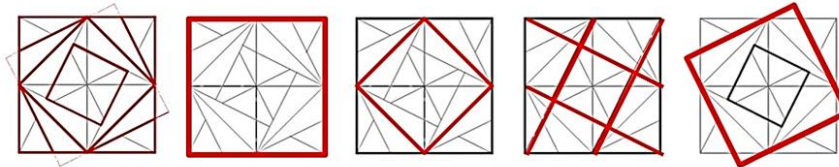
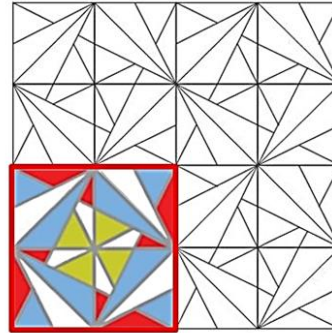
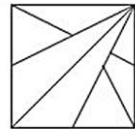


Figure 5. System of proportions governing the composition of earthenware tiles. (Chennaoui. Y, & Akeblersane. I, 2024).

4. Discussion.

In addition, we incorporated a theoretical framework based on the Fibonacci digital system, which was explored and developed in Algerian projects by architect Walter Netsch. We identified a basic pattern from various geometric manipulations, surrounding the Fibonacci suite, using a grid published by SOM on an internet platform. (SOM, 2016).

Fibonacci series is a theoretical field that relies on the mathematical system of Fibonacci (1, 2, 3, 5, 8, 13, 21, 34, etc.) and has numerous variations. The system is currently being explored for projects in Algeria where Fibonacci developed his mathematical system.” (SOM, 2016).

From a unitary central square, it is then possible to draw a first grid, following the growth system of the suite, and which will serve as a support for the initiation of a first spiral of Fibonacci – a spiral approaching the golden spiral. Three repetitions of the process were made with successive rotations at 90° around the same unit quadrilateral, which resulted in the formation of the pattern's distinctive helical structure. The four primers obtained in turn define a second square, tangent to the different vertices generated by the curvature of the spirals and whose side is equal to three times the side of the central square, then a third square, rotated at 45° and determined by the extension and intersection of the propeller arms. Different lines and segments, including diagonals and mediators, are used to form the divisions and subdivisions of the four main quadrilaterals and form the remaining details of the pattern. (See figure 6).

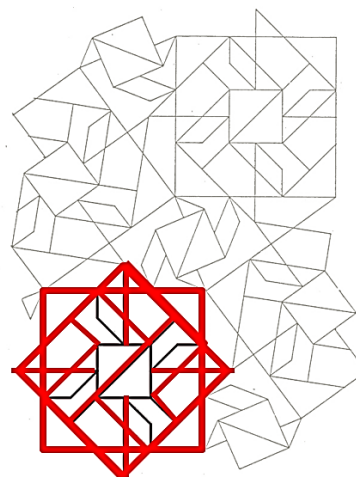
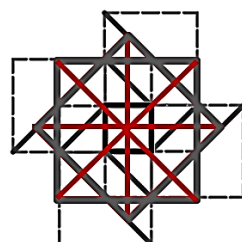
Fibonacci's follow-up :

(0 ; 1 ; 2 ; 3 ; 5 ; 8 ; 13 ; 21 ; 34 ...)

Increasing sequence of integers defined by recurrence, according to the expression:

$$F_n = F_{n-1} + F_{n-2} \text{ for } n \geq 2$$

with $F_0 = 0$
 $F_1 = 1$



FIBONACCI SERIES © SOM

Figure 6. Identification of the usage of Fibonacci Suite in the architectural grid design. (Chennaoui. Y, & Akeblersane. I, 2024).

It is possible to identify many analogies by superimposing the resulting pattern and adapting it to the plan of one of the original three faculties. Firstly, the unitary (or central) square of the pattern defines the inner courtyard, which is the core of the building. Second, the main square of the pattern delimits the frame of the main structural grid of the pavilion (that of 7.5 x 7.5m), extended to include the basic triangles intended to accommodate the service spaces. The primers of the four propellers, forming the square oriented at 45° of the patterns, define the hypotenuse of one triangle on two and thus determine the inclination of the elements in front integrating the vertical circulation. Finally, the main divisions of the grid pattern (diagonal and median) define the elements and supports on which the fundamental geometric manipulations to compose the pavilions are based. The diagonals and mediators represent the axes that divide the building into four blocks and determine the center and angle for generating them from a first.

The pattern thus repeated makes it possible to generate different pavilions and pathways connecting them. The University of Blida 1 Saâd Dahlab seems well underpinned by a structure ensuring the coherence of the whole and articulating the parts and the whole. The institution develops at different scales according to the same scheme, similar to fractals, with the aim of creating various subsets based on a logic that involves organizing spaces around a central core. (See figure 7)

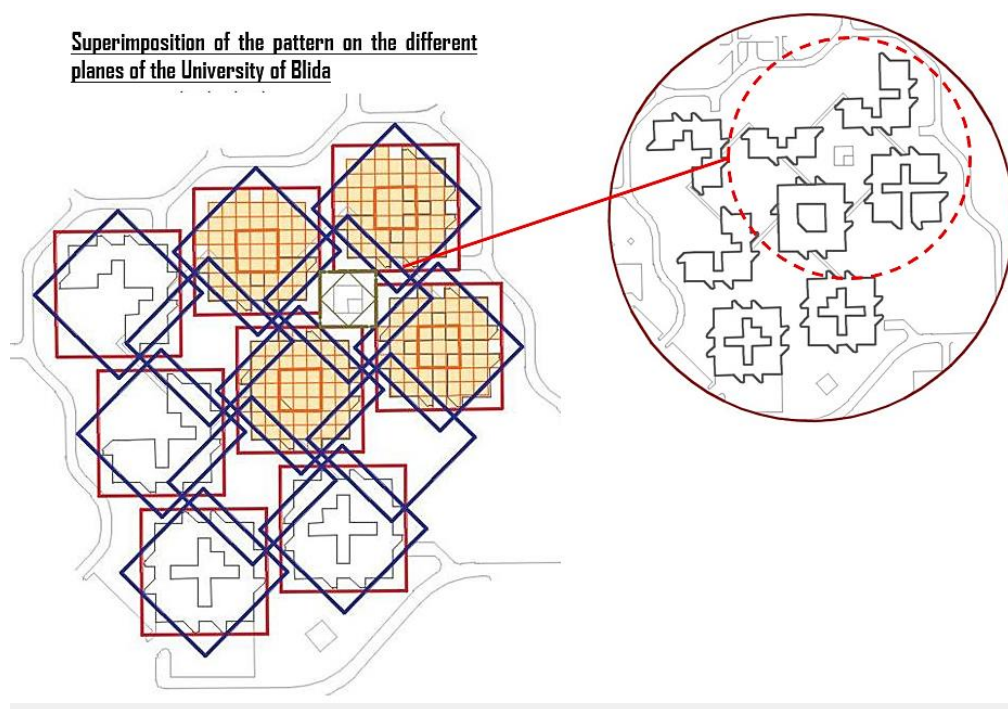


Figure 7. Superposition of the pattern of the different plans of the University of Blida. (Chennaoui, Y., & Akeblersane, I, 2024).

Walter Netsch has profoundly impacted modern architecture with his groundbreaking design methodology, termed Field Theory. His significant designs encompass the University of Illinois at Chicago (UIC) Campus (1965), where he emphasised functional clusters of buildings that facilitate user interaction. The University of Illinois at Chicago (UIC) campus design by Walter Netsch was influenced by early Greek and Gothic buildings as well as the DNA double helix. The Behavioural Science Building, Science and Engineering South, and Architecture and Design Studios Building were among the first designs, with elaborate floor plans. Netsch changed the campus's layout in spite of early criticism in order to improve accessibility and usage while addressing difficulties with upkeep and inadequate finance.

Walter Netsch's designs for the University of Illinois at Chicago (UIC) campus and Blida Campus University in Algeria are testament to his Field Theory architectural approach. Netsch's dedication to community engagement and geometric complexity is evident in the designs of these campuses, which incorporate his innovative geometric principles. The UIC campus, which is influenced by DNA patterns and early Greek and Gothic architecture, endeavours to cultivate a sense of community and intellectual exchange through complex building arrangements.

On the other hand, the Blida Campus University likely implemented comparable geometric principles to establish a cohesive educational environment that is responsive to its cultural and landscape context. The campus boasts a series of squares that have been rotated, resulting in floor plans that resemble a labyrinth, which promotes interaction and exploration. Critics initially refer to it as "Fortress Illini" because of its elevated walkways and imposing structures. However, the design likely includes open spaces and concentrations of buildings that encourage interaction and movement, like it's was conceived in Blida university.

The effectiveness of this integration would be contingent upon the extent to which the campus promotes accessibility and engagement with its surroundings.

In general, Netsch's Field Theory approach in these two comparative cases underscores his adaptability as an architect and the significance of addressing local environments while pursuing innovative architectural solutions.

5. Conclusion

The application of field theory at the University of Blida is characterized by many characteristics, just like the projects designed by Walter Netsch. Each discipline set has a continuous and homogenous dimensional structure that allows for control over the internal dimensions of each pavilion and the articulation of different units between them. By adding identical modules, Blida University's plan is structured in a similar way to structuralist theory structures. Blida University places a strong focus on geometric order and mathematical rigor. Blida University has a framework that underpins every aspect, from the ground plan to the decor elements, and the configuration of the institutes. A system of proportions is provided to ensure that the parts and the whole are coherent. (See figures 8).

Teaching faculties are configured using an additive and modular process. The central building's core is formed by the arrangement of the different spaces, with a quadrangular inner courtyard being the first module. A radioconcentric scheme is used to multiply the obtained unit into a second module, which generates the paths and entities that host the various Institutes. The module portions are determined by the program's requirements. At different levels, it appears that the lines at the bottom of the plans are the result of a clever geometric arrangement between the square, the square oriented at 45°, and the circle. These elementary figures become complex compositions when combined using various scale ratios, which are primarily based on three numerical systems of proportion, namely the Fibonacci suite, 2 and 5.



Assembly of earthenware tiles; University of Blida I.

Earthenware tiles adorning the Palais des Rais. © Wikimedia Commons, CC-BY-SA-3.0.

Figure 8. The use of various features from the Casbah architecture of Algiers (Missoum, 2003) & (Ravereau, 1989) in the design of the University of Blida. (Chennaoui, Y, & Akeblersane, I, 2024).

Lastly, it can be observed that the project does, in fact, draw inspiration from the geometric tradition and richness of forms and materials found in Muslim culture. A number of elements are used that tend to evoke the unique characteristics of the architecture of the Casbah of Algiers (Missoum, 2003) & (Ravéreau, 1989), such as the pavilions' introverted configuration, the helical scheme's application in the composition of plans and decorations, and the hierarchy of outdoor spaces.

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The authors declare there is no conflict.

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