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Elian Coral Moreno-Sánchez
Doctora en Arquitectura, Diseño y Urbanismo, Profesor de tiempo completo - B, departamento de Arquitectura, Instituto de Arquitectura, Diseño y Arte Universidad Autónoma de Ciudad Juárez, Juárez, México
https://orcid.org/0000-0001-8865-1294
elian.moreno@uacj.mx

NUMERICAL HARMONIES IN ARCHITECTURAL EDUCATION: VILLARD DE HONNECOURT'S GRID

ARMONÍAS NUMÉRICAS EN LA EDUCACIÓN ARQUITECTÓNICA: RETÍCULA VILLARD DE HONNECOURT

HARMONIAS NUMÉRICAS NA EDUCAÇÃO ARQUITETÔNICA: A RETÍCULA DE VILLARD DE HONNECOURT

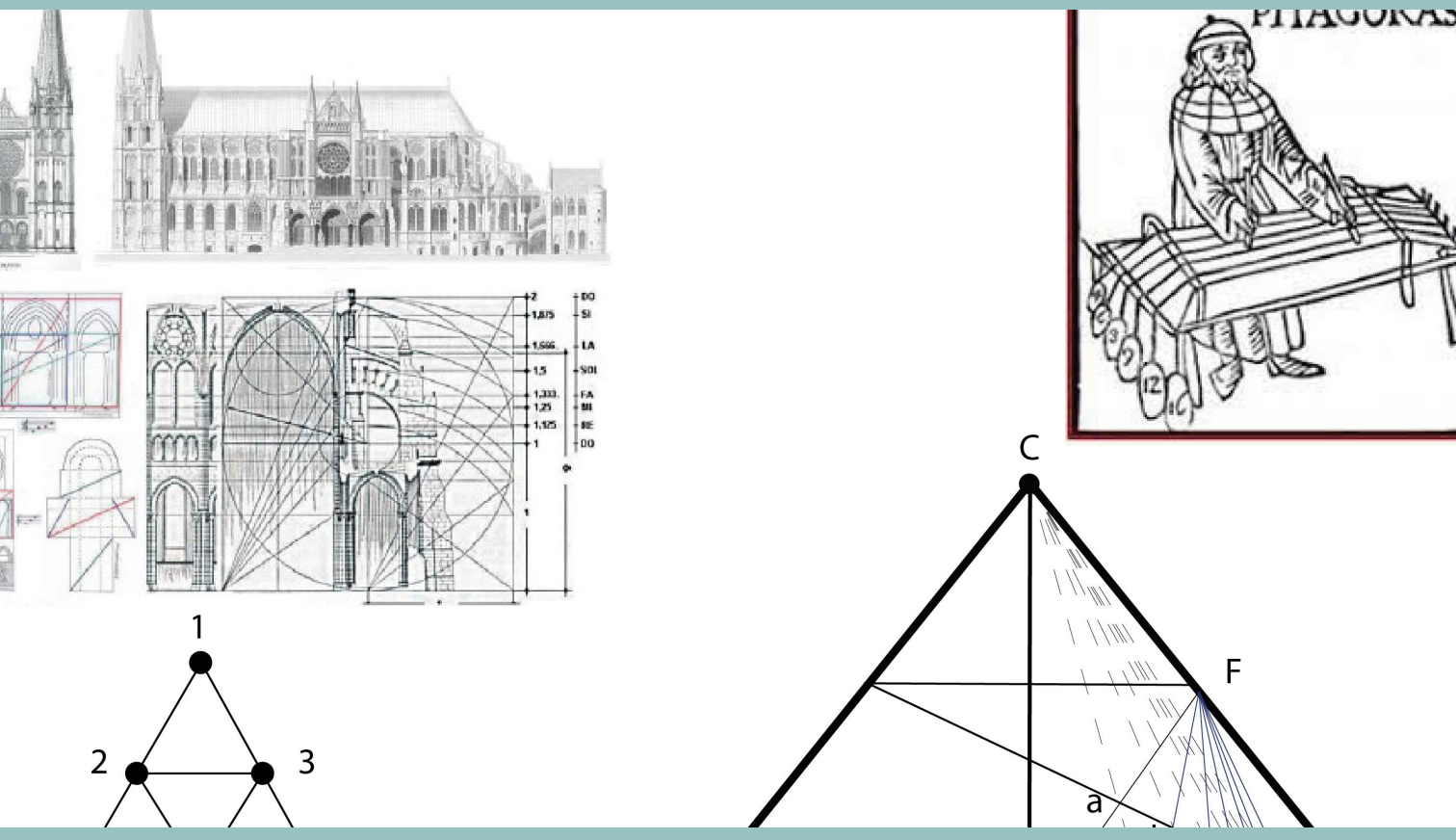

Figure 0. Graphs of the Pythagorean scale and practical examples during the Middle Ages in the construction of Gothic cathedrals such as the Cathedral of Chartres. Source: Based on a collection of several academic texts.

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RESUMEN

El análisis de la retícula de Villard de Honnecourt y su rol en la arquitectura medieval ofrece una perspectiva enriquecedora para la educación arquitectónica contemporánea. Durante la pandemia de COVID-19, en el año xx, en la Universidad Autónoma de Ciudad Juárez, México, se implementó con éxito esta herramienta histórica. La elección estratégica de la retícula como punto de partida permitió explorar las técnicas constructivas medievales integradas con herramientas digitales. Este enfoque no sólo resalta la conexión entre arquitectura y música, evidenciando la influencia de la escuela Pitagórica y Platónica en la Edad Media sino que también, demuestra la versatilidad de la retícula en la formación académica. A través de análisis prácticos y estudios de caso, se promovieron habilidades analíticas y creativas entre quienes se dedican a estudiar arquitectura. La transformación de la enseñanza de la arquitectura en entornos universitarios actuales, alejándose del modelo tradicional, plantea desafíos. La disyuntiva entre herramientas digitales y acceso a la información permite reinterpretar métodos compositivos. El análisis del uso académico de la retícula de Villard de Honnecourt, y su predecesor la retícula Van Der Graaf, destaca su relevancia histórica y características geométricas distintivas. Desde sus orígenes medievales hasta su aplicación contemporánea, la retícula se consolida como una herramienta pedagógica esencial. Este estudio realizado en la Universidad Autónoma de Ciudad Juárez, reflexiona sobre el modelo propuesto por la retícula. Analiza sus implicaciones en los procesos de enseñanza-aprendizaje académico, revelando su impacto en dimensiones físicas, documentales y tecnológicas. En síntesis, destaca la adaptabilidad y relevancia continua de la retícula como herramienta pedagógica esencial en la formación de arquitectos.

Palabras clave: retícula de Villard de Honnecourt, arquitectura medieval, educación arquitectónica contemporánea, herramientas digitales, proceso de enseñanza-aprendizaje.

ABSTRACT

The analysis of the grid designed by Villard de Honnecourt and its role in medieval architecture offers an enriching perspective for contemporary architectural education. This historic tool was successfully implemented during the COVID-19 pandemic at the Universidad Autónoma de Ciudad Juárez, Mexico. The strategic choice of the grid as a starting point allowed exploring medieval construction techniques integrated with digital tools. This approach not only highlights the connection between architecture and music, evidencing the influence of the Pythagorean and Platonic schools in the Middle Ages, but also demonstrates the versatility of the grid in academic training. Through practical analyses and case studies, analytical and creative skills were promoted among those who dedicate themselves to studying architecture. The transformation of architecture teaching in current university environments, moving away from the traditional model, poses challenges. The dilemma between digital tools and access to information allows for reinterpreting compositional methods. Analysis of the academic use of the Villard de Honnecourt grid and its predecessor, the Van Der Graaf grid system, highlights their historical relevance and distinctive geometric characteristics. The grid has become an essential pedagogical tool from its medieval origins to its contemporary application. This study, which was carried out at the Universidad Autónoma de Ciudad Juárez, reflects upon the model proposed by the grid. It analyzes its implications in academic teaching-learning processes, revealing its impact in physical, documentary, and technological dimensions. In summary, it highlights the adaptability and continued relevance of the grid as an essential pedagogical tool in the training of architects.

Keywords: Villard de Honnecourt grid, medieval architecture, contemporary architectural education, digital tools, teaching-learning process.

RESUMO

A análise da retícula de Villard de Honnecourt e seu papel na arquitetura medieval oferece uma perspectiva enriquecedora para a educação arquitetônica contemporânea. Durante a pandemia da COVID-19, no ano XX, na Universidad Autónoma de Ciudad Juárez, México, essa ferramenta histórica foi implementada com sucesso. A escolha estratégica da retícula como ponto de partida permitiu a exploração de técnicas de construção medievais integradas a ferramentas digitais. Essa abordagem não apenas destaca a conexão entre arquitetura e música, evidenciando a influência da escola pitagórica e platônica na Idade Média, mas também demonstra a versatilidade da retícula na formação acadêmica. Por meio de análises práticas e estudos de caso, as habilidades analíticas e criativas foram promovidas entre aqueles que se dedicavam ao estudo da arquitetura. A transformação do ensino de arquitetura nos ambientes universitários atuais, afastando-se do modelo tradicional, apresenta desafios. O equilíbrio entre as ferramentas digitais e o acesso às informações permite a reinterpretação dos métodos de composição. A análise do uso acadêmico da retícula Villard de Honnecourt e de sua antecessora, a retícula Van Der Graaf, destaca sua relevância histórica e suas características geométricas distintas. Desde suas origens medievais até sua aplicação contemporânea, a retícula se estabeleceu como uma ferramenta pedagógica essencial. Este estudo, realizado na Universidad Autónoma de Ciudad Juárez, reflete sobre o modelo proposto pela retícula. Ele analisa suas implicações nos processos acadêmicos de ensino-aprendizagem, revelando seu impacto nas dimensões física, documental e tecnológica. Em resumo, destaca a adaptabilidade e a relevância contínua da retícula como uma ferramenta pedagógica essencial na formação de arquitetos.

Palavras-chave: retícula de Villard de Honnecourt, arquitetura medieval, educação arquitetônica contemporânea, ferramentas digitais, processo de ensino-aprendizagem.

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INTRODUCTION

The Villard de Honnecourt grid, attributed to the namesake French architect, is a graphic construction with exact delimitations and proportions rooted in medieval architecture (12th - 15th centuries). This intricate geometric framework reveals essential numerical harmonies behind the architecture of that period (Kruft, 1994). This article explores the grid's historical importance and contemporary relevance in architectural education.

The grid is a visual map of geometric principles and proportions that have endured over time. Its design is deeply connected to the period's philosophical and mathematical influences, particularly the Pythagorean and Platonic schools. This link between architecture and philosophy reflects a cosmic harmony that transcends the aesthetic, highlighting the symbolic richness incorporated by Villard in his work (between 1225 and 1250).

The grid, attributed to Villard de Honnecourt, a medieval French architect, is a geometric diagram reflecting his period's essential architectural principles. This framework served not only as a practical construction tool, but also as an educational guide on geometric proportions and harmonies, fundamental in medieval architecture (12th – 15th centuries). Villard's manuscript was not initially conceived as a literary treatise, but as a sketchbook to which explanatory text was later added. In particular, the section on loggia geometry shows a clear correspondence between the illustrations and the texts, probably influenced by Roman traditions, as seen in the "Gromatici veteres" (Kruft, 1994). The geometric figures used in his work, such as the square, the circle, the triangle, and the pentagon, were applied to both organic and architectural forms, highlighting a synthesis between the artistic and the constructive. Although projected on organic bodies, these geometric figures retained autonomy in proportions, revealing a more geometric than naturalistic approach. The grid was also used in architectural contexts, such as the Cistercian church's plans and building roofs' design. This use of geometric shapes underlines the importance of mathematics and geometry in Gothic architecture, evidencing a connection between ancient and medieval architectural traditions.

Exploring the grid in the context of medieval architecture and its applicability in contemporary education responds to the need to understand the discipline's historical roots. Returning to historical fundamentals offers a unique perspective in a digitized world where design tools are evolving rapidly. The grid is a tangible testimony of the principles that guided medieval architects, providing a solid foundation for the contemporary teaching of future architects of the 21st century.

During the COVID-19 pandemic, from 2020 to 2022, the Autonomous University of Ciudad Juárez (UACJ) in Mexico implemented Villard's grid from remote teaching in April 2020 as part of its

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architectural educational program. This practical approach not only demonstrated the grid's adaptability to virtual environments but also fostered a deep understanding of medieval constructive methods. Through projects and analysis, the students internalized both the technique and the philosophy behind the grid, enriching their academic training.

This article underlines the connection between architecture and music, adding dimension to the understanding of the grid. The grid's harmonic arrangement manifests the influence of the Pythagorean school (from the middle of the 6th century), which sought numerical relationships in music and geometry. This link between two forms of artistic expression suggests the omnipresence of mathematical principles in several creative disciplines.

The case studies and analyses demonstrate the grid's versatility in architectural education. This geometric framework's ability to adapt to different contexts and challenges underscores its continuing relevance. It is not only a pedagogical tool but also a bridge between the past and the present, allowing students to explore and understand architecture from a holistic perspective.

Despite the challenges associated with implementing the grid in educational settings, it recognizes the importance of balancing the appreciation of history with practical application in contemporary design. The adaptability and effective integration of this tool into academic curricula raise questions about pedagogical tools and strategies that allow learning to be built beyond the physical spaces of the classroom.

The UACJ started a new academic program in 2019 to subsequently face the arrival of the COVID-19 pandemic in 2020, which forced a rapid transition to remote teaching. This adaptation generated challenges, especially in Architectural Theories, but it also became a unique opportunity to explore theoretical research by reusing Villard's grid (1225-1250). The main objective was to understand medieval construction techniques and explore the influence of medieval architecture on contemporary architecture, integrating digital tools to generate new design products.

The success of using the grid in classrooms, both remote and face-to-face, underlines its relevance as a significant architectural element, both historical and contemporary. This article invites reflection on the importance of preserving and adapting historical tools in training 21st-century architects, highlighting how a grid of the past can remain a valuable tool in modern education.

THEORETICAL FRAMEWORK

The Notion of Numerical Harmonies for the creation of grids

The research focuses on the digital development of the Villard de Honnecourt (VH) grid, supported by theoretical-historical resources. It seeks

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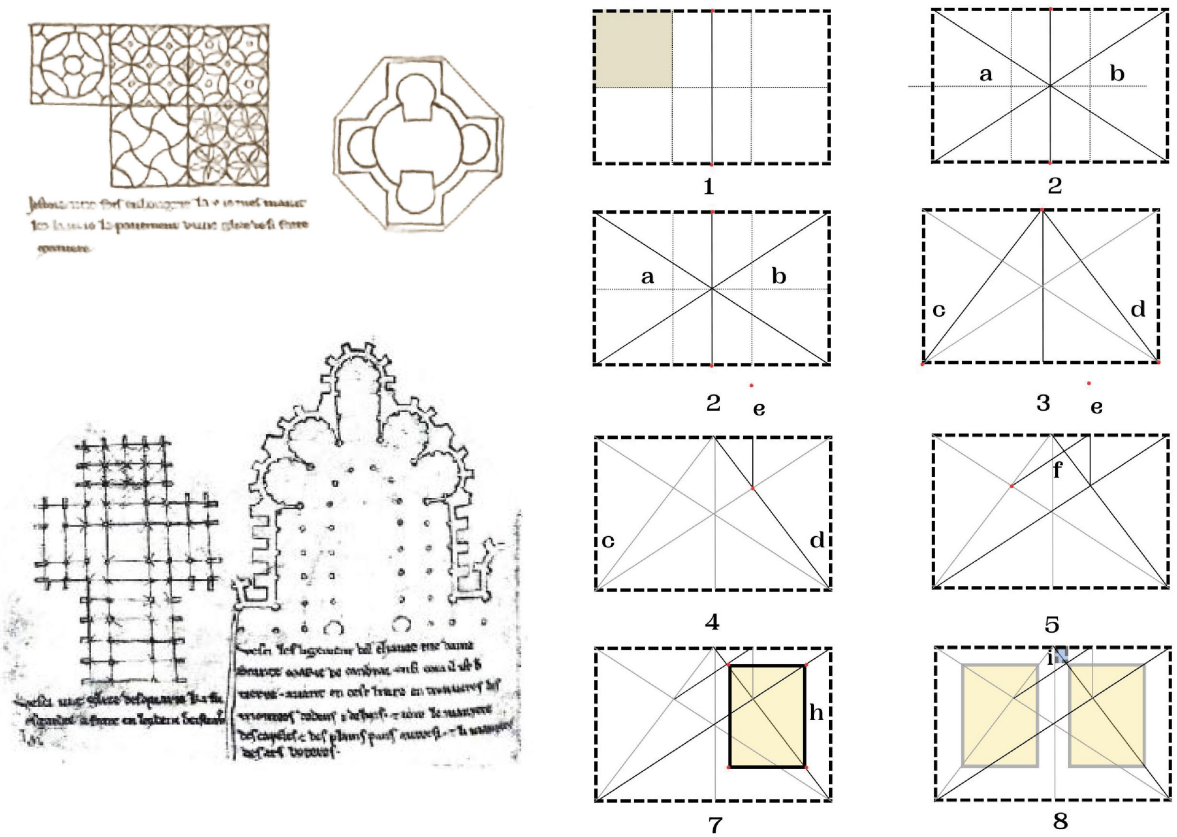

Figure 1. Reticular lines can be found in history, such as those developed by Villard de Honnecourt and reinterpreted today. Source: Interpretation by the author.

to generate guidelines for infographic works and analyze architectural elements from antiquity to illustration. The connection between music and architecture, from ancient Greece to the Late Middle Ages, is explored (CANVA, 2022), highlighting Pythagoras and Plato.

The grid structure and the search for proportion and number captured architects' attention, leading to a combination of theories on such a valuable tool that formed ensembles, cathedrals, palaces, and villas for centuries in the ancient world. Despite man's impossibility of generating an ontological change in the natural order or the essence of objects, design processes based on this modernist standardization propose attractive localized possibilities. The grid (weaving, interlacing) and rhetoric (discourse, the art of speaking well) make up an ordered discourse in architecture that tries to unite the analytical order and the world of practice in the work (Figure 1). Meanwhile, the aesthetic, practical, functional, and normative assessment of change attributed to the project process is jeopardized by proposing that all the works of their natural regions are parties to the unequivocal development of a unique system (Bertola, 2015).

In mathematics, Pythagoras of Samos, in the 6th century BC, developed the theory of the Music of the Spheres, relating music and arithmetic to "perfect harmony." This theory proposed that the universe was organized according to whole numbers and musical consonances produced by the celestial bodies in their orbital revolution, albeit imperceptible to humans.

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Pythagoras discovered that musical notes could be interpreted spatially by vibrating two strings under the same conditions and with proportional dimensions. For example, if the strings were in a 1:2 ratio (fingerboard), the shorter string produced a note one octave higher than the longer one. When the ratio was 2:3 (diapent), the height difference corresponded to a fifth; if the ratio was 3:4 (diatessaron), there was a quarter interval between them. Thus, the consonances of the Greek musical system were expressed by the progression 1:2-2:3-3:4, built from the first four whole numbers, searching for the secret of the ideal harmony of the universe. Its intervals, like the octave and the fifth, are fundamental for the music-architecture relationship. Plato contributes the golden ratio in "Timaeus," represented by Phi ($\phi \approx 1.618$), connecting music and architecture through this geometric ratio (O'Connor C. et al., 2005).

Plato, following Pythagoras, explained in his work "Timaeus" (around 360 BC) that the order and harmony of the cosmos obeyed certain numbers derived from the squares and cubes of double and triple unity. These geometric progressions (1, 2, 4, 8 and 1, 3, 9, 27) represented the planetary distances, taking the distance from the Earth to the Moon as a unit. This set of numbers contained the secret eurythmy of the macrocosm and the microcosm, implying both the inaudible musical order of the universe and the structure of the human soul (Eggers, 2005).

The Pythagorean and Platonic theory integrated the four elements of universal harmony into the Tetraktys, where Mathematics, Geometry, Astronomy, and Music were combined in a triangular structure. Boethius, a philosopher of ancient Rome, compiled these ideas establishing three simple proportions: eighth (1:2), fifth (2:3), and fourth (3:4), which would become the basis of beauty and harmony in the Middle Ages (Sánchez, 2011).

In ancient Rome, Vitruvius (80-15 BC), an architect and military engineer under the command of Emperor Julius Caesar, embodied in his treatise ***On Architecture***, the ideas about harmonic proportions, based on the symmetry and proportion of the human body, which he transferred to architecture, influencing the design of buildings of his time and subsequent centuries. Boethius (480-524 A.D.), a Roman philosopher of the Early Middle Ages, unified music and geometry in his work ***De Institutione Musica***. In it, he defined the arithmetic, geometric, and harmonic proportions that founded medieval music theory. During the Gothic period, between the 12th and 15th centuries, European cathedrals reflected cosmic harmony, integrating mathematical proportions, such as musical intervals and the golden ratio, into their architecture. This elevated the concept of beauty through a symbiosis between art and science (Egido, 2018).

Saint Augustine (354-430 A.D.), one of the most influential figures of Christian thought in Late Antiquity, adopted Platonic ideas by affirming that the number was the basis of beauty, positing that art should imitate this

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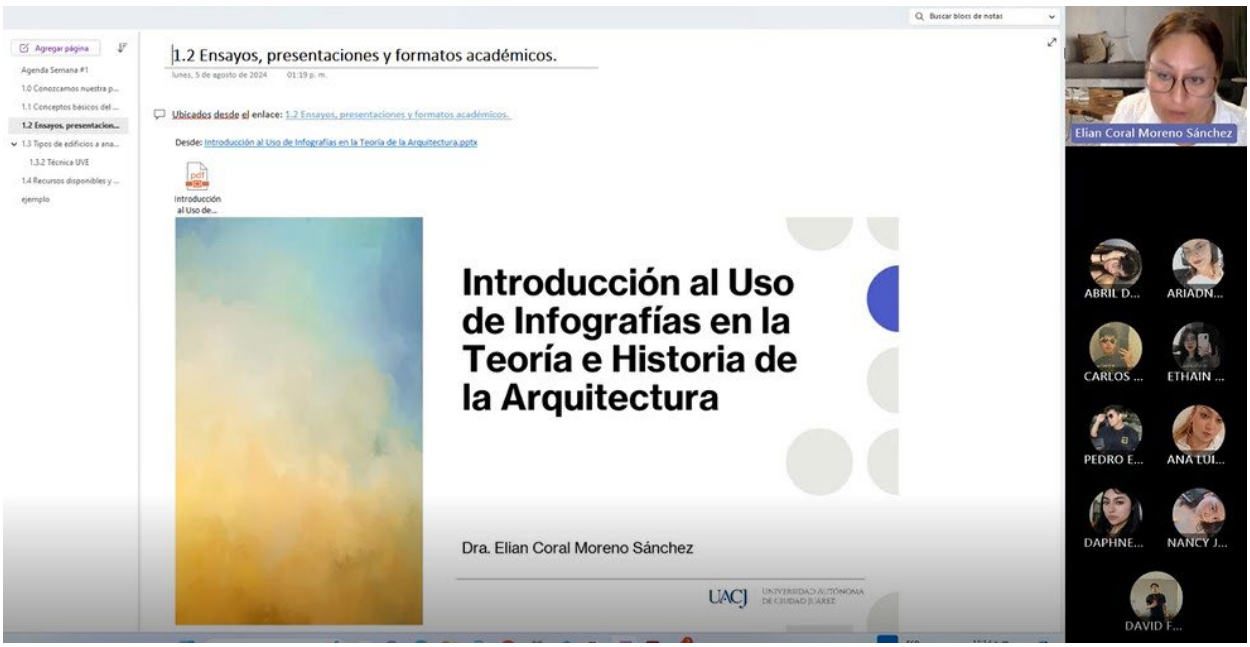

Figure 2. Screenshot of remote class on the use of the grid in the theory of architecture. Source: The author's private files.

divine principle. In his work ***On Music***, he classifies Music and Architecture as sister disciplines due to their rhythmic and mathematical properties, highlighting the importance of proportion in artistic creation. Saint Thomas Aquinas (1225-1274 A.D.), a key figure of medieval thought, reinterpreted these insights in his ***Summa Theologica*** (1265-1274 A.D.), where he argues that harmony between the parts provided the sense of beauty, a concept applicable to all artistic forms, including Music and Architecture. In this way, both thinkers contributed to integrating classical philosophy into Christian aesthetics, founding the relationship between proportion, beauty, and art in the Middle Ages.

In summary, the relationship between mathematics and architecture is established through principles of rhythm and proportion. The numerical harmonies discovered by Pythagoras and developed by Plato and other thinkers have influenced architectural theory and are essential for creating grids, which are used to organize architectural design and construction harmoniously and proportionately (Figure 2).

For his part, Villard de Honnecourt, considered the "Gothic Vitruvian" (Kruft, 1994), is a valuable resource in contemporary architectural teaching and practice. His grid, rediscovered in the 19th century, persists in its versatility and relevance, serving as a bridge between the past and the training of 21st-century architects. Ultimately, the grid of V.H. is a living source of inspiration and knowledge in contemporary architectural design.

His grid offers theoretical and architectural solutions, influencing contemporary design. Its rediscovery connects with medieval architectural evolution. Researchers such as Hahnloser (1972) and Willis (1859) systematized his drawings, highlighting architectural elements and his focus on geometries.

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Most of what is known about Villard de Honnecourt comes from his portfolio, which shows a deep interest in geometry applied to architecture and the representation of the human and animal body. Although Villard does not systematize his work methodologically, his visual approach can be interpreted as reflecting training in both the trivium and the quadrivium, which suggests a broad education in the liberal arts of his time. His drawings' use of geometric figures such as the triangle and the square reveals an intention to apply mathematical principles to organic forms, a characteristic of medieval thought in which geometric proportions and symmetries reflected the cosmic order. Despite the limitations of its compilation, his portfolio offers an insight into how architectural and geometric knowledge was transmitted in his time (Murray, 2014). They are subjective expressions about canons that made up his visual mind (the portfolio), coming from an education: it was the author's own personal education and an author's referentiality of the canons that had elaborated a conscious and reflective search of his contents (Binski, 2012).

For example, some calculations are proposed between the design of two arches. That is to say, when designing a circle of 6, the semicircle is divided into 12 units: above, the major semicircle is divided into 8, which, added to the three that arrive directly in the middle of the first marked circle, gives 11 over the 12 of the first arc. Obviously, the perfection of one and the other causes the harmonic relationship between them. 7 over the diameter comes to be 1 plus 1/6, while the length of the rectangle measures 4 plus 1 and 5/10; an interesting contribution to compose a rectangle which is approximately the 1.5 x 8 that we call the Villard rectangle.

Since the 20th century, in contemporary editorial design, Villard's grid has stood out against the golden section (Haslam, 2006). Its application in digital design contributes to geometric understanding and the creation of standards for primarily infographic documents.

The grid of V.H. is also a two-dimensional geometric tool that facilitates the harmonious arrangement of architectural elements. It is most prevalent in architectural floor plans due to its ability to delineate precise proportions and alignments, creating a solid foundation for 3D design. The grid introduces 2D geometry using guidelines that structure the space into repetitive and proportionate modules, allowing a coherent and aesthetically pleasing composition (Kruft, 1994).

This geometric tool is applied in both 2D and 3D designs. In the architectural floor plans, the grid of V.H. helps organize spaces and structures in an arrangement that reflects mathematical principles of harmony and proportion. In 3D architecture, these proportions are translated into volumes and shapes that maintain the coherence and symmetry established in the 2D plane.

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Figure 3. Instructions on how to make the Villard de Honnecourt grid. Source: Preparation by the author.

It can then be stated that there are categories of modules, such as those that unfold from a grid universe on a numerical basis. Since all their links are hierarchical, they distribute their intersections on the supported surface through the vertices of regular polygons or intersections of these.

The grid has constantly evolved over several historical periods, adapting to each era's needs and architectural styles. During the Renaissance, in the 15th and 16th centuries, additional principles, such as the golden ratio, were incorporated, allowing for greater sophistication and harmony in architectural compositions. This mathematical approach enriched the design of emblematic buildings, reflecting an ideal of beauty based on symmetry and balance. In the modern era, between the 20th and 21st centuries, the grid has been reinterpreted thanks to digital tools, facilitating the creation of more complex and adaptive designs that, despite their innovation, maintain traditional geometric principles as a structural basis (Figure 3).

Working with Villard's grid in modern architecture is relevant because it can harmonize historical concepts with modern applications. This geometric tool not only facilitates the design process but also enriches the theoretical understanding of architecture, allowing students and professionals to explore and apply mathematical and aesthetic principles in innovative ways.

However, although this idea of reticular structure has been present in architecture (and everyday life) since ancient times, a theoretical framework that would consolidate the "image of structural thinking" was developed during the 20th century. This is because, during that period, structuralism

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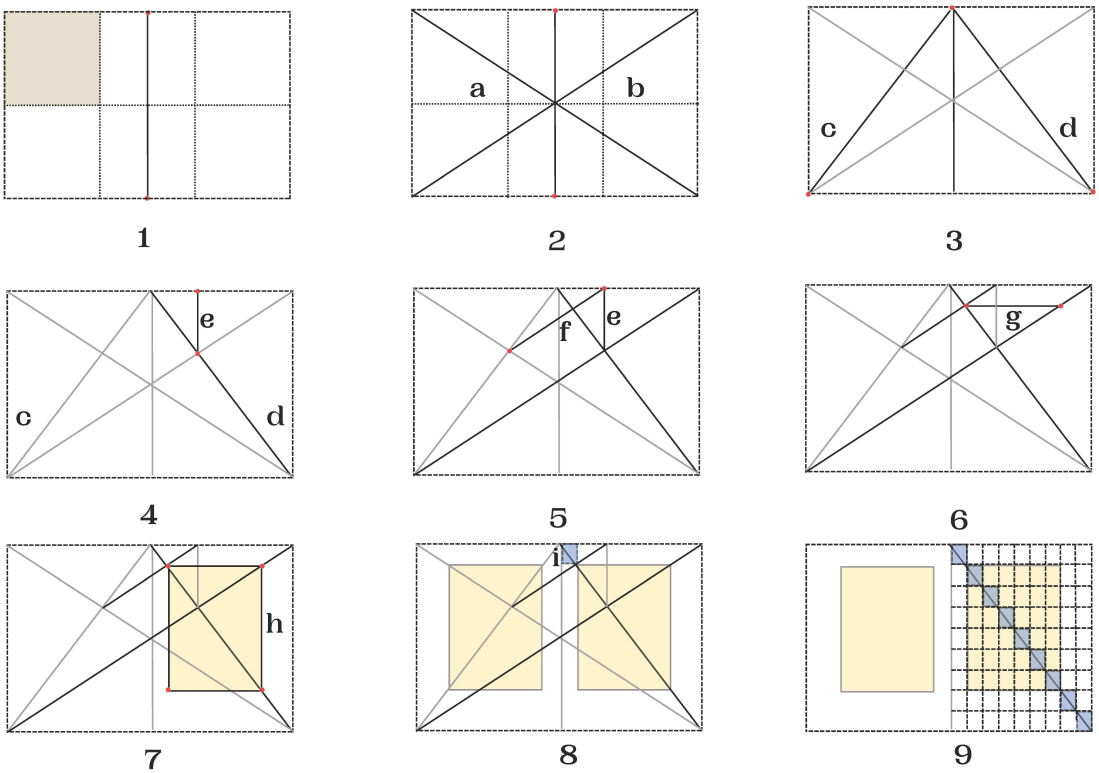

Figure 4. Key Elements when applying the Villard de Honnecourt grid in the Academic Digital Teaching of Architecture. Source: Preparation by the author based on what was proposed by Villard de Honnecourt in 1225-1250 AD.

emerged as one of the main driving forces of scientific, philosophical, and artistic discussions. With this thought, a conception of "structure" was formed that would guide research in linguistics, cultural activities, social habits, the mind, cinema, anthropology, and architecture, among other fields (Foucault, 1966).

Thus, the Honnecourt grid, rediscovered in the 19th century, is a valuable resource in contemporary architectural teaching and practice. Its versatility and relevance persist, serving as a bridge between the past and the training of 21st-century architects. Ultimately, it is a living source of inspiration and knowledge in contemporary architectural design (Figure 4).

METHODOLOGY

Educational Transformation in Architectural Theories in the face of the COVID-19 pandemic

Between 2020 and 2021, in response to the COVID-19 pandemic, teaching was reconfigured at UACJ, including the subject of Theories of Architecture, beginner level, incorporating a new approach to the Villard de Honnecourt grid through documentary and correlational research. The key variables included adaptation to virtual teaching, integration of digital tools, and connection between architectural theory and practice.

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Figure 5. Applications of the Villard de Honnecourt - Haslam Grid in Student Designs (2021-2024). Source: The author's private files.

Based on the proposal of Sifuentes-Solís and Torres-Landa (2014), the implementation explored the "e-topía" as an integrating digital educational space. Different approaches were identified in the historiography of architecture, from the classification of objects to the hermeneutic interpretation of space experiences. The subject was reformulated to describe, identify, and classify theoretical-architectural objects using digital tools (Figure 5).

The strategic choice of the V.H. grid was based on understanding medieval techniques and their contemporary relevance. This tool not only introduced 2D and 3D geometry, but also implemented digital tools, developing essential digital skills. The students acquired knowledge about medieval architecture and crucial digital skills in current practice, among other things.

In addition to incorporating the grid, the approach redesigned the course structure, assessments, and student-teacher interactions, encouraging creativity and exploration. This change contributed to a dynamic and participatory learning environment, evidencing a comprehensive transformation in architectural education during times of crisis.

DISCUSSION AND RESULTS

Innovative decoding of the Villard de Honnecourt grid

The transition to remote teaching during the COVID-19 pandemic led to an evolution in the digital presentations of Architectural Theories that combined face-to-face and remote classes in a defined hybrid system once the health emergency was over. Despite the new modalities, the implementation of the Villard de Honnecourt grid was consistent in both contexts, evidencing its post-pandemic relevance. The urgency of overcoming social distancing drove the rapid adoption of digital tools in educational

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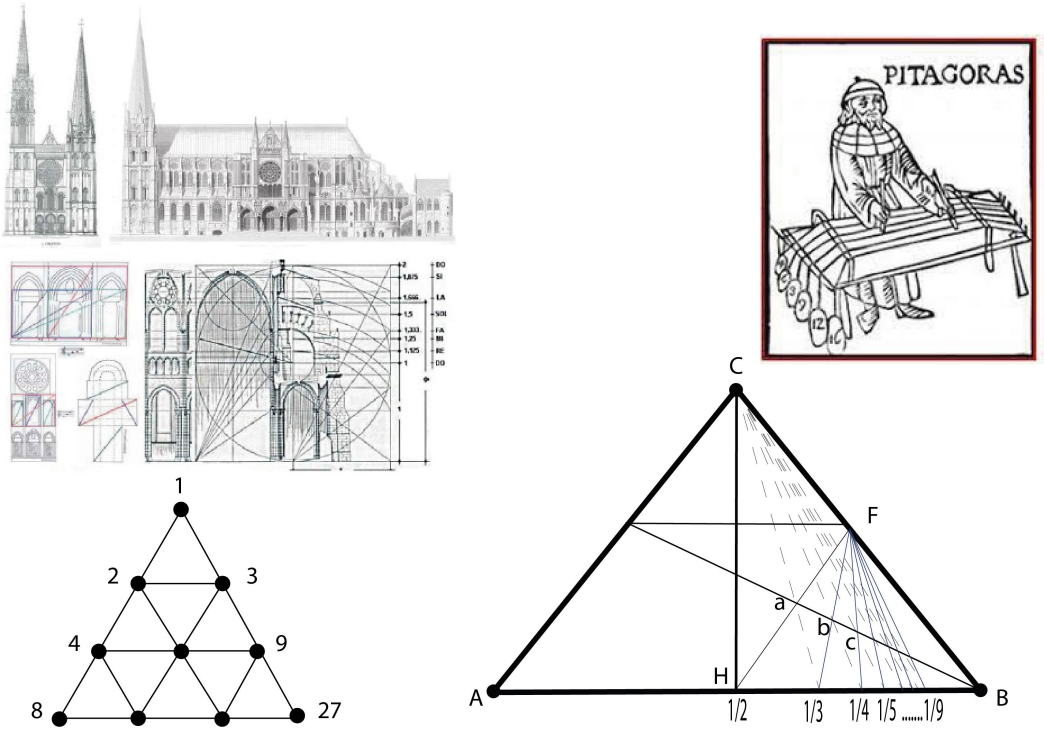

Figure 6. Graphs of the Pythagorean scale and practical examples during the Middle Ages in the construction of Gothic cathedrals such as the Cathedral of Chartres. Source: Based on a collection of several academic texts.

institutions, facilitating the creation of infographic summaries focused on architectural theory.

COVID-19 forced a reconfiguration in teaching, including the subject of Theories of Architecture at the Autonomous University of Ciudad Juárez (UACJ). This transformation involved adapting to virtual teaching, integrating digital tools, and taking a more practical approach to architectural theory using the Villard de Honnecourt grid. This methodology was supported by documentary and correlational research, where different approaches were explored in the historiography of architecture and its connection with digital tools. The sampling yielded the following: The studied population was 2021, 2022, and 2023, with two semesters per year (Semester 1 and Semester 2). Each semester, the Villard de Honnecourt grid technique was applied to 1 to 3 groups on Architectural Theories, each comprising 20 to 30 students (Figure 6).

The total number of students per year was estimated at 40 to 90, considering the total of both semesters and the different groups. This gave a range between 120 and 270 students in the three years.

The sample calculation revealed that 87% of the students reported having learned and enjoyed using the Villard de Honnecourt grid to develop infographics. In groups of 20 students, 17 expressed this appreciation, and in groups of 30, 26 students stated the same.

Based on the Villard de Honnecourt grid, between 17 and 26 students per group confirmed positive learning in each semester.

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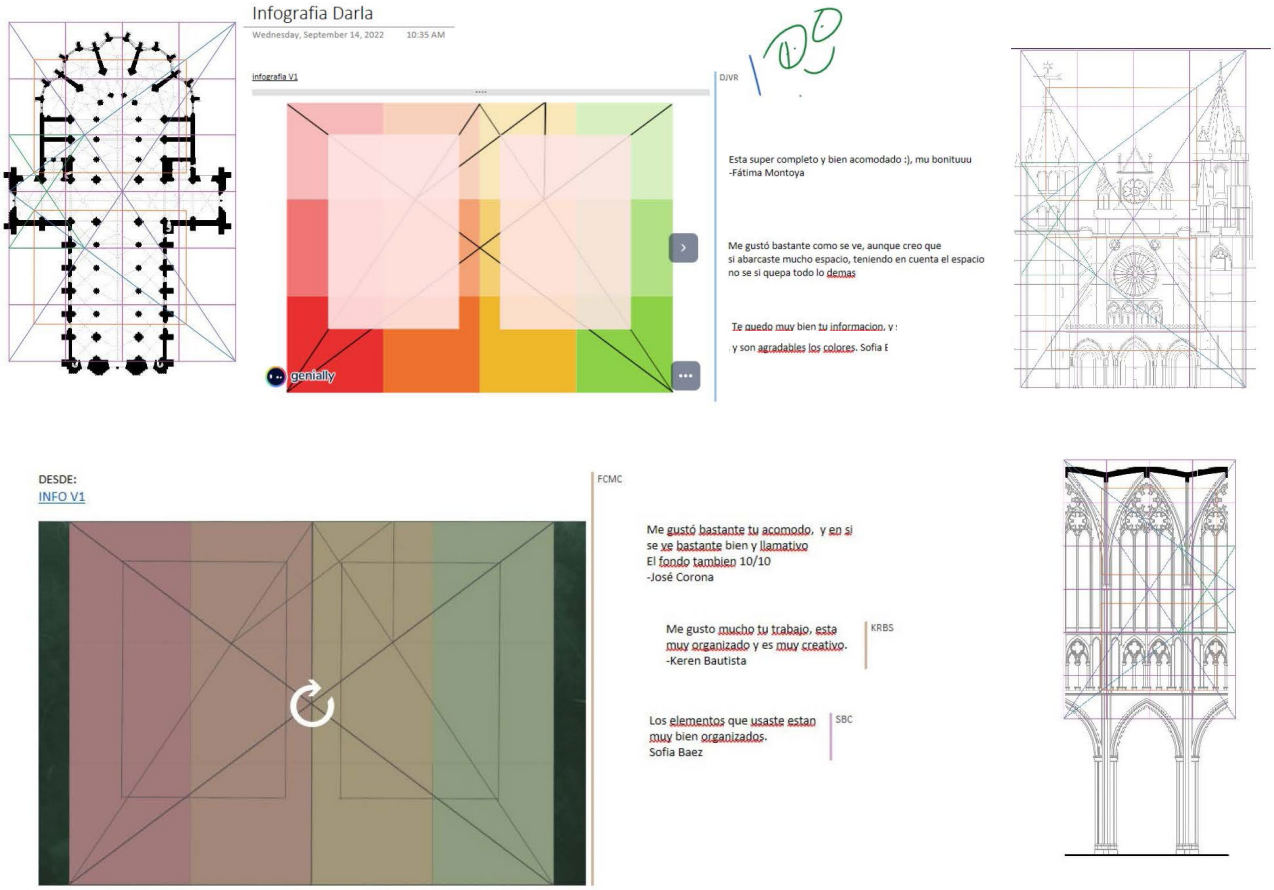

Figure 7. Graphs that exemplify the Pythagorean or Tuning scale. Source: Preparation by the author.

Total Sample:

- **2021:** 34 and 156 students were consulted, of which 29 and 136 stated that they liked the grid.
- **2022:** 34 and 156 students were consulted, obtaining the same affirmative range from 29 to 136.
- **2023:** Again, 34 and 156 students were asked, who in ranges of 29 and 136 confirmed their appreciation for the grid.

Adaptation to Virtual Teaching

The transition to remote teaching was based on the proposal of Sifuentes-Solís and Torres-Landa (2014), which promotes "e-topía" as an integrating digital educational space. This approach made it possible to identify different approaches in the historiography of architecture, from the classification of objects to the hermeneutic interpretation of space experiences. The subject was reformulated to describe, identify, and classify theoretical-architectural objects using digital tools, facilitating understanding complex concepts in a virtual environment (Figure 7).

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Integration of Digital Tools

The implementation of the Villard de Honnecourt grid as a central pedagogical tool was based on its ability to harmonize historical concepts with modern applications. Medieval construction techniques and their contemporary relevance were explored, integrating digital tools that allowed students to develop new competencies. This approach not only promoted a deeper theoretical understanding, but also the mastery of digital skills essential for current architectural practice.

The Use of Infographics in Teaching

The infographics designed based on the Honnecourt grid emerged as a key tool for facilitating the communication and understanding of complex information in architecture theory. Infographics combine images, data visualizations, graphics, and minimalist text to summarize topics clearly and attractively. In this context, infographics were used to:

- Provide quick summaries on architectural theories.
- Explain complex design and construction processes.
- Present research results or case study data.
- Compare and contrast different architectural styles and methodologies.

So, the infographics were adapted to visually represent complex architectural concepts, facilitating the retention of information and improving understanding. Some specific applications included:

- **Statistics:** Presentation of quantitative data on projects and materials.
- **Informative:** Detailed explanation of architectural theories and concepts.
- **Timeline:** Visualization of the evolution of architectural styles.
- **Process:** Description of design and construction stages.
- **Comparative:** Contrast of different architectural approaches and solutions.

To design effective infographics, these steps were followed:

- **Organization of information:** Creation of a draft structuring the main ideas.
- **Template Selection:** Choosing a template appropriate to the specific content.
- **Personalization:** Adaptation of the template with colors, fonts, icons, and graphics related to architecture.
- Tools such as Canva, Piktochart, and Adobe Illustrator were used to design custom infographics, using their features to create visually attractive and easy-to-understand content (Figure 8).

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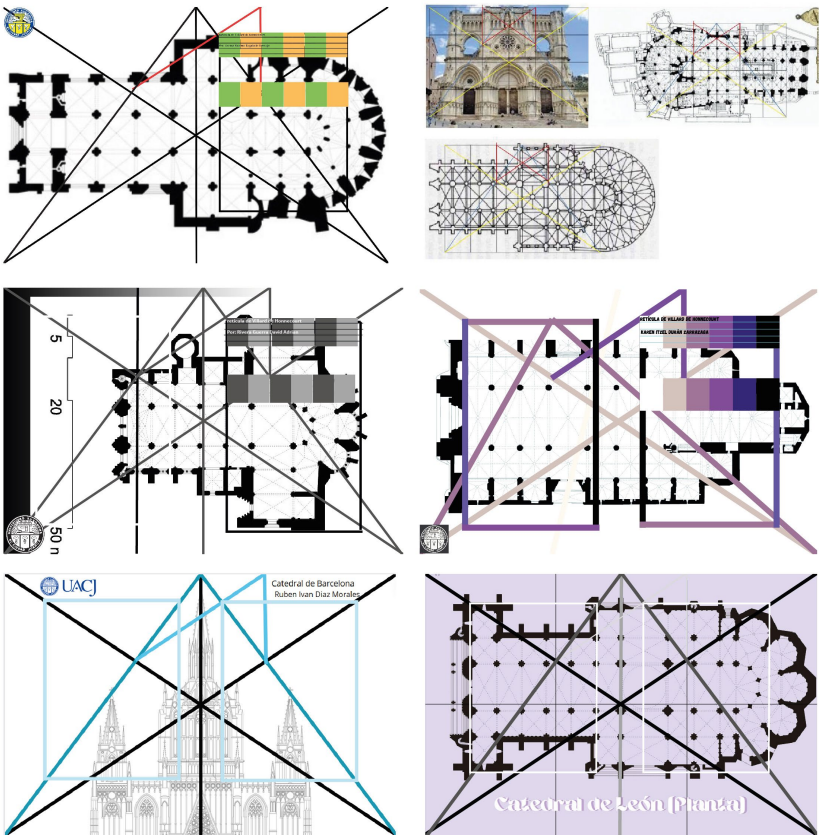

Figure 8. Plans, cross-sections, or facades analyzed using the Villard de Honnecourt grid, student results (2021-2024). Source: The author's private files.

CONCLUSIONS

Thus, infographics in the teaching of architecture proved to be an effective strategy to transmit complex information clearly and efficiently.

The implementation of the Villard de Honnecourt grid, combined with the use of infographics (Genially, 2022), transformed the structure of the Theories of Architecture course, promoting creativity, individual exploration, and collaborative work. Students developed digital skills and a deep understanding of architectural elements, effectively linking medieval techniques with contemporary tools (Gamma, 2024).

The key inferences stand out:

- **Theoretical-Practical Link:** Strong connection between theory and practice through the use of the grid.
- **Practical and Conceptual Skills:** Development of digital skills and in-depth understanding of theoretical concepts.
- **Significant Impact:** Adaptability of the grid as an essential pedagogical tool in the training of architects.

Despite the continuous implementation of the Villard de Honnecourt grid in the field of Architectural Theories, his meritorious contributions have not been able to be extended to other teachers of the same subject. The post-pandemic adjustments and the imminent reaccreditation

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of the architecture program by the ANUIES in 2024 justify the theoretical-historical academy's reluctance to coordinate these subjects. However, the lack of dissemination of its benefits limits the educational potential in architecture, which sometimes deviates toward sociological aspects without fully understanding the discipline's purpose and role.

In the current context, it is concluded that questions about copyright, values, and creativity arise as digital algorithms advance in creating works of art and in analytical prediction. The growing presence of artificial intelligence raises the question of whether architects and other professionals will eventually be replaced in their activities. From Daniel Innerarity's perspective (2023), digital tools, including artificial intelligence, have both a banal and a singular character. They serve as auxiliaries while revealing the creative core of art.

In this sense, adopting software as an assistant in architecture parallels history, especially with the medieval era. The harmonic compatibility between mathematics, architecture, and music is materialized through these digital tools with algorithms focused on generative artificial intelligence, reaffirming the ability to choose between various possibilities, but without the monotony of transpositions of harmonies, enabling instrumentation and orchestration (conducting) so that one can choose between various possibilities that, through his grid, Villard de Honnecourt solved approximately 774 years ago (in 1250 A.D.).

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