

EVOLUTION OF ARCHITECTURAL GRAPHICS IN THE HISTORICAL CONTEXT

¹O. V. Perepelytsia

perepelytsiaokvl@ogasa.org.ua, ORCID 0000-0002-7364-0205

¹O.M. Samoylova,

amsam288@gmail.com, ORCID: 0000-0002-0748-519X

¹Odessa State Academy of Civil Engineering and Architecture, Ukraine

Abstract. The article explores the dynamics and transformation of visualization methods in architectural graphics at different stages of history. The aim of research lies in the analysis of the evolution of these methods in historical development and their influx into current practice. This research is based on a review of the literature and analysis of the historical data and current trends in architectural graphics. The various stages in the development of methods for creating visual images in architectural graphics are examined, starting from traditional manual techniques and up to modern digital tools. It was found out that the training of architects in the period of antiquity and the Middle Ages was carried out orally, followed by the development of the method of building an object directly in practice. That is, the architect was personally involved from the creation of the idea to the construction of the object. It was mentioned that during the Renaissance, the workshop system of architectural education continued to study new theories and methods of depicting architectural graphics. Factors have been identified that influence the evolution of these methods: technological progress, cultural and social changes, and others.

The article states that one of the professional benefits of architectural practice is the development of the author's handwriting or graphic language, which is used to identify the author of the project, architect, or organization. We want to point out the best visual presentation of projects of architectural bureaus. It is seen that modern graphic language is diverse and a mix of traditional and modern visual techniques. It has been established that the evolution of methods for creating visual images in architectural graphics is rich in aspects and dynamic. The prospects for further research are also highlighted, including an analysis of the influx of digital technologies, the aesthetic aspects of visual communication, and the synthesis of traditional and current approaches. Recognize the need for further research for a deeper understanding of the evolution of architectural graphics and the development of innovative approaches to the creation of visual images.

Keywords: architectural graphics, author's handwriting, method of creating an architectural image, graphic visualization of an object, graphic style, master craftsmen, architectural bureau.

Relevance of the research. Each historical era has its architectural style, its system of priorities and requirements for the results of the architect and designer, and its method of creating an image of an architectural object. Architectural style combines features of constructive, artistic, and functional order, which is inherent in a certain historical society and manifests itself in geometric architectural form and elements. Thus, visualization and its graphic language are an indispensable part of the process of creating an architectural object and are an indicator of the level of skill of the architect and designer.

Statement of the problem in general. Architectural graphics play a key role in the process of visualization and communication of architectural ideas. Over time, methods of creating visual images in architectural graphics have undergone significant changes, from hand-drawn drawings and painting to digital models and virtual reality. However, despite many studies devoted to this topic, many questions remain regarding the evolution of these methods, their influence on modern architectural design practices, and the perception of created images.

Analysis of recent research and publications. Prominent architects of different historical periods have been extensively studied by scientists and architectural specialists. Vitruvius, Leon

Baptista Alberti, and Albrecht Dürer, among others, developed fundamental ideas for pictorial and visual practices. Today, experts confidently continue to explore and expand upon these concepts in the digital realm, including cutting-edge research on virtual and augmented reality for architectural visualization. This involves the development of innovative methods for interacting with space and visualizing architectural projects. The study of aesthetic and psychological aspects of architectural graphics, particularly the impact of visual images on the perception and emotional reaction of viewers, is a popular area in architecture. Additionally, research in sustainable and environmentally responsible design, including the use of architectural graphics to visualize and analyze sustainable architectural concepts and solutions, is highly relevant. Architectural graphics development is a crucial topic in the architectural and artistic space.

The purpose of the research is the study the historical development of visualization methods in architectural graphics to understand their evolution and influence on contemporary practice.

The research tasks are: to analyze historical sources to identify the key stages in the development of visualization methods in architectural graphics, including changes in techniques, materials, and artistic approaches; to consider the contribution of key figures and schools of thought in the development of architectural thought and their contribution to the development of methods for creating visual images in architectural graphics, with an emphasis on identifying significant creative and technical innovations; to evaluate the influence of historical changes in the methods of creating visual images in architectural graphics on modern design and visualization practices; to investigate the evolution of artistic approaches and styles used in architectural graphics throughout different historical periods to comprehend aesthetic trends and their impact on the development of visual language in architecture; to determine the role of architectural graphics in communication among architects, designers, specialists in other fields, clients, and other project participants; to identify the impact of changes in visualization methods on the perception and interpretation of architectural concepts, as well as the quality and visual impact of the created images using unique methods and authorial styles for architectural graphics will be developed; to comprehend the consequences of modern technological innovations in the field of architectural graphics on the process of designing and creating an image of an architectural object.

Main material and results. Consider the historical steps of graphic (visual) and craft activities in the architectural space. With the development of architecture, geometric aspects and geometry as a science gradually developed. Thus, the ancient Egyptians began to use practical geometry as an integral part of the construction of monumental structures, temples, and pyramid tombs. The first scientist and architect known in history, Imhotep, who worked at the court of Pharaoh Djoser, used the square and its derivatives in his constructions. The process of finding a personal style and developing methods for creating a graphic image of an object for architects of the past began with the transfer of knowledge from experienced recognized masters and was carried out orally, followed by further development through the construction of an object directly in practice. Basic knowledge was acquired in the school of scribes, and skills were usually acquired from a family that already had the experience and skills of previous generations based on observation, comparison, and contrast.

The Egyptians intuitively used the orthogonal design method, which is based on geometric constructions, to build the drawing (the method of two Monge images). In the works of many ancient Greek scientists, mathematicians well represented the first theoretical information about the perspective. For example, the invention of the ancient Greek scientist Thales (about 625-c. 547 years. BC) is used in architectural graphics theorems of promising constructions. In the works of Pythagoras (VI century. BC), the first information about the "golden section" appeared, which was reflected in ancient Greek architecture. Therefore, a prerequisite for the graphic visualization of the future object of architecture, as well as the basis of fine art are perspective images that laid the foundation for 3d dimensions and a new tool for graphic language.

During the reign of Pericles in Athens, classical ancient Greek architecture flourished. This period marked the development of architectural canons that created a sense of grandeur,

conformity, and balance in building design. The modular order systems were the cornerstone of these canons. The orders combined the base, columns, and floors to create a harmonious graphic language that seamlessly blended new styles from different eras. Experienced masters under state protection taught novice architects in small private schools, where they learned both established techniques for creating architectural graphics and new visual methods for expressing ideas. At that time, the concept of educational levels, especially higher education, had not yet been developed. Ancient Greek architects were highly educated individuals who possessed knowledge in philosophy, mathematics, and the order system. Practical skills were acquired and practiced directly during the implementation of real design work based on previous oral lectures. It is important to note that for the Greeks, the architect was not only the chief builder but also an artist who performed craft work.

The arch-order system was developed by the ancient Romans, combining the Italian arch, the Greek order, and the cylindrical vault. Roman architectural techniques were taught in specialized schools, where the methods of individual masters were the primary means of transferring and assimilating knowledge. This ensured a clear and logical progression of information. Mark Vitruvius Pollion, an ancient Roman architect, engineer, historian, and geometer, established the content of classical architectural education in ancient Rome through his treatise 'Ten Books on Architecture' in the late 1st century BC. According to the treatise, architects in the Roman era were required to know geometry, drawing, philosophy, law, medicine, and astronomy. Vitruvius' comprehensive approach to architectural education set the standard for the construction industry, emphasizing the importance of a broad range of knowledge and skills, including geometry, and building techniques. Architects traditionally develop their skills through craft-based training, which includes practical skills and foundational knowledge in geometry and graphic visualization of ideas.

Vitruvius explained in the section on geometry that architects use three types of images when creating a structure: IHNOGRAPHY, which is a plan of construction built on the surface of the earth using a compass and ruler; ORTHOGRAPHY, which is a vertical image of the facade, section, and picture of the appearance with observance of proportions and a clear projection connection; and SCENOGRAPHY, which is a vertical section in combination with a perspective view of the building interior (Fig. 1). It is interesting to note that during the Renaissance, the concept of scenography was renamed 'perspective' [1,3].

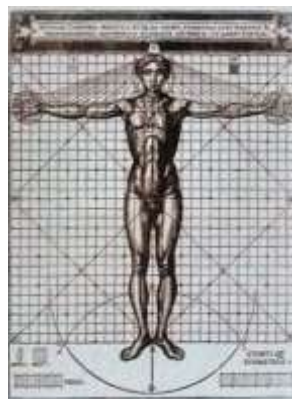


Fig. 1. Restored drawing of Vitruvius.

During the Middle Ages, the cities of Western Europe and monasteries were the primary centers for the creation of architectural images and graphic representations. The professionals were highly skilled and practical, with a focus on hands-on experience. The master's workshop did not allocate specific time for theoretical stories, nor did it have any specific terms for mastering the craft. The apprentices were able to gain expertise in the craft through this time-tested method, which has been successfully passed down through generations. Instead, the apprentices learned by

assisting an experienced architect in everything, mastering the particular method of the master without modifications to meet the requirements of the time. This method was passed down from generation to generation within the workshop or tradition of a family of hereditary architects, such as Steinbach. The method of training employed during the Middle Ages, which relied on intuition and creative design rather than clearly designed projects with geometric and graphic parts, contributed to long-term issues and delayed construction. It is evident that future architecture specialists were trained in the medieval craft workshop style.

During the Renaissance, the workshop system provided practical solutions to technology and construction problems. The most scientific and progressive method of constructing images was based on geometric laws, leading to a new level of visualization and graphic execution of architectural objects. Italian scientist Leon-Battista Alberti (1404-1472) stated in his treatise 'Ten Books on Architecture' that without knowledge of geometry and the willingness to study it, even the most talented individual will never become a great artist [7. 11].

Under the supervision of the master craftsman, the future specialist learned everything that an architect needs to know. This included canons, geometric foundations of design, and graphic methods such as perspective on a geometric basis and the theory of perspective. Visual methods were predominant. The Renaissance period resembled a certain academic system in which the skills of the drawing hand, the ability of the observer's eye, and the development and formation of the imagination were used in the creative work of the professionals (fig. 2).



Fig. 2. Leon Batista Alberti. «Ten books about architecture»

Albrecht Dürer's Guide to Measurement by Compass and Ruler (1471-1528) is an exceptional manual for artists and the first German textbook on geometry. The book covers the basics of geometry, perspectives, optics, astronomy, architectural forms, and the theory of ornament with remarkable clarity and precision. This text is a testament to Dürer's expertise and mastery of the subject matter. Albrecht Dürer (1471-1528) confidently opened his own school and successfully implemented the Italian method of training. With his dedication to studying the history of art, drawing, and geometry, Dürer was able to theoretically justify orthogonal projection on two mutually perpendicular planes and propose graphical methods for constructing perspective images using orthogonal projections. These groundbreaking methods are now known as the 'Dürer method' or the ray trace method (Fig. 3) [2, 6].

During the X-XVII centuries, the study of the graphic and geometric foundations of architecture was conducted within workshops and continued through corporate training in architectural design. This educational approach originated in Italy and later became known as the Italian educational system in architecture. The 'Building Artels' extended this type of architectural education. The training in architecture and its geometric justification occurred through the transfer of practical skills via oral explanations and visual demonstrations of construction techniques. The graphic representation was not precise, as it was based on the workshop corporate system of separate construction artels. Descriptive geometry emerged as a new scientific practice, marking

the beginning of generalizing and systematizing knowledge about the representation of spatial forms on a plane (Fig. 4). 'Geometric Descriptive' (1795), the work of French engineer and geometer Gaspard Monge, provided a strong foundation for this field. Constructing an image of an architectural object using this method requires learning in an academic model. The student is taught by the teacher in an auditory, which is separated from practice. For a modern engineer and architect, knowledge of descriptive geometry is mandatory [9].



Fig. 3. Albrecht Dürer. The Return of the Prodigal Son

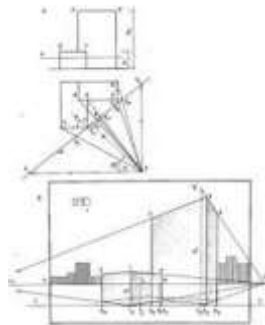


Fig. 4. Building a perspective by the "architect's method"

Architectural mastery in the 20th century was a complex process due to disagreements between the artistic, compositional, and engineering components of architectural education. However, the curriculum of the Bauhaus (Institute of Art, Design and Architecture in Germany) confidently aimed to combine industry and artistic creativity through a synthesis of art, technology, and science in the development of propaedeutic courses for teaching professional disciplines. The Bauhaus teaching cycle for the geometric-graphic basis consists of three parts: propaedeutic (initial), practical (basic), and master's (constructive thinking course) [4, 5].

The 21st century has witnessed remarkable progress in materials science, construction science, and design technology. These advancements have facilitated the fusion of architecture and natural landscape, enhanced architectural formation, and a departure from pragmatism towards innovative and unconventional solutions. A modern architect can confidently develop an original architectural project without being bound to a specific style, thanks to the capabilities of geometric language and CALS technologies of graphic visualization. Architecture students today receive extensive training in graphics and geometry and regular updates in complex fine and engineering disciplines. The development of computer graphics opened new paths in graphic art and new possibilities in design. Developing a unique graphic language that distinguishes the project bureau or architect is a challenge in architectural practice. The author's handwriting, also known as the

graphic language, varies among artists, with some using classical methods and others creating their own presentation systems.

At the moment, the relevant questions are:

- originality in graphic solutions;
- a strong relationship between the architectural project and its presentation.

The visual language utilized by practical architects is based on a system of rules. This text presents various examples of architectural methods and approaches to effectively solve problems related to graphic visualization of architectural objects, as demonstrated by multiple bureaus before presenting their projects.

Jeanne Gang's Bureau presents a variety of architectural graphics to develop eccentric ideas for the project. The presentation materials should clearly convey the essence and conceptual design of the project. An excellent example of this is the 40 Tenth Ave project (Fig. 5). The bureau proposed a compromise solution for this object. The reason for this proposal was the desire to preserve the park near the object and avoid shading the territory unnecessarily. The project's concept was to utilize sunlight, and the building's geometry was designed based on an analysis of sunlight reflection and propagation. To minimize shadows in the park, the corners of the house are clipped inside the volume. The project's graphical diagram illustrates the concept and demonstrates its functionality. The architects named their principle 'solar carving' - 'carving by the sun.' They liked the idea of connecting the sun with the bureau building's form, so they continued to work on three additional projects. The object's shell geometry is formed based on the angle of incidence of sunlight. The use of various versions of graphic images is inherent in modern architectural graphics. Architectural presentations have always aimed to fully and easily present the general idea or design object [10,13].



Fig. 5. Bureau of Jeanne Gang Project 40 Tenth Ave. Approved project and initial idea

Hamzah & Yeang Architectural Bureau (supervisor Ken Young) also uses various types of graphics to present his ideas. The Bureau's "green style" focuses on the application of landscaping. According to the bureau, manual sketching makes the project more emotional and spiritual (Fig. 6). But in our time, this does not exclude the combination of traditional with computer visualization [8].



Fig. 6. Architectural Bureau T.R. Hamzah & Yeang (supervisor Ken Young)

In general, architectural presentations serve as a powerful visual tool to convey project content and describe imaginary objects or ideas that have not yet been realized. Graphical presentations are an extremely effective means of communication. Advancements in computer

technology have elevated architectural graphics to a new level of quality. This is due to improved software for visualizations and the increased processing power of personal computers.

Conclusions. The current state of the art is a fusion of traditional techniques and modern technology: 1. The study unequivocally demonstrates that the evolution of methods of creating visual images in architectural graphics is inextricably linked with the historical context and technological progress. 2. Architectural graphics have evolved significantly throughout history, from manual techniques like drawing and watercolor to modern digital tools and virtual reality. Cultural and social factors have played a crucial role in shaping the development of visual image creation methods in architectural graphics, as research indicates. Changes in aesthetic preferences and architectural styles have significantly influenced the methods and techniques of visualization. 3. Modern technologies, such as computer graphics, virtual reality, and augmented reality, play an increasingly important role in architectural graphics. These tools empower architecture and design specialists to produce highly accurate, lifelike, and captivating visual representations. As a result, the visualization of architectural concepts is greatly enhanced, leading to improved customer and public perception. 4. The study demonstrates the significance of combining traditional and modern methods for creating visual images in architectural graphics. While new technologies offer various opportunities, they should not entirely replace traditional approaches, as they can produce valuable and distinctive outcomes.

The dynamic and multi-layered evolution of methods for creating visual images in architectural graphics necessitates constant adaptation and innovation in this field. Computer graphics and virtual reality have significantly impacted the development of architectural graphics. They allow architects and designers to create more complex and realistic visual images.

Prospects for further research. Many aspects of the topic of methods for creating visual images in architectural graphics remain studied not really sufficiently. To fully understand the history and future possible ways of creating visual images in architectural graphics, it is essential to continue research in certain areas. The impact of digital technologies on the creative process, as well as specific digital technologies such as artificial intelligence and generative algorithms, must be carefully considered. Analyzing innovative methods and tools can aid in understanding how new technologies shape the future of the industry. Furthermore, analyzing the aesthetic and sociocultural aspects of visual communication in architectural graphics is essential. Architectural graphics play a significant role in the emotional perception of the audience and the socio-cultural connotations of visual images. Our research can focus on the synthesis of traditional and modern methods of creating visual images in architectural graphics. By analyzing the possibilities of integrating different approaches, new techniques, and tools can be developed using the best aspects of classical and modern methods. Further research in these areas can greatly expand our understanding of the evolution of architectural graphics and help develop innovative approaches to creating visual images in this field.

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ЕВОЛЮЦІЯ АРХІТЕКТУРНОЇ ГРАФІКИ В ІСТОРИЧНОМУ КОНТЕКСТІ

¹О.В.Перепелиця

perepelytsiaokvl@ogasa.org.ua, ORCID 0000-0002-7364-0205

¹О.М. Самойлова

amsam288@gmail.com, ORCID: 0000-0002-0748-519X

¹Одеська державна академія будівництва та архітектури, Україна

Анотація. Стаття є дослідженням динаміки та трансформації методів візуалізації в архітектурній графіці на різних етапах історії. Мета дослідження полягає в аналізі еволюції цих методів у контексті історичного розвитку, та їх впливу на сучасні практики. Дослідження ґрунтується на огляді літератури, аналізі історичних відомостей та сучасних тенденцій в архітектурній графіці. Розглянуто різні етапи розвитку методів створення візуальних образів в архітектурній графіці, починаючи з традиційних ручних технік, і до сучасних цифрових інструментів. Виявлено фактори, що впливають на еволюцію цих методів: технологічний прогрес, культурні та соціальні зміни, та інші. В статті наголошено, що одним з професійних викликів у архітектурній практиці є завдання формування авторського почерку графічної мови, за яким впізнають автора проєкту, архітектора або організацію. Були наведені приклади цікавої візуальної подачі проєктів архітектурних бюро тощо. Розглянуто, що сучасна графічна мова різноманітна, є сумішшю традиційних і сучасних візуальних технік. Зроблено висновки, що еволюція методів створення візуальних образів в архітектурній графіці є багатоаспектною та динамічною. Також визначаються перспективи подальших досліджень, включаючи аналіз впливу цифрових технологій, естетичних аспектів візуальної комунікації та синтезу традиційних та сучасних підходів. Робиться висновок щодо необхідності подальших досліджень для глибшого розуміння еволюції архітектурної графіки та розробки інноваційних підходів до створення візуальних образів у архітектурній практиці.

Ключові слова: архітектурна графіка, авторський почерк, метод створення архітектурного зображення, графічна візуалізація об'єкта, графічний стиль, майстри-ремісники, архітектурне бюро.