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MODERN METHODS OF GEOMETRIC CREATION BASED ON THE SOURCES OF CENTRAL ASIAN ARCHITECTURE

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Abstract: This article provides information on the implementation of computer graphics in Auto CAD graphic programs in the formation of geometric constructions and gyrikhs presented in the sources of Central Asian architecture.

Key words: Pargor, Central Asia, Architecture, IX-XV centuries, "Ilmi handasa", girix, Auto CAD.

In the 9th-15th centuries, the cultural achievements of universal importance were creatively combined in the culture of Central Asia, at the same time, the culture of the region effectively influenced and enriched the cultures of other nations.

Science, culture, art, architecture, urban planning, and handicrafts have been developing in Central Asia since the 9th century, which is considered the era of renaissance. During this period, Central Asia became economically stronger and cities flourished. As a result, scientists began to appear in a number of scientific schools in the region.

The most famous scholars who wrote their works in Arabic in the 9th-15th centuries were from Central Asia. Among them are Muhammad ibn Musa Khorezmi (9th century), Abu Ali ibn Sina (980-1037), Abu Nasr Farabi (873-950), Abu Rayhan Beruni (973-1048), Abul-Wafa Bujani (940-998) and others. there was Later, Mirza Ulug'bek (1394-1449) and Ghiyosiddin Jamshid Koshi (XIV-XVasrlar) joined their ranks.

It is known that medieval Eastern scholars diligently studied the philosophical and mathematical works of ancient Greek authors. They popularized them throughout the Islamic world and made a great contribution to their further development. Central Asian scholars also produced great works in all fields of secular science, including mathematics, geometry, astronomy, philosophy, medicine, and music.

In addition, in the works of Eastern and Central Asian scientists created in the Middle Ages, a number of issues related to geometric structures and proportions, which are necessary for architects and craftsmen, were also covered. For example, in the Middle Ages, a number of great encyclopedic scholars emerged from Central Asia, whose works have not been fully studied until now.

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Abu Nasr Farabi (873–950) The full name of Farabi, a famous Central Asian philosopher and encyclopedist who made a great contribution to world culture, is Abu Nasr Muhammad ibn Muhammad ibn Uzlug Tarkhan. Farobi was born in 873 in the family of a military officer from Turkic tribes, in a place called Farob-O'tror on the banks of the Syr Darya. The area where he was born was ruled by the Samanids and was considered the northern border of the Arab caliphate.

After he got his academic degree, he wrote more than 160 works covering almost all fields of science. Farabi's works on mathematics, astronomy, medicine, music, philosophy, linguistics and literature became famous all over the world. He wrote "On the Purposes of Aristotle's Metaphysics", "On the Organs of Living Beings", "The Book of Music", "On the Attainment of Happiness", "Siyasat al-Madaniyya" ("Politics on Cities"), "The City of Virtuous People". ", "Essence of Issues", "Book on Laws", "On the Content of Thinking", "Book on Introduction to Logic", "Book on the Essence of Philosophy" and other works testify to the incomparable breadth and depth of the scope of knowledge and worldview of the great scientist.

According to Abu Nasr Farabi, arithmetic and geometry are part of all sciences and arts. His "Book of Spiritually Beautiful Methods and Natural Secrets About the Elegance of Geometric Forms" written in the 10th century was of great interest to architects. In it, Farobi revealed the secrets of beauty related to the creative research of the best proportions, beautiful proportions, and the geometric harmony of works of art. Abul-Wafa al-Buzhani mentioned that it is almost completely consistent with "The book about what is necessary for artisans from geometric designs" written after Farabi.

According to Farabi, "Beauty and usefulness cannot be separated from each other, and their combination leads to harmony." In the 1st chapter of this treatise, that is, "...he gave each of these pieces the shape of a certain figure (image) and began to place them in a certain order. Thus, triangles, rectangles, pentagons were created, and in this way, the figures were created based on the divided pieces according to the order of the infinite numbers This is how we need a science that can know the figures that connect these pieces. Thanks to this science, we can compare the figures and find their general dimensions, thanks to this science, we can determine the similarity of one figure to another, thanks to this science, which figure fits into which and which one is its own. we can know the composition and other properties of the figure. This science is the science of measurement."

We can conclude from these. Through these verses, Farobi laid the initial foundation for architectural figures and the concept of measurement by mentioning the origin of the concept of measurement and its interpretation, which is also called geometry in Greek. Further developing his thoughts, he says, "The origin of this science is four elements: fire, air, water, and earth, and the fifth element that moves them is the sky." It states that all existence in the world is made up of these four elements and the sky that moves it.

of Muhammad al-Khwarizmi (783–850) " *At first glance, his work entitled "A short book on algebra and reciprocal calculus" seems to have nothing to do with architecture, but in fact, the information about right-angled triangles and irrational quantities, as well as*

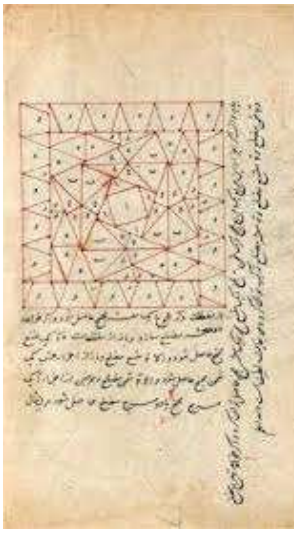
information on determining the volume of cubes, parallelepipeds, cones, and pyramids, aroused great interest among architects.

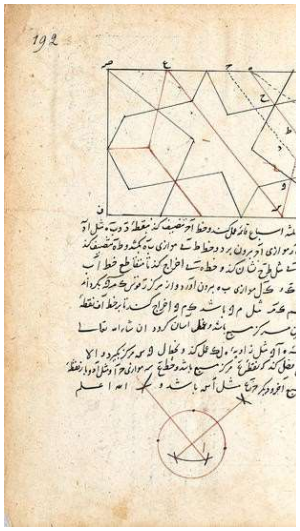
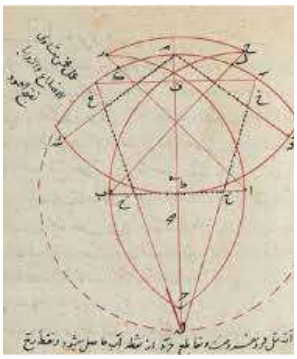
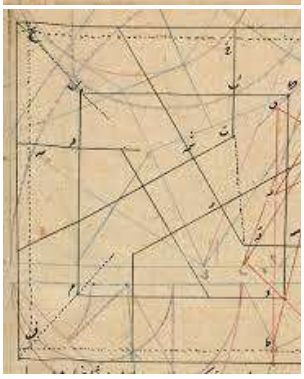
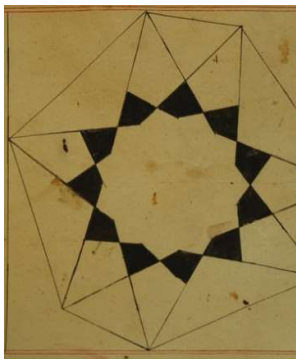
Al-Kharozmi, for example, "I proposed a short book on algebra and al-muqabila calculation, which includes simple and complex arithmetic problems, "because in the distribution of inheritance, in making a will, in the distribution of property and in justice, in trade and in all transactions, it is also necessary for people in land surveying, canalization, geometry, and other such diverse works" refers to the execution of architectural measurements using the methods of arithmetic and geometry. At the same time, Khorezmi states that he intends to solve the needs of the caliphate, the issues that arise according to the requirements of Islam and Sharia, and the issues related to architecture and irrigation.

Abul-Wafa al-Buzhani (940-998) He was recognized as a great scientific personality in his field and had close relations with the great scientists of his age such as Abu Rayhan Beruni. When Abu Rayhan Beruni was in Khorezm, he arranged with Bujani, who was in Baghdad to study lunar eclipses, to compare the lunar eclipses at two different points. Buzhonyi made a great contribution to the development and prosperity of geometry, trigonometry, applied geometry, astronomy and mathematics. That's why they nicknamed him "Account" and "Engineer".

Abul-vafa Buzhoni's work entitled "The book on what craftspeople need from geometric designs" is especially noteworthy. In this work, along with his own researches, Bozhoniy collects unknown researches on geometric drawing and brings them into a collection. Currently, a copy of this collection in Persian is kept in the National Library of France in Paris. In this work of Abul-Wafa al-Bozhani, special attention is paid to geometric drawings made with the help of a circle (pargor).

Abul-Wafa al-Buzhani lived in the third period of the development of the science of mathematics. His works are also a clear example of the mathematics of this period. The theoretical and scientific resources enriched by the third period of mathematical science were first of all aimed at solving the most difficult scientific problems of that time. During this period, the burden of conducting research on the science of mathematics was placed on Muslim mathematicians.



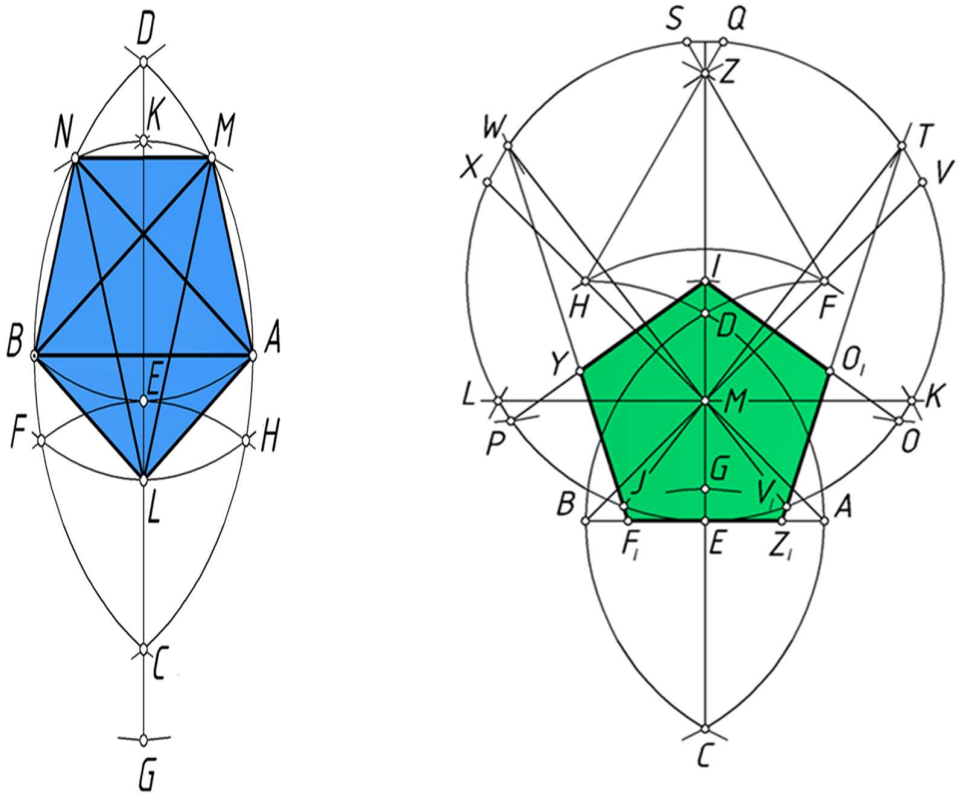


Figure 1.

Abul-Wafa al-Bozhani's geometrical constructions are presented in the book "The Book of What Craftsmen Need from Geometrical Constructions".

Let's try to make a regular pentagon from one of the geometric constructions given in the above source in the Auto CAD graphic program of computer graphics.

AV cross-section with a certain length is drawn  -(lines) draw one of these lines with the command  -(copy) is copied and one end is joined to the other end 72^0 turning the corner (Figure 2, a) perpendicular straight lines are drawn from the centers of two straight lines, the point of intersection of the perpendicular straight lines  -(multiplication) command is selected 

transferred to the department 

and after entering the number of the object, the center of rotation, i.e., the point of intersection of the transferred perpendiculars, is determined as the center. Then, if the section AV is selected and confirmed at the stage, a regular pentagon is formed (Fig. 2).

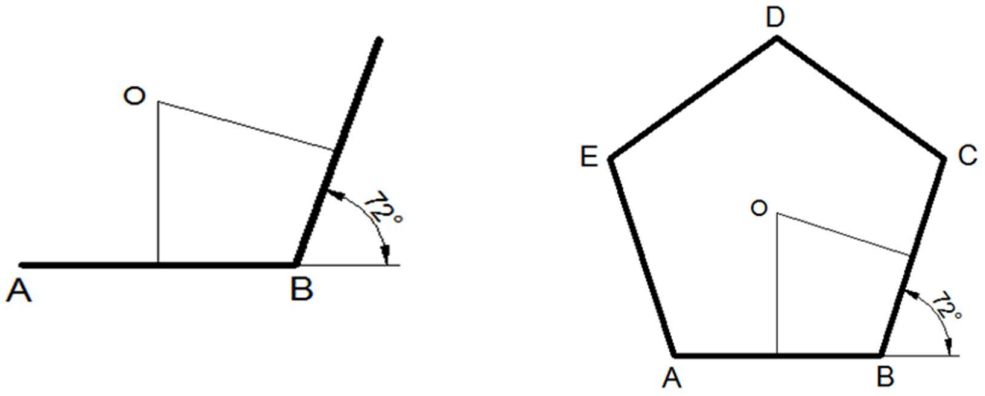


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Figure 2.

Abu Rayhan Beruni (973-1048). The great allama of Khorezm, Abu Rayhan Beruni, was orphaned by his parents at a very young age and was brought up in an Iraqi household. He created about fifteen of his works here. It is known that he wrote a scientific work about architecture, and this work was called "Kitab al-khiyal ar-rukhaniyya wa-l asrar at-tabiyya fi daqiq al-ashkal al-khandasiyya" and it consisted of 10 books. This work has been the main rule of architecture from the time of Beruni until today. In addition, the work "Science of the stars" or "Understanding the basics of the science of the stars" (Kitab at-tafkhim li avail sino at-tanjim) consists of an introduction and 8 chapters, and the 1st chapter is called "Geometry" and it consists of 71 chapters. : it contains the definition of geometry, the definition of a body, measurement of space, length, width, depth (or height), "six sides", that is, measurement taking into account directions, surface, line, point, plane and straight line, angle, types of angles, plane shape, circle, diameter, etc. A person who has completely interpreted these two chapters will be able to easily apply all the geometrical and mathematical methods in architecture. For example, the most important elements of architecture are point, line (straight and curved), arc, rectangle, circle, prism, numbers, ratio, proportion, square, root, rational and irrational, golden mean (golden ratio), so if you find all the necessary concepts from this source will be

Abu Ali ibn Sina (980–1037) two works of "Donishnoma" and "Ash–

"Shifa" contains chapters related to geometry and mathematics, which were of great importance for architects in their time. In particular, "Ash-Shifa" consists of four parts, the third of which is "Usul ilm al-handasa" (Methods of the science of geometry) in "Riyaziyot" In it, Ibn Sina showed dividing the line into the middle and edge, that is, the "golden section". Ibn Sina, in his "Laws of Medicine", explained the need for sunlight to enter and ventilate the rooms of residential buildings, the windows and doors facing east and north, and the entry of winds blowing from the east into the building and writes about the need for sunlight to reach all parts of the rooms.

In this work, Ibn Sina, in addition to a clear picture of the mechanisms, also describes their drawing in a scheme. For example, screws with wheels. also illustrates wheel, screw, and block welding while also showing them graphically.

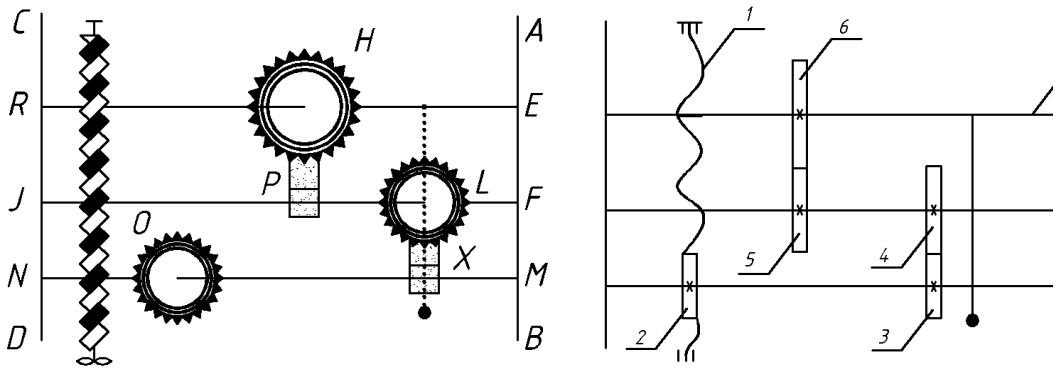

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Figure 3.

Such drawings can be found in the works of scholars such as Abu Rayhan Beruni, Al-Khorazmi, Ali Kushchi.

Abu Abdullah Khorezmi (10th century) Born in Khorezm, he worked as a secretary in the palace of Somoni Nux II in Bukhara. Little is known about his life and work. The only work of the scholar, namely the encyclopedia "The Key of Knowledge" (Mafotikh al-ulum) has reached us. It consists of 93 chapters and provides information about 20 disciplines. It was studied in general and partially by E. Wiedeman, Van Floten, M. M. Khairullaev, G. P. Mamvievskaya, R. M. Bakhodirov and others. J.H. Ibodov translated from Arabic into Russian and Uzbek the chapters on theoretical, practical calculation, criteria, geometry, astronomy, scientific instruments, and mechanics of "The Key of Sciences" with comments. Chapter 5 of this work is "Khandasa, that is, about geometry." It consists of four seasons:

1) introduction to this art; 2) about lines; 3) plains about; 4) about bodies.

The book "Miftah al-hussab fi-l-hisab" by Ghiyaziddin Koshi (1380-1429) is mainly about the basics of arithmetic, and its three-part chapter titled "Measurement of Buildings and Buildings" covers all the issues of architectural theory.

The author says that "those who know the science of architecture have never thought of writing a work about the need to measure structures and buildings. Taking this into account, I included the science of measuring buildings among the necessary knowledge.

Koshi calls the cup of muqarnas - byte, each row placed on top of each other is tabaka, the largest and main size module of the cup - scale. Gives information about four types of muqarnas: 1. Minbar - simple muqarnas; 2. At-tiyn - pottery muqarnas; 3. Al-qaws - arc-shaped muqarnas; 4. Ash-shirozi - Shirozi muqarnas.

Many architectural monuments were built in the 9th-15th centuries on the basis of the geometric constructions founded by Central Asian scientists and have been preserved to this day.

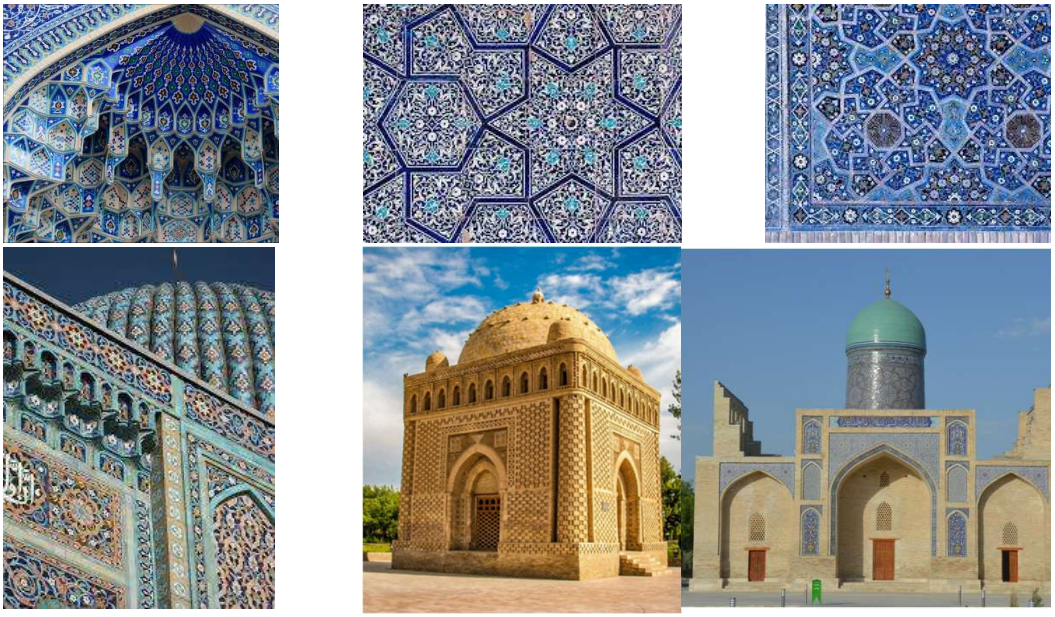

Figure 4.

In the process of depicting the geometric shapes of the architectural monuments in their original form, engineering graphics is an easy and time-efficient tool to perform on the basis of modern graphic programs. In the repair (part) of the geometric gyrikhs on the walls of the Magoqi Attori Mosque in Bukhara built in the 10th century (Fig. 5, a), we will try to perform their basis in the Auto CAD program of computer graphics.

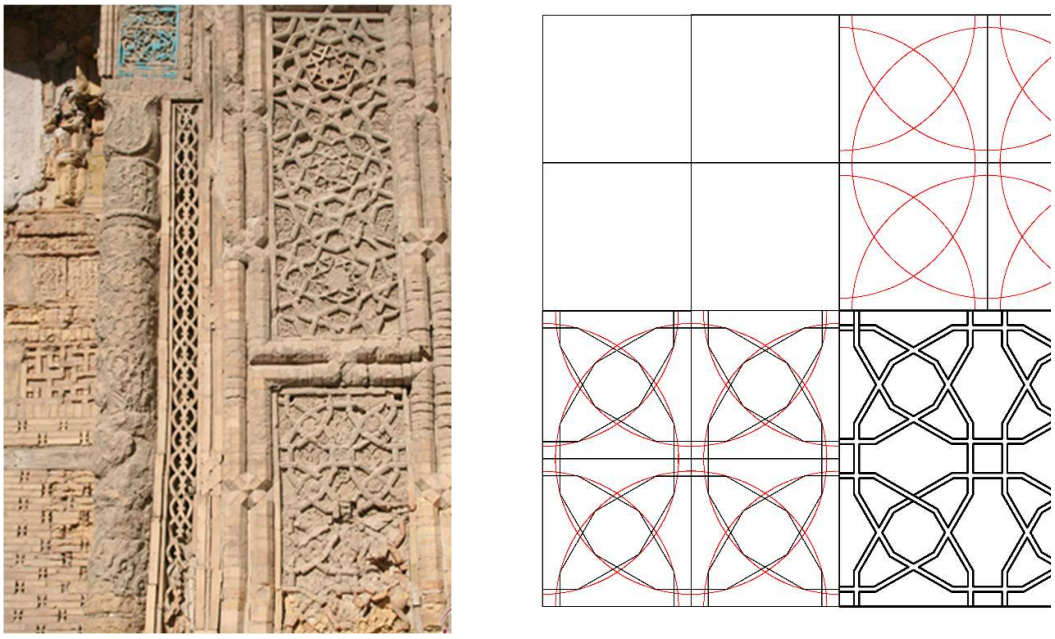

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Figure 5.

To do this, first of all, a square corresponding to the shape is located in the drawing panel of the Auto CAD graphics program -(a square is drawn through the rectangle) command -(The sides of the square are divided into equal halves by the command s line-lines) and circles of the same size are drawn from the center of the square, from the center of the sides, and from the ends of the square without changing the radius of the circle, in order to describe regular twelve-sided polygons inside this square. -(circle) and some parts of the circles that are left outside the square -(cut) is deleted with the command and equal to the diameter of the arcs of the circle, a regular dodecagon in the inner part of the circle, -(polygon) is drawn with the command (when the command is selected, the number of sides and the process of making the polygon on the inside or outside of the circle must be clearly indicated), as a result, circles are divided into twelve regular parts (the sequence of the execution process is shown in Fig. 5, b) and the circle and the arcs are deleted. Paralleling the straight lines of the resulting regular polygon at the same distance (actual distance) on both sides -(similarity) is copied with the command and becomes the basis for making the original appearance. Through these geometric constructions, a three-dimensional image of a geometric gyrix is also created (Fig. 6).

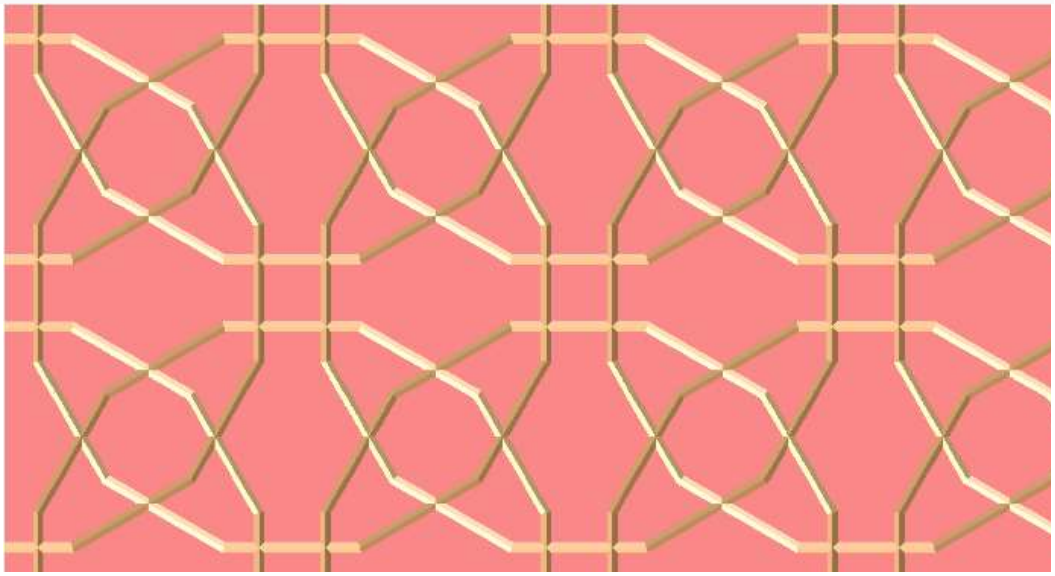

Figure 6.

There is no doubt that the architectural buildings that were built in their time and have not lost their status until now were built on the basis of the sciences of mathematics, physics, mechanics, geometry, including drawing geometry. The research conducted by many scientists in this regard is the result of scientific schools created in the 9th-15th centuries. We are always thinking about the responsible task of studying the many undiscovered aspects of these scientific schools.

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