Finding a New Method of Geometric Harmonization Based on the Scientific Results of Scientists

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ABSTRAC: *In this paper, the principles of geometric harmonization of traditional architecture of Central Asia and the solution of problems of proportionality are found and analyzed by scientists on the basis of scientific results.*

KEYWORDS: *geometry, dynamics, tradition, principle.*

Introduction.

In the process of studying the scientific works of Central Asian and foreign scholars on the harmonization of architecture and the results of scientific research, the lengths of the sides were integers,the right-angled triangle (the length of the sides: 3; 4; 5) aroused great interest in me and I used it to form a square.

Each geometric shape used in architecture had its own divine essence and symbolic meaning. For example, the square is a symbol of the world and nature, and its four sides represent the four elements, the four sides of the world, the four seasons of the year, and the four different times of day and night; the circle is seen as a symbol of the universe and divine power[1,1; p.22].

The Egyptian triangle is a right-angled triangle with legs 3 and 4 and hypotenuse 5, and by Pythagorean theorem the sum of the squares of the legs is a geometric shape equal to the square of the hypotenuse ($a^2 + b^2 = c^2$).

Well, now let's make the smallest square using an Egyptian triangle. To do this, take the ABC triangle: the small catheter AB-3 centimeters, the large catheter AC-4 centimeters and the hypotenuse BC-5 centimeters.Now we use this triangle to create a rectangle ABCD: then AC = BD = 3 centimeters and AC = BD = 4 centimeters, where we can see that the rectangle AC-4 is a rectangle with a diagonal and a width of 4 centimeters and a length of 3 centimeters.As a result of placing three such figures next to each other in width (4 + 4 + 4 = 12 cm) and four in height (3 + 3 + 3 + 3 = 12 cm) the side length (assuming the side length of the square as a) is a = 12 cm the square is formed. The square is rich in the golden rule and is considered a "perfect square" because it is made using an Egyptian triangle.

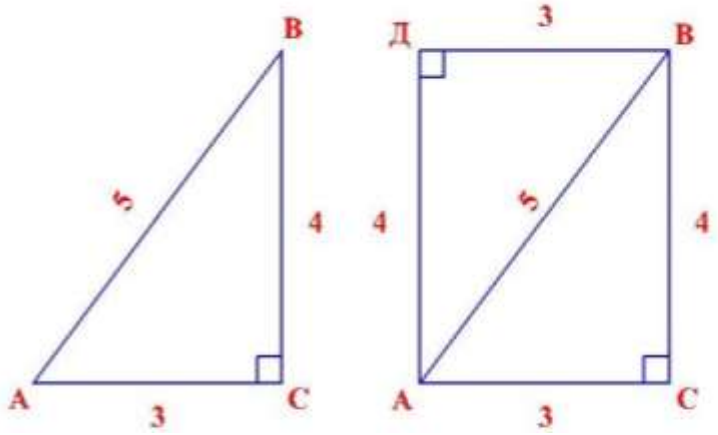


Figure 1. The Egyptian triangle and a straight rectangle made using it.

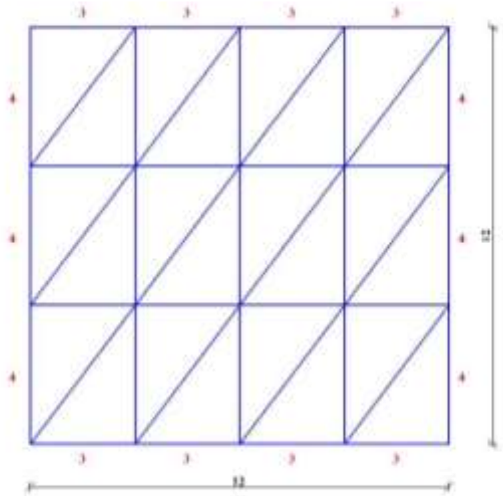


Figure 3. Perfect square

The origin of the golden ratio, the views of the ancient Greek scholars, Pythagoras, Plato and Aristotle, that ancient Greece dealt with the question of proportion, reflect at least the reflection of these questions in ancient philosophy and mathematics, primarily in Pythagoras. Pythagoras, one of the Greek philosophers, was probably the first to attempt a mathematical analysis of the nature of compatible relations. Pythagoras knew that the intervals of an octave could be expressed in numbers to the corresponding oscillations of the string, and Pythagoras considered these numerical ratios to be appropriate. Pythagoras knew arithmetic, geometric and harmonic ratios, as well as the law of the golden section.

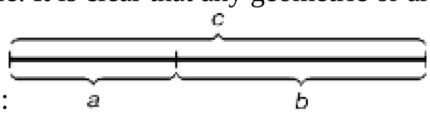
Pythagoras and his school are the main source of the divine proportions of the golden part (1: 2 = 3: 5 = 5: 8 = 8:13, etc.). This ratio appears in a series of numbers that are the sum of the previous two, that is, each subsequent number (1, 2, 3, 5, 8, 13, 21, 34, 55, 89, and so on).The ratio of two adjacent numbers is an irrational number between them (3-2, 5-3, 8-3, 13-8, and so on).However, as the number of consecutive numbers increases, the ratio between them becomes closer, which is the most complete value of this relationship [1.2; P-221].

Pythagoras revealed the secret of symmetry and asymmetry.Pythagoras described the rules for constructing geometric shapes, determining the area and volume for a cylinder, cone, pyramid, truncated pyramid, cube, parallelepiped. He also found a rational triangle (with sides in parts 3, 4, and 5). According to some evidence, he built right angles with three, four, and five ropes (only twelve knots)[1,2; p-226].

Today we think of the Pythagorean theorem as an algebraic relation, $a^2 + b^2 = c^2$, from which the length of one side of a right triangle is found, taking into account the lengths of the other two sides. But Pythagoras studied it, which, according to him, was a geometric statement about these places. It was only with the rise of modern algebra about 1600 CE, that the theorem took a familiar algebraic form. If we follow evolution, it is important to keep this in mind.For about 2,500 years since Pythagoras proved it for the first time, the theorem has perpetuated it. And he was not even the first to discover it: the theorem was known to the Babylonians and probably to China, a thousand years before it[1.3; P-11].

Many writers have commented on the beauty of the Pythagorean theorem, written in 1895 by Charles Lutvidge Dodgson, whose literary name is well known by Lewis Carroll: “It is as dazzlingly beautiful as it is today,” and Pythagoras was the first to discover it [1.3; P-12].

Plato, embracing Pythagoras ’doctrine of harmony, acknowledges the absolutely abstract“ ideal ”beauty behind regular geometric parts and especially moderately proportioned bodies in Pythagoras’ conversations with Socrates. He also emphasizes the importance of serving as a link between two often different quantities.Two parts or two quantities cannot be satisfactorily connected to each other without the aid of a third number; the most beautiful connecting joint, combined with the two initial quantities, provides the most perfect combined integrity. This is best achieved by a proportion (similarity) in which three numbers, a plane or an object, one of which is averaged and the other is averaged over the first. It follows that the mean belongs to the second, because the former can replace the first and the second, the first and the second average, and all together form an integral whole. It is clear that any geometric or arithmetic ratio meets these conditions.

Here: 

a:b=b:c, **a-b=b-c** stems from the attitude.

Aristotle promotes order, symmetry (i.e., proportionality) and limited volume as the basic requirements of beauty. The order requires certain ratios of the dimensions of the individual parts relative to each other and to the whole, not random. In the Shari'a, in his opinion, the rhythmic relations of the verse based on small number ratios give a beautiful impression. In addition to the simplicity based on the proportions of the individual parts of the whole, he also recognizes the importance of proportions, which, like Plato, establish the correct relationship between the three and four quantities of the highest beauty of regular figures[1.7; P-10].

Among mathematicians, this proportion is called the "division of a given section into edge and middle ratios," while in the language of architects and painters it is called the "golden section". The name was first given to him by Leonardo da Vinci, a famous architect and painter of the European Renaissance (15th century).It was later referred to in architecture as the “golden ratio” or “golden division,” and many scholars have conducted research on geometric shapes and proven ways to derive the “golden ratio”.

Now the reason the square is called perfect is that the number a = 12, which is the length of the side, is simultaneously divisible by the numbers 1, 2, 3, 4, 6, 12 without remainder, and the number of divisors is six. We know that in mathematics, if the divisor of a number is more than three, the number becomes complex.

For example, if we take the number 10, the divisors of this number are 1, 2, 5, 10, that is, four, and if we take the number 14, it is known that the number of its divisors is four (1, 2, 7, 14), but there are six divisors of the number 12 is an unusually complex number. The division of the sides of a square into such integers (1, 2, 3, 4, 6, 12) is very useful in architecture.

Бу another feature of the square is that the division ratios on the sides form rational numbers such as 1: 2, 1: 3, 1: 4, 1: 6, and 1:12.

Now, if we look at the numbers that are multiple to the number 12, that is, they form an arithmetic progression: 12, 24, 36, 48, 60, 72, 84, 96, 108, 120, 132, 144, 156, 168, 180, 192 ... are indicative of and are used in many square monuments in Central Asian architecture.

For example, the history of the Samanid mausoleum in Bukhara is square and its side is 1080 centimeters long,similarly, the side of a square house in Nisa (Turkmenistan) is about 6,000 centimeters and even the history of the Taj Mahal, built by the Baburis in India, is square, with a side length of 12,000 centimeters, proving that the lengths (1080 cm; 6000 cm; 12000 cm) used in the history of these monuments are directly proportional to the side of our "perfect square".

Similarly, in the "perfect square" we create a series of dynamic squares.To do this, we divide the "perfect square" into 12 equal parts and create a grid. This creates a grid of squares of 1x1 cm. Then we move the diagonals to the “perfect square” and connect the points where the modulus grid intersects the diagonals, parallel to the sides of the “perfect square”, we get a series of dynamic squares (the lengths of the sides are integers: 2x2 cm; 4x4 cm; 6x6 cm; 8x8 cm; 10x10 cm; and 12x12 cm). If we express the resulting dynamic squares in rational numbers, that is, in ratios, ratios such as 1: 2, 2: 3 gold ratio, 3; 4, 4: 5, 5: 6 are formed.

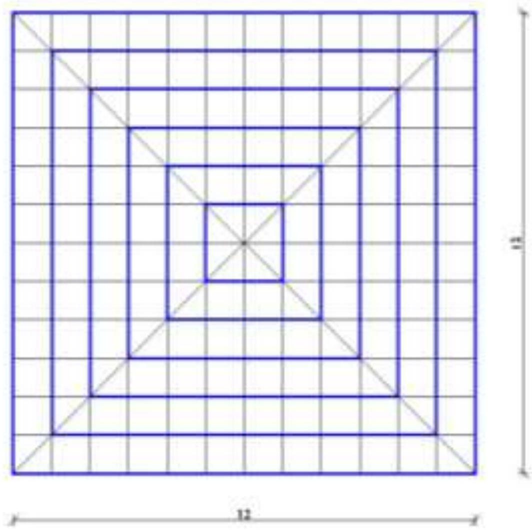


Figure 3. Dynamic squares

For example: we use two squares at the same time (8x8 and 12x12) and if we enlarge these squares 90 times, we get inner and outer squares of 720x720 cm and 1080x1080 cm, respectively. Amazingly, this is a proof of the history of the Samanid mausoleum.

Using the “Perfect Square”, we create a series of squares of different proportions, a grid of squares, that is, rectangles of right angles.

If we place the square side by side and form a series of squares, the following simple rational integer ratios (1: 2, 1: 3, 1: 4, 1: 5, 1: 6 etc.) are formed. If we repeat the square several times in width and length, in the form of a rectangle, the result (2: 3, 2: 5, 3: 4, 4: 5, 5: 6, 6: 7, 7: 8 many) is a simple integer ratio, ie the squares form a grid or a right-angled rectangle, and these ratios repeat and confirm the idea of proportion in the scientific work of the Russian scientist K.N. Afanasev. The difference is that we have the exact size of the side of the square.

So what does the number 12, which is the length of the "perfect square" side, mean today and in history, and where has it been used?

From time immemorial, various nations have also relied on the number system of five and ... twelve. Its counting is based on the number of joints in the four fingers of one hand. The thumb is not taken into account, because we count the remaining joints using it. In this system in Europe, twelve of the things counted were one dugins, twelve dugins were one gross, and twelve grosses were mass. This is also reflected in the units of measurement: the English measure of length - the foot is divided into 12 inches, the troy pound is equal to 12 ounces. In general, a twelve number has advantages over a decimal number: it is divisible by four without a remainder: 2, 3, 4, 6. Ten is only two numbers: 2 and 5 without a remainder. The number twelve is also very common in daily life and is of great importance in various spheres of life. Pay attention to the most important of them: In time measurements: the year consists of twelve months, divided into two (day and night) twelve hours a day. The national clock displays 12 digits, the minute hand of which rotates 12 times faster than the hour hand. The Zodiac cycle is 12 years, and the constellations are also twelve... [1.8].

It follows that the number 12 is rooted in our historical traditions and our past. Now let's assume that if this number was used a lot in ancient times, this number may have influenced architecture and probably used it.

It should be noted that Babur Mirzo in his work "Baburnama" also dwells on delicate jurisprudential issues in several places.As mentioned in Mubayyin, these kurohs were marked according to one mile:

Tort mingdur qadam bila bir mil,
Bir kuroh uni hind eli der bil.
Dedilar bir yarim qari bir qadam,
Xarqaribilki, bordurol tihandful.
Har handful turtelik, yana harelik
Oltijavarzi boldi, bil, bubilik.

We have defined the measure of tanap as a forty-year-old with one and a half elders mentioned and nine ears, whose face tanap will be a kuroh[1.5; p.259].

According to A.S. Uralov, Babur (1483-1530) describes the length as follows: "Each kari , know that it is six handful, each handful is four fingers, and each finger is six barley width". The kari in the Baburnama is equal to 60 cm. However, anthrometrically, the kari is equal to the Greek elbow, which is also six handful (each handful is four fingers) or 46.35 cm.

However, it seems that Babur Mirza's words about the measurement were interpreted differently by researchers. So let us dwell on the words of Babur Mirza and analyze them:

Each handful four fifty; if we take into account the four fingers, it has 12 joints, so that 1 handful is equal to 12 cm;

Every old man knows that there were 6 handful; Here (1 kari 6 handful) x (1 handful 12 cm) = 72cm and 1 kari turns out to be 72cm.

They said one and a half kari is one step; where (1 step is 1.5 kari) x (1kari is 72 cm) = 108 cm, and it follows that one step is equal to 108 cm.

Four thousand steps a mile; Here (1 mile 4000 steps) x (1 mile 108 cm) = 432000 cm and it follows that 1 mile is equal to 4320 m and is proportional to the number 12.

Rui Gonzalez de Clavijo, a Spanish traveler and ambassador who visited the palace of Amir Temur in the 15th century, writes in his diary:On Friday, the twenty-first of November, the ambassadors left and moved from there, from Samarkand, along a good, smooth, and busy road. For six days they walked and were given everything they needed, as well as shelter and food.

On Thursday, the twenty-seventh of November, we arrived in a great city called Bukhara. It lies in a wide area, flat and surrounded by a soil shaft and a deep ditch. At one end the castle was also earthen, for there were no walls or stones to make the walls [1,6; P-145].So Rui Gonzalez de Clavijo left Samarkand on Friday and arrived in Bukhara six days later on Thursday.

M.K. Akhmedov said the caravans usually walked only at night and from dawn to dusk in the heat of summer.The distance traveled in winter and summer was not the same. Therefore, the average distance printed is about 35-55 km. Taking this into account, and considering that the settlements correspond to the days of the week, we see that long-distance settlements are formed on the basis of a certain rhythm, if it is not possible, settlements (medieval caravanserai, hazora, teahouses and guest houses). This rhythmic step is accompanied by a larger stop every 35-55 km and other intermediate points every 16-24 km [1.4; p.110].

It follows that the caravan stopped at a distance of 10-11 miles on average (43200 m or 47520 m) and about 4-5 miles (17280 m or 21600 m) in one day (according to Babur Mirza about the measurement).

Similarly, the Central Asian "sharia" arshin used in history is 60-62 cm, which is equivalent to a double heel or the part of an outstretched arm from the shoulder to the fist. In the XVIII-XIX centuries in Bukhara was used "horn arshin" with a length of 108 cm. However, architects preferred to use half of the arshin (30-32 cm) or 52-54 cm. Because the dimensions of bricks are suitable for this as well. Thus, not only the "canons" of proportion corresponding to the human figure, but also the dimensions of length served as an important tool in ensuring the proportions of architectural forms.Length measurements (tovom, span, kari, arshin, half arshin) are derived from the dimensions of human body parts.

It can be seen that the Central Asian "Shariat" arshin used in ancient measurements was 60-62 cm, in Bukhara in XVIII-XIX centuries the "horn arshin" was 108 cm long, and architects used half of the arshin (30-32 cm) or 52-54 cm, this proves that the arshin measurements used are directly proportional to the side of the "perfect square".

Forinstance: 1 arshin 60cm = 5x12; 1 arshin 108cm = 9x12; half arshin 30cm = 2.5x12; half arshin 54sm = 4.5x12. The accuracy of these results proves that the “perfect square” serves as a new method in finding the secrets of geometric harmony and proportion in architecture.

In short, the "perfect square" based on the Egyptian triangle serves as a new way to unravel the mysteries of geometric harmony and proportion, as evidenced by the Central Asian memorials built in direct proportion to its sides. The above differs from the square-based methods of the scientists in that it has precise dimensions of the sides of the "perfect square" and consists of an Egyptian triangle.Furthermore, the number 12, which is the length of the side of the square, is a very significant number in history. It can be used to study the memorial monuments of our country.

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