"REDISCOVERY" OF THE GOLDEN SECTION (RATIO) IN BYZANTINE ART

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Abstract. The principle of the golden section is "rediscovered" and used in the design of civil and religious constructions, and in creating large-scale systems used in artistic creations.

Keywords: golden proportion, golden section, Byzantine art.

Introduction

Analyzing the artistic and architectural creations of ancient Greece, one can say that most of the knowledge of the Egyptian civilization "migrated" over the Mediterranean; this migration was possible through the travels taken by the Greek scientists and historians in the Egyptian Empire, its influence on the archaic Greek culture being evident. Along with the blossoming of the Greek city-states and with the crystallization of the artistic styles in this area, one can see the strong cultural evolution that took place, and which certainly influenced the development of European culture throughout history. Since the ninth century B.C. Athens, Corinth, Sparta, Ephesus became centers where science and art greatly developed, largely due to political consolidation and economic development of those cities. Philosophical principles and visions on the universe led to major changes in both the artistic concepts and the structure and social organization.

Materials and methods

Thus, the principle of the golden section is "rediscovered" and used in the design of civil and religious constructions, and in creating large-scale systems used in artistic creations. The golden ratio (or section) is studied both, from a mathematical and from a philosophical point of view, being used as a criterion for determining the "beautiful". In Timaues, Plato showed that the Pythagoreans paid special attention to the study of the five regular convex polyhedra (the *tetrahedron,* the fire symbol, its sides being represented by four equilateral triangles; *the cube* with six square sides, the symbol of earth, the *octoedron,* bounded by eight equilateral triangles, the air symbol; *the icosaedrum* with 20 equilateral triangles as its sides, the water symbol, the *dodecahedron*, the symbol of the cosmos with everything in it, is the only regular polyhedron consisting of 12 pentagon sides and not of triangles or squares).

Pythagoreans argued that numbers were the basis of the universe existence; they were the ones who found analogies between the harmony of musical sounds and mathematics. Thus, they believed that harmonic sounds were in close relationship with specific numerical reports, which led to the study of whole numbers, fractions, and to the discovery of irrational numbers, the notion of *harmony* being applied not only in relation with music but also in relation to the entire existence. These principles, and that of kalokagathia, developed by philosophers in the Age of Pericles were the main criteria used for achieving artistic creations. These criteria were implemented in architecture and sculpture, in the process of ideatic evolution, assimilating both, the influence of the ancient Greek culture and the knowledge of the Assyrian-Babylonian and Egyptian civilizations. The artistic and architectural creation of the fifth century BC is dominated by the feeling of grandeur and harmony, and by a profoundly humanistic character, evidenced especially in the shapes and sizes of Parthenon from Athens. The construction of the assembly represents materialization in architecture of the complex geometrical knowledge that the ancient Greeks possessed, the use of the golden section being an essential element both, in the overall planning of the temple and in its detailed dimensions.

At G.I. Sokolov's indications, in order to achieve a harmonious composition, the engineers raised the land in the south part of the Acropolis; the area in front of Parthenon, the length of the Athens temple and the length of the Acropolis surface temple behind the Parthenon were created by using the golden ration. Watching the ensemble from the area of the front gates one can see the same relation between the size of the rocky mountain and the overall height of the temple. Its facade is framed in a

rectangle with a side ratio of 1:2 and the basis in a rectangle with a side ratio of 1/(square root of 5). It is well-known that the diagonal of the rectangle with side ratio of 1:2 has the size of square root of 5, and by that one can see that this is the starting point in the geometric building of the Parthenon (Fig. 1). The temple has a width of 100 Greek feet (3089 cm), and a height, according to N.I. Bruno's data, of 61.8 feet.

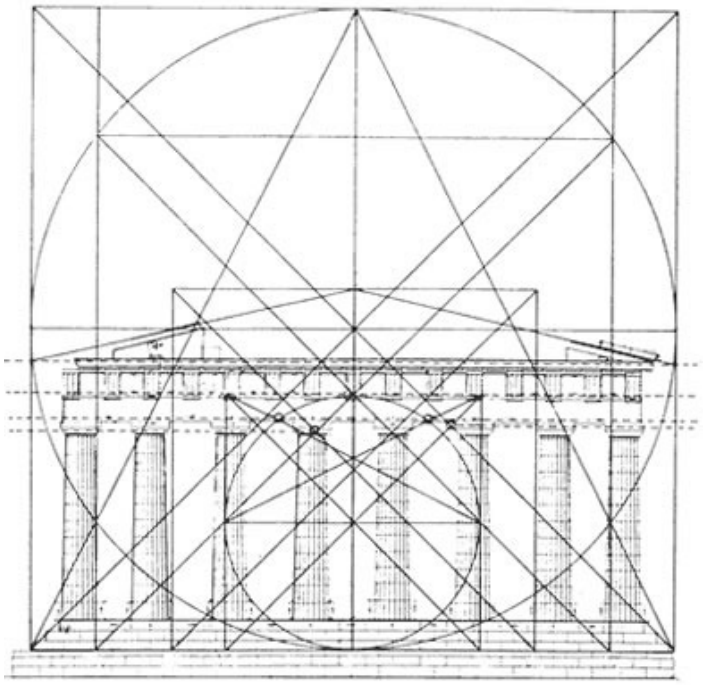

Fig. 1. **N.I. Bruno, Parthenon**

The height comprising three levels of the base and the height of the column is 38, 2, and the height of the metopes and of the pediment is 23, 6 feet. The dimensions presented represent a sequence of the golden section. (100: 6.18 = 61.8: 38, 2 = 38, 2: 23.6 = phi) [1].

According to I. Sevelev's studies, from the length of the base (100 feet) and its height (6 feet or 185.4 cm – man's average height) one can deduce all the other dimensions of the temple, using the ratio of 1: square root of 5 (Fig. 2).

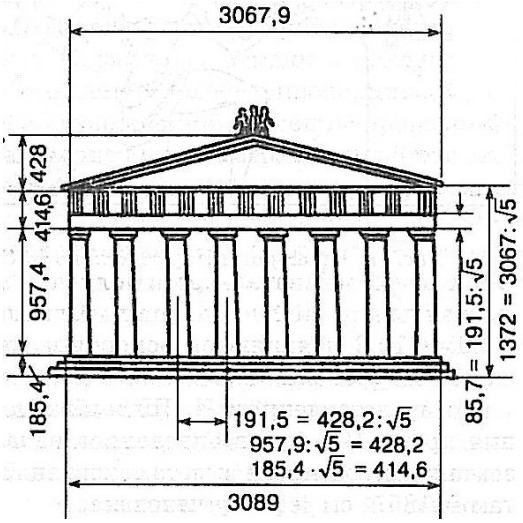

Fig. 2. **I. Sevelev's studies of the Parthenon construction**

This ratio is a basic link of the Parthenon construction, which is also related to the height, the column diameter and the distance between them (using the height one can determine the distance between the columns, and from this one can determine the diameter). The grooves applied to the

column underline their verticality, introducing "the spatiality in volumetric analysis" by exacerbating the "brightness" of the marble. Note that the horizontal and vertical lines are practically missing from the construction of the temple. The lines parallelism create an illusion of deformation, and in order to compensate this effect, the areas of the steps from the base of the temple are slightly raised towards the center, and the columns are inclined slightly inward, having also different sizes (thicker towards the outside). The columns inside the temple are thinner, exacerbating the effect of depth. All these deviations from the geometric lines exactitude are hardly noticeable and are considered insignificant, but it is them that contribute significantly to the plasticity and harmony of the whole.

Thus, the builders' mastery is proved not only by the use of concrete, objective mathematical data, but also by the fact that they have to take into account the optical effects of the whole, the way it is perceived by the viewer. The Hellenistic period caused for most elements of the Greek civilization to be handed down to the colonies of the Mediterranean area, which were afterwards collected and assimilated by the Roman civilization.

In recent decades scientists have increasingly talked about the cultural heritage of Byzantium, as of a sort of treasure held in trust to present generations. But to be always alive, especially in the artistic forms of expression, this legacy must be integrated in a specific lifestyle. The characteristic of the Byzantine art is primarily the fact that its source lies in the divine worship, constantly updated – which is why the respective art cannot be considered a "dead" art.

Results and discussion

The golden ratio, as a basic element in the structure of scale systems used in architecture, is part of the knowledge assimilated within the Byzantine Empire, a fact evidenced by the proportions of the cathedral of St. Sophia in Istanbul (Constantinople). The proportions achieved on the basis of the same relationship are used in the design of many civil and religious buildings situated on the territory of the Italian Peninsula. Later on, in the fourteenth and fifteenth centuries, the Italian architects made constructions in Russia (Moscow's Kremlin), passing on knowledge to local architects, blending the stylistic features of Byzantine Russian art with ancient scale systems. "St. Basil's" Cathedral, a true miracle of Russian architecture, dominated by Byzantine elements, is a towering presence in central Moscow. Among the best known symbols of the Orthodox Russia, this church was dedicated first of all "to the circumcision of our Lord", but along with the burial of Blessed Basil in that place (Vasily Blajenii), the church took on in history and in the consciousness of Muscovites, the name of this holy mystical, very praised in the Russian Church. The cathedral was built between 1555 – 1561 in order to mark Ivan the Terrible's victory over the Tatar khanate of Kazan. The number of the nine towers which haughtily rise above the monumental building from the Red Square represents the number of churches that lie under one roof. Within the architectural ensemble one can find a special combination of geometric lines, gathering triangles and semicircles and rhombus in one of the fewest designs in the world that takes one's breath away. For this reason, the Cathedral of Blessed Basil was compared with the famous Taj Mahal from India.

Studying the cathedral in terms of architecture and the golden proportion, one can see a harmonious blend of asymmetric proportions, many geometrical "irregularities" being built within the same seemingly symmetrical whole (Fig.3). The dynamics of the architectural details and the variety of decorative elements transmit a feeling of elevation, which persist throughout the entire compositional framework of the church. Relating the height of the building (taken as 1 unit) to different dimensions of it, B.Smoliak obtains the series of ratios 1:φ:φ2: φ3: φ4: φ4: φ5: φ6: φ7, where φ – 0.618. It is this presence of the golden ratio in the proportions of the cathedral that gives unity and harmony to the architectural details (so different) present in the whole composition, as in the entire Byzantine art [2].

Analyzing a large number of civil and religious Russian edifices and comparing their proportions with those of the ancient monuments, architect G.D. Grimm demonstrates the presence of the golden proportion in both cases and suggests as basic notions the use by lay-out men of such proportions, or at least "the corrections" of the projects achieved intuitively. It is worth noting that one of the stylistic features of the Russian Byzantine style is the building of churches with a number of 1, 2, 3, 5, 8, 13, or 21 domes, numbers corresponding to Fibonacci sequence.

The study of the human figure proportions, formed on the basis of anthropometric data, shows the presence of the gold ratio in most relationships between the body fragments. Thus, the face height (up to hairline) is in the golden ratio with the distance from the eyebrows to the chin, which is, in turn, in the same ratio with the distance from the bottom of the nose to the chin. The height of the mouth is on the golden section of the distance between the chin and the nose, like the brows line, which is on the golden section of the distance between the chin and the top of the head. The man's *fingers* consist of three phalanges, basic, medium and distal. The length of the base phalanges of each finger, except of the thumb, is equal to the sum of the lengths of the other two phalanges, and the lengths of each phalanx, is for each finger, in golden ratio to the next one. In the 19th century, Adolf Zeising performed a study on the golden ratio and its existence in the human body proportions and in plant development. By making measurements on thousands of subjects, the author concluded that the golden ratio was an elementary proportion of the well-developed human body. Zeising's observations on the golden ratio and its applicability in the field of aesthetics have influenced the studies and results of many researchers and artists, such as Fechner or Le Corbusier [3].

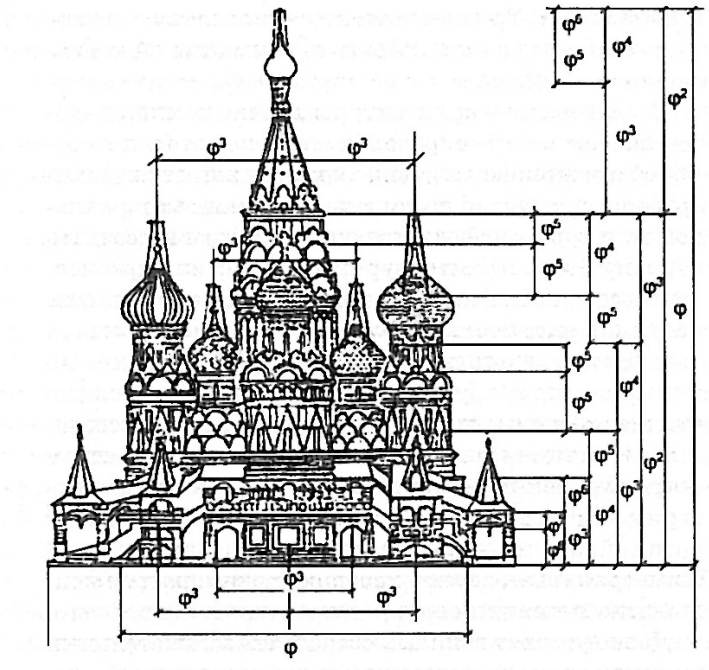

Fig. 3. **"St. Basil's" Cathedral a true miracle of Russian architecture, dominated by Byzantine elements**

As Timerding stated [4], the golden ratio can have two forms. In the first version, two observed dimensions coincide on the same direction (vertical or horizontal), being imaginary determined by two parallel lines. A third parallel will divide the distance between the two in a golden section. In the second variant, both dimensions compared represent the dimensions of an area (width, height), being the sides of a rectangle. The fact that this ratio has a nice effect on the visual perception, it does not mean that it is the only existing ratio that causes an aesthetically pleasing impression. In European realistic landscape one can observe the scrupulous observance of the golden ratio rules; but after the appearance of Impressionism, the placement of the horizon line at distances close to the sides of paintings represents an infringement of the rules. This demonstrates that there is no preset rule for the representation in the artistic field of a certain proportion or size, located at determined distances from the eye's height. Seeing the golden ratio only as an aesthetic function may lead to the risk of reducing the scope of the fields in which this ratio is present and used. Meanwhile, a mystical interpretation of this ratio may distort the scientific vision necessary for the understanding of artistic standards and of the psychological conditions in which these are perceived.

Conclusions

Nowadays, the Byzantine culture is reinstated; it becomes more and more obvious that only a great civilization is able to exercise such a long and powerful influence, and this is enough in order to put this civilization that was the glory of the long gone Byzantium in its place and assign the rank it deserves in history. The Byzantine heritage can be a museum, historical, civilizational, sociological inventory sometimes very rich, or a current form of spiritual life from which the artistic life is continually pouring. The "rediscovery" of Byzantine art with the help of the golden proportion is a proof that the respective art does not have to be considered a "dead" art. We must rediscover and value what happened in the space of the Christian East for over two thousand years.

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