

Compositional analysis of Gothic architecture in Europe and Ukraine

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The article carried the compositional analysis of Gothic architecture in Europe, namely France, Italy and Germany. The authors investigated and compared patterns in proportions for example Ukrainian gothic cathedral and churches of Western Europe.

Key words – cathedral, proportions, equilateral triangle, rectangular, lviv architecture.

I. Introduction

The development of modern architecture is impossible without an in-depth study of the history of architecture, which is a jewel of gothic style. Gothic style is the quintessential combination of philosophy, religion and scientific, that is why investigation of the compositional analysis of Gothic architecture opens for us the possibility of deeper understanding of the laws of harmony and proportion.

Studies and publications known specialists in the field of Gothic architecture were reviewed by authors [1,2,3,4,5,6]. They covered the geometric regularities of Gothic buildings. Attention is paid to certain proportions and ratios of geometric shapes that we can observed on the facades and plans.

Gothic architecture originated in the northern part of France (Ile de France) in the middle of twelfth century and reached a peak in the first half of the thirteenth century. The term "Gothic" was introduced in the Renaissance as a pejorative designation of all medieval art that was considered "barbaric". Gothic art is appointed to cult and religious topics. It was correlated with eternity, with "higher" forces [5].

Progress was expressed in following tasks: compute cross vaults and ensure their sustainability. Gothic architecture solved the problem by using rib arch, and the problem of stability by using arc-boutant [2].

Thus, the purpose of our work is to study the formation of the architectural outlook based on religious beliefs and historical experience in different European countries and Ukraine. It is advisable to analyze the Gothic architecture of Europe and its relationship with the architectural heritage of Ukraine, which is implemented by the example of Latin Cathedral in Lviv.

II. Gothic architecture

August Tirsh, Buassere, Viola Le Duc, where Vohyue, Dehyo, A. Von Drah were the first authors that have engaged in this method of determining the proportions as "triangulation". Then there important additions of A.Witzel, O.Volfa, Ya.Haaze, Tseyzynha appeared. These individual studies appear in random order and were not related. But, then this information can be combined and analyzed. The basic principle is a comprehensive geometrical classification, division of the circle and the setting up of polygons in it (Fig.1).

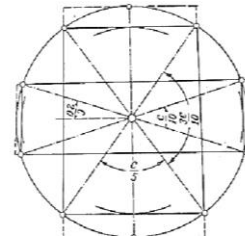


Fig. 1. Rectangle decimal division

The partition of the circle and its product are a system that is often used by ancient masters (Fig.2).

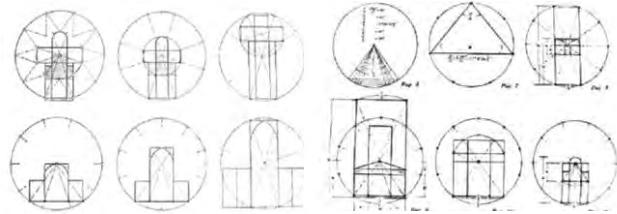


Fig. 2. Types of architectural proportions

Due to the constant ratio that occurs on this basis, the size of the architectural and sculptural works of art consist in a simple relationship, creating increasing or decreasing the progression (Fig.3 a,b) [3].

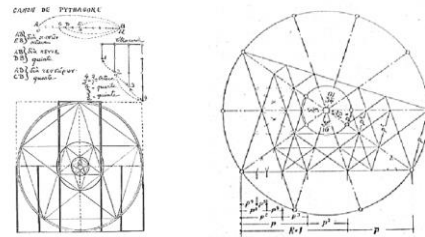


Fig.3(a) Gothic system of proportions (by Ghic).

Fig.3(b) Typ Star-decagon of the second order.

There were also attempts to combine the proportions of Gothic architecture intervals with "Pythagorean" geometry (Fig. 4).

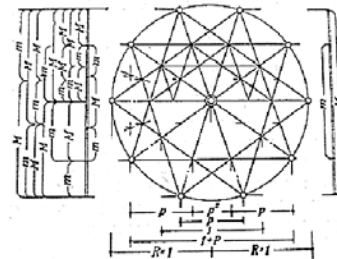


Fig. 4. Proportional section of triangles

There is a term "sacred geometry" covering "Pythagorean" geometry and the geometry of Neo-Platonism, which at one time influenced the development of Gothic architecture and the idea of shaping churches and their elements. There are a number of elements of "sacred geometry" (Fig.5) [7].

Many proportions of Gothic cathedrals were created by using squares and double squares, which were developed

during the Middle Age. The Christian religion has used the cross as its main religious emblems, in geometric terms - as deployed cube. This tradition continues in modern Christian church architecture (Fig.6) [7].

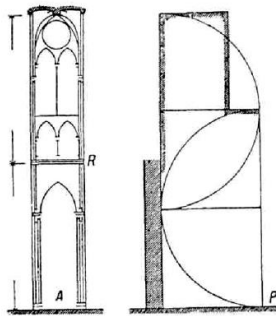


Fig. 5. The division of the nave of Amiens cathedral

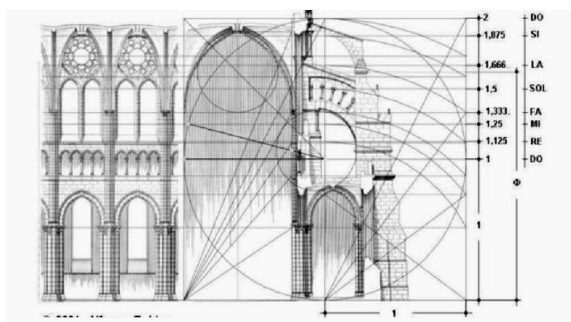


Fig. 6. Connection of geometry in architecture and religion

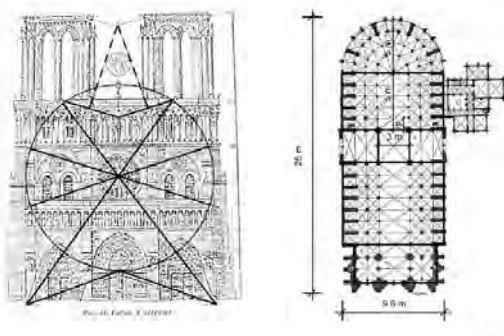


Fig. 7(a) Compositional analysis of the facade of cathedral Notre-Dame
Fig. 7(b) Compositional analysis of the plan of cathedral Notre-Dame

Reims Cathedral. It was built by a group of architects: 1255- 1285 Bernard Suasrnnskym, 1211- 1275 Jean d'Orbe, 1231- 1237 Jean- Le Well, 1247 , 1255 Gaucher Reims. This cathedral - one of the most important Gothic buildings in France, both in terms of architecture, and the number of sculptural elements - 2303. This is listed in the UNESCO World Heritage Site since 1991. [8] The height of the arch to the nave is 38 meters, so it is less in than Amiens Cathedral (42.30 m) or at St. Peter's in Beauvais (46.77 m). However , the relative narrowness of the nave gives the impression of height. Exterior general view of the cathedral, typical of the Gothic style, gives the impression of a gust of heights. Both eastern towers no steeples, yet they reach a height of 82 meters. The highest point of the cathedral - a sculpture angel apse is situated

at an altitude of more than 87 meters. The cathedral is located on the axes South- West and North- East. Thus, it is not oriented to the east, and the axis of the summer solstice [1]. In compositional analysis of this cathedral highlight played the proportions circle and square (Fig. 8 a,b) (Messelem). The first tier is a square, and the second – half of the height of the square .

Amiens cathedral was built in 1220- 1528 by Robert de Lyuzarshem, Tom de Cormon, Renaud de Cormon. The cathedral is the tallest complete cathedral in France, where a set of stone arches reaches a height of 42.3 m (higher then Amiens cathedral is unfinished cathedral of St. Peter). It also has a huge internal volume - the greatest of all the cathedrals in France, and it is approximately 200,000 m3. The cathedral was built between 1220 and 1270, and registered in the World Heritage of UNESCO in 1981 . Despite losing most of the original set of mosaic glass, Amiens cathedral famous for the quality and quantity of Gothic sculptures early thirteenth century , located on the main facade from the west and the south gate transept [8]. There are two major division level in the nave of the cathedral , demarcated zone R, running at half height (Fig. 5) [1]. The main idea of the proportions of the two previous examples is saved (Fig.9 a,b), namely Reims cathedral and Notre Dame (Messelem).

Analyzing historical sources ideas proportions of Gothic cathedrals, we found out that there is a theory that all Gothic buildings were built using secret mathematical code , taken from the Bible. Confirmation of this, we found in French architecture, here we have the following figures:

- Height of the city of God was 144 elbow (Ivan Bohoslov), which was taken by a new standard. Examples of this are Amien cathedral and the cathedral in Bouvet.

- The length of Noah's Ark was 50 cubits (as the Old Testament, Genesis. 6-9), whose value is used in the construction of the central part of the Amien cathedral and Notre Dame cathedral. Proportion of height 30 cubits by 60 (as the Old Testament) used in the Temple of Solomon - the height of the first floor was 30 cubits, and the second - 60. This proportion used in the Cathedral of Notre Dame and the Cathedral of Saint-Denis [10].

III. French architecture

We made compositional analysis on the example of French architecture of the Cathedral of Notre- Dame de Paris. It was built in 1163-1345 by the architect Maurice de Sully . The cathedral has dual stylistic influences: on the one hand there are elements of Romanesque style of Normand, with his power and unity, on the other hand - the use of innovative architectural achievements of the Gothic style. This gives the building an impression of lightness and simplicity of construction structure (frame support structure as it can be seen only from the outside) [8]. After analysis of French Gothic architecture we can say that the first tier is a square, and the second –half part of the height of this square, based on the compositional analysis of Notre Dame. We can see that circle and square play the key role in the proportions (Fig.7 a,b). They emphasize the symmetry and aspirations of architecture to the height (Messel).

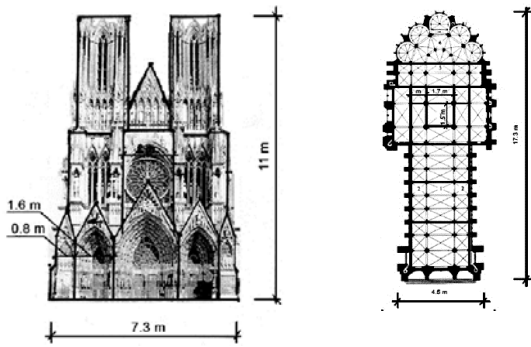


Fig.8 (a) Compositional analysis of the façade of the cathedral of Rheims

Fig.8 (b) Compositional analysis of the plan of Reims cathedral

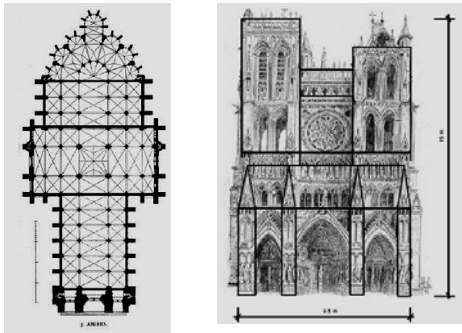


Fig. 9 (a) Compositional analysis of the plan of Amiens cathedral

Fig. 9 (b) Compositional analysis of the facade of Amiens cathedral

IV. German architecture

We made compositional analysis of Gothic cathedrals in Germany. Ulm Münster was built in 1377-1890 by architect Ulriha Aysinhera. Ulm Münster was finished only in the nineteenth century. From the observation deck at a height of 143m panoramic view of Ulm you can see Baden- Württemberg and New Ulm in Bavaria, and in good weather you can see the Alps from the top of Santis to the Zugspitze[8]. In the baset of fasade you can see isosceles triangle, which is defined by modular ratio. It is present also in the plans [3] (Fig. 10 a,b).

Cologne Cathedral was built in the 1284- 1880 by architect Gerhard Von Rilye in Cologne, Germany. It is renowned as a monument of Christianity and German Catholicism. Cathedral dedicated to Saint Peter and the Blessed Virgin Mary. There are also relics of the Three Kings and the Holy Irmhardis. Cathedral is a World Heritage Site UNESCO, is one of the most famous architectural monuments of Germany, and Cologne's most famous landmark, which UNESCO defines as "exceptional work of human creative genius" [8]. There is an isosceles triangle at the heart of the building facades, defined by the modular ratio, which is also present in the plans. Analyzing the cathedral in Cologne, we have concluded that this is an example of Gothic architecture which has modular ratio (Fig.11) which is based on a triangle.

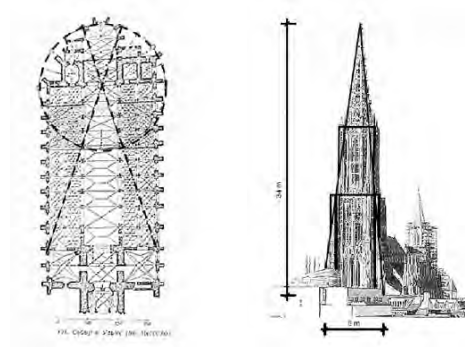


Fig.10 (a) Compositional analysis of the plan of Ulm Münster

Fig.10 (b) Compositional analysis of the facade of Ulm Münster

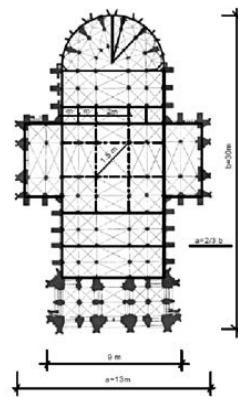


Fig.11 Compositional analysis of the plan of Cologne Cathedral

This relationship is also presented on the facade (Fig. 12) (Messelem).

V. Italian architecture

Compositional analysis of Gothic architecture of Italy. Milan cathedral was built in the 1386 – 1965 by Bramante Leonard in the Gothic style of white marble. Building started in 1386, was completed only at the beginning of the XIX century. He is one of the largest cathedrals in the world , second capacity Gothic cathedral after the Seville Cathedral and the second capacity cathedral in Italy, after St. Peter's in Rome [8]. In the cathedral outline of the central nave is determined by equilateral triangle (Fig.13 a,b) [3].

Siena Cathedral in Florence was built in 1215, 1263 by Giovanni Lorenzo Berini. Compositional analysis of Siena Cathedral indicates that there is equilateral triangle in the base of plan as in Milan Cathedral (Fig.14).

It is also in the base of front fasade (Fig.15) (Messelem).

VI. Latin Cathedral in Lviv

We analysed Latin Cathedral in Lviv it is the object of our own research. Catholic basilica located on Cathedral Square. Monument of sacral architecture of XIV-XVIII centuries. Temple Length - 67 meters, width - 23 meter. It is three-nave building, common- type, with elongated prezbiteriyem and faceted apse. There are two volumes of bell towers (rectangular in the plan) from the west side. Right bell tower was built just to the height of the nave vaults. Originally

cathedral was propped up by 12 which had four storey, that ended just below the roof eaves. The main space is almost cubic, but later additions greatly complicate the configuration of the temple [9]. Through compositional analysis of the cathedral, we noticed that key role is played by the proportions of the circle and the square, which are inscribed in an isosceles triangle on the plan and on the facade (Fig. 16 a,b).

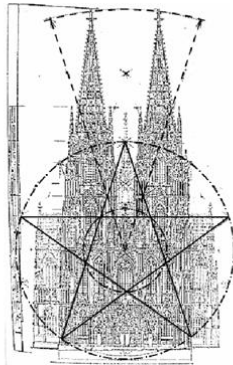


Fig. 12. Compositional analysis of the facade of Cologne Cathedral

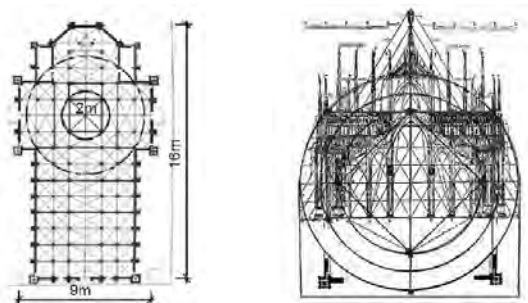


Fig. 13 (a). Compositional analysis of the plan of Milan cathedral
Fig. 13 (b). Compositional analysis of the facade of Milan cathedral

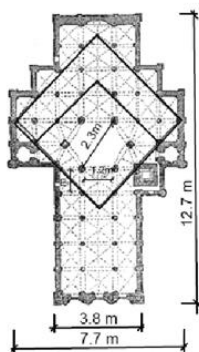


Fig. 14. Compositional analysis of the plan of Siena Cathedral

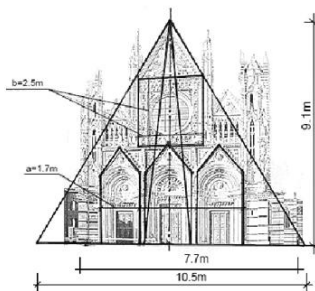


Fig. 15 Compositional analysis of the facade of Siena Cathedral

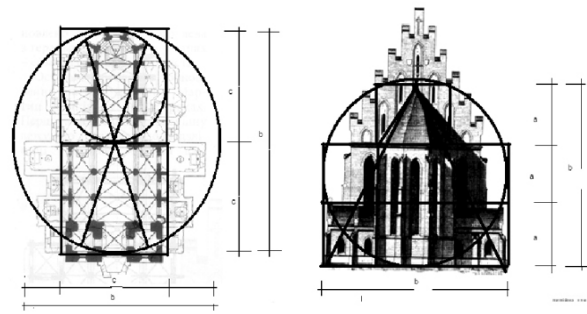


Fig. 16 (a) Compositional analysis of the plan of Latin Cathedral

Fig. 16 (b) Compositional analysis of the facade of Latin Cathedral

Conclusion

To sum up, we found characteristic features of Gothic cathedrals in France, Germany and Italy as a result of our work. Through compositional analysis, we concluded that the churches of these countries have the common geometric shapes. There are: circle, square and triangle, which are formed by using ratio and proportion in the plans and facades. The main difference was that the basis of the proportions of the cathedrals of Italy is an equilateral triangle. All other countries - isosceles.

We also made our own research of Latin Cathedral in Lviv, and found that there are circle, squares and equilateral triangles, that formed plan and facade of this building. It gives those proportions, which it reached, that shows great impact of Italian architecture.

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