Study about Geometry and Decorative Arts

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Abstract

Though apparently geometry and decorative arts-related notions seem to exclude each other, as one is a branch of mathematics, i.e. of exact sciences, and the other an expression of human creativity and sensitivity, in fact, the two merge together. The extent to which they restrict or complement each other depends on the topic and field of reference. In the present paper, the authors aim at performing a study on the way in which geometry interfered in art, mainly in the ceramic decorations of various civilisations. From mosaics to plating, in Christian and Islamic art, in ancient and medieval times, examples are given and discussed. Starting from the basic geometrical figures, such as the triangle, square and circle, one can develop a varied range of graphical motifs and geometrical designs representing a metaphor of both real and mystic world.

Rezumat

Deşi aparent cele două noţuni par a se exclude una pe cealaltă, geometria fiind o ramură a matematicii – adică o componentă a ştiinţelor exacte, iar arta o expresie a creativităţii umane – ce ţine de suflet şi de trăiri personale, în realitate cele două concepte se întrepătrund. Măsura în care acestea se condiţionează şi se complementează, depinde de tematica şi domeniul la care acestea se referă. În această lucrare, autoarele îşi propun să realizeze o disertaţie legată de modul în care geometria stă la baza lucrărilor de artă în ceea ce priveşte decoraţiile ceramice în diverse civilizaţii, ca de pildă cea antică şi medievală , respectiv din diverse culturi, şi anume cea creştină şi cea islamică. Pornind de la figurile geometrice elementare: triunghiul, pătratul şi cercul, se poate dezvolta o gamă generoasă de motive grafice şi desene geometrice care reprezintă o metaforă pentru lumea naturală şi cea mistică.

1. Introduction

Since very ancient times, people felt the need of expressing visions, experiences and feelings in concrete manners. Plastic arts gather together all these practices and achieve artistic and aesthetic representations of the people's experiences through shape and volume.

The desire of making the everyday life environment more beautiful led to the development of decorative arts. At the beginning, the applied and decorative arts were taken as part of the so-called major arts – architecture, painting, sculpture – and were included among craft activities in the very

expressive form they took (textile, furniture, pottery, ceramic arts, metal processing – silver or gold work, etc.). As time went on, however, the complexity and beauty of the works produced in the fields mentioned made them be comprised among fine arts.

Decorative arts represent a demonstration of the fact that human creative imagination is not limited by space or time. Elements of decorative arts can be found in various cultures, since very old times, beginning with the Greek-Roman and Byzantine styles, continuing with the arts of the Middle Ages, respectively the Romanic, and Gothic styles, and the styles of the Renaissance, Baroque and Rococo. The development of new materials and technologies, and an increasing pragmatic character of the modern society led to new artistic currents, among which: Bauhaus, Art Deco, Art Nouveau or Op-Art (Optical art). In general, the latter put their basis on the functional clarity and simplicity arising from geometrical images. In this new artistic environment, the decorative arts have won a special and individual role among fine arts and form the starting points of many inter-disciplinary approaches.

2. Role Played by Geometry in the Decorative Arts

In the decorative arts, an important role is played by the geometrical motifs, achieved at the beginning with simple instruments, such as the rules and the compasses. Using the elementary geometrical figures - the triangle, square, pentagon, hexagon and circle – by repetition, symmetry, shape displacement and recurrence very complex and sophisticated geometrical patterns could be developed.

2.1 Basic Geometrical Figures and Recurrent Shapes

Geometrical shapes can be decomposed – in imagination or actually – in basic figures. Since Antiquity, scholars defined and established computational relationships for such figures and shapes. Thus, polygons were defined as figures having a greater than or equal to three sides. Regular polygons received a special attention as they were characterised by equal sides and angles and by their capacity of being inscribed in a circle. In this way they were linked to the circle, which is another basic figure in plane, much used both in the real and mystic world.

In Figure 1 [3], one can notice the way regular basic polygons are built, namely:
   a) the construction of the triangle and hexagon;
   b) the construction of the square and determination of the side of the octagon;
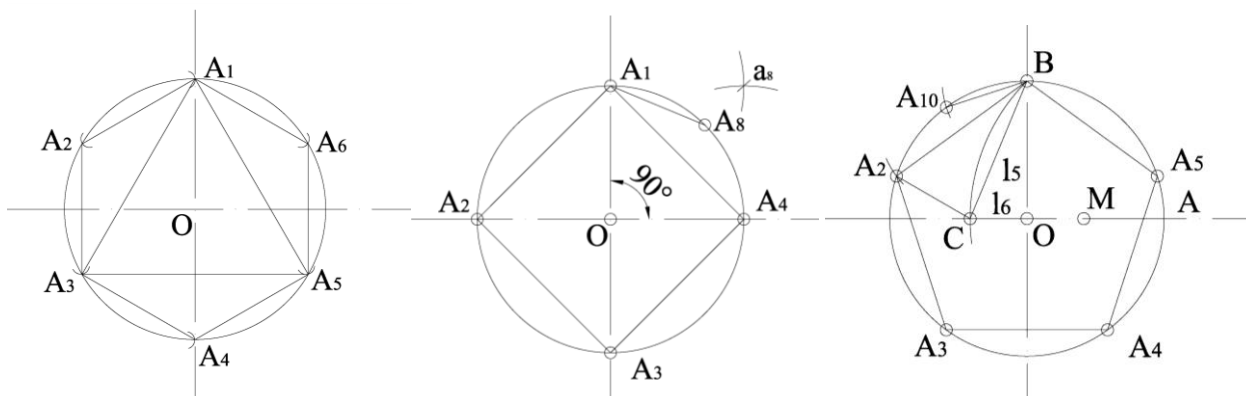   c) the construction of the pentagon and determination of the side of the decagon.

Figure 1: Construction of regular polygons inscribed in a circle

In the decorative art, besides the regular convex pentagon, one often meets the star pentagon,

represented in Figure 2, and also named pentagram. This geometrical figure has always been a debatable figure for mathematicians, astrologers or mystic people.
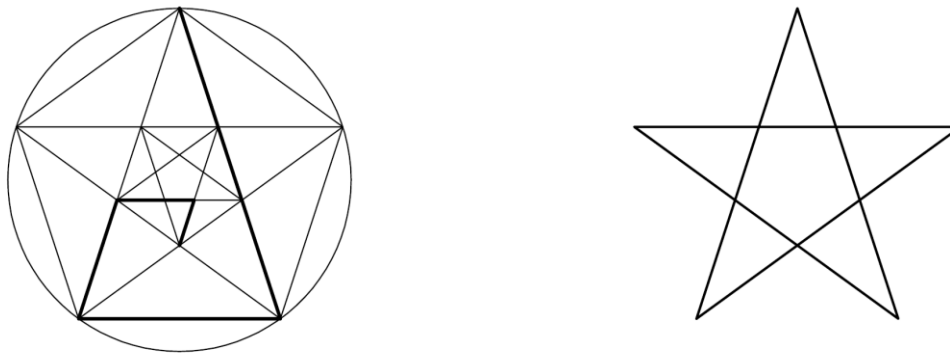
Figure 2: Star pentagon

In the decorative arts, one of the most frequently met approaches is recurrence. Recurrent shapes maintain similarity when summed up or multiplied, respectively when subtracted or divided. In Figure 3, are given recurrent figures whose base is an equilateral triangle and a square [1].
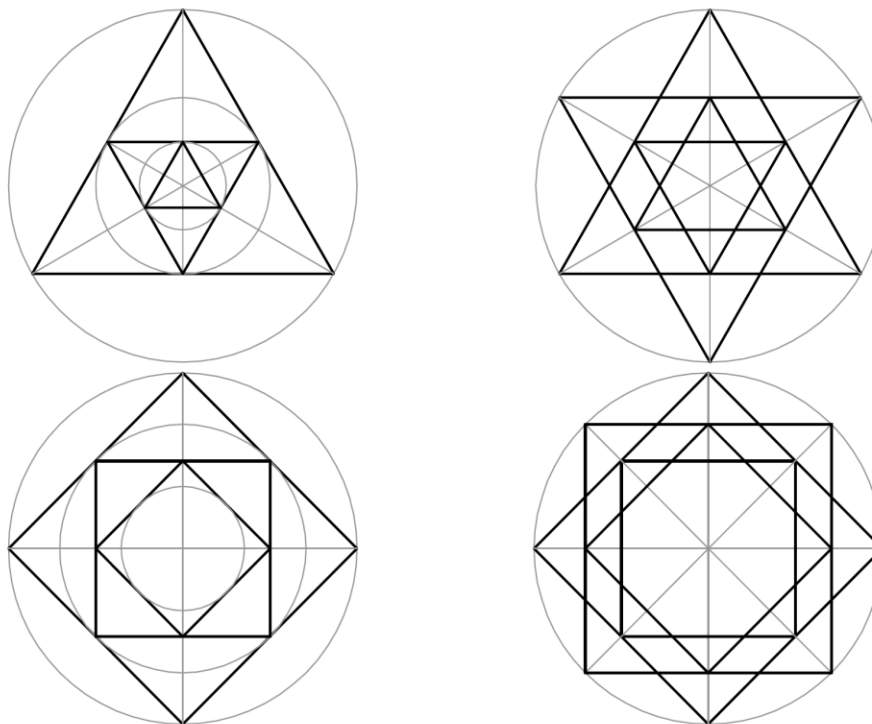
Figure 3: Recurrent shapes based on triangles and squares

2.2 Geometric motifs in the Decorative Art

Besides the basic geometrical figures, the structures and forms originating in the surrounding nature also represent a source of inspiration. The elementals and shapes first created and developed were then taken over and mixed with more complex and newer elements.

For the decorative arts, the following represent the basic elements [5]:
- language-representing elements: points, lines, plane geometrical figures;
- brushing up nature-based components;

-   application of techniques such as repetition, recurrence, juxtaposition, translation, intersection and intertwining of language representation elements – Figures 4, 5 and 6;
-   techniques to mix geometric elements with brushed natural elements – Figure 7

The purpose of making use of all these techniques can sometimes be two or three dimensional optical illusions, an apparent movement of shapes that can be stressed by means of colour and contrast – Figure 8 [10].

In the decorative art, the following types of elements can be used individually or mixed together:
-   the motif: the arabesque, torsade, stalk, palm, trefla, rosette or cartridge;
-   the applied decoration, usually made from other materials than the material of the object;
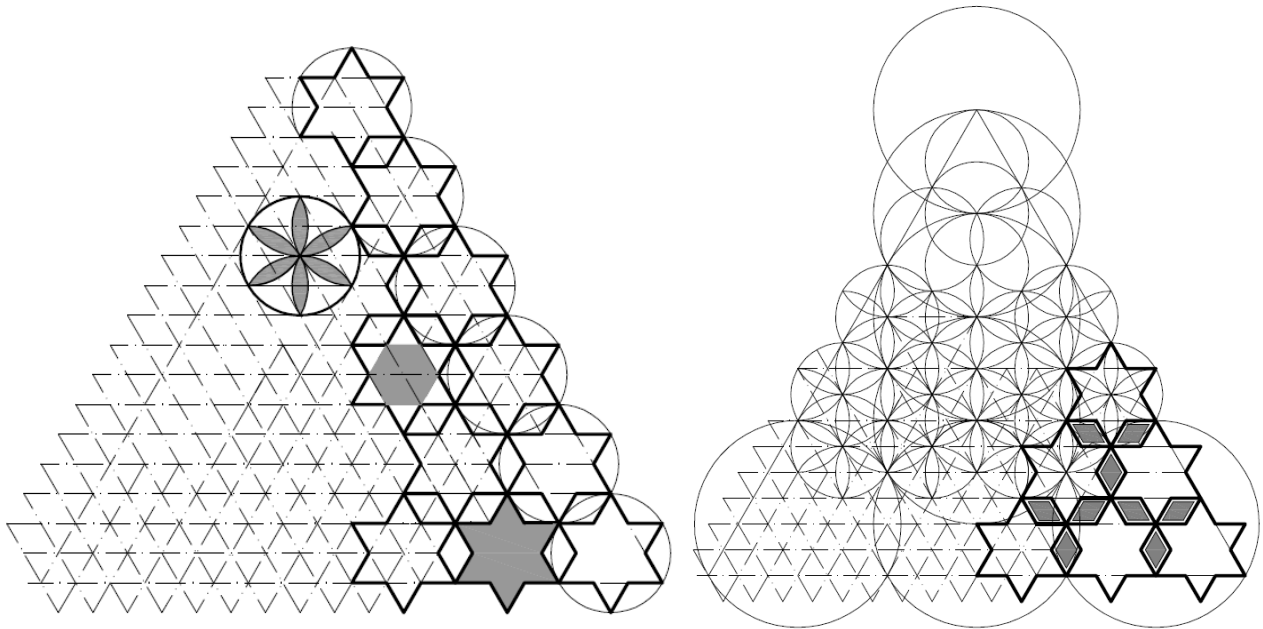-   the ornament, which can be even-shaped, raised or in nets (grids).

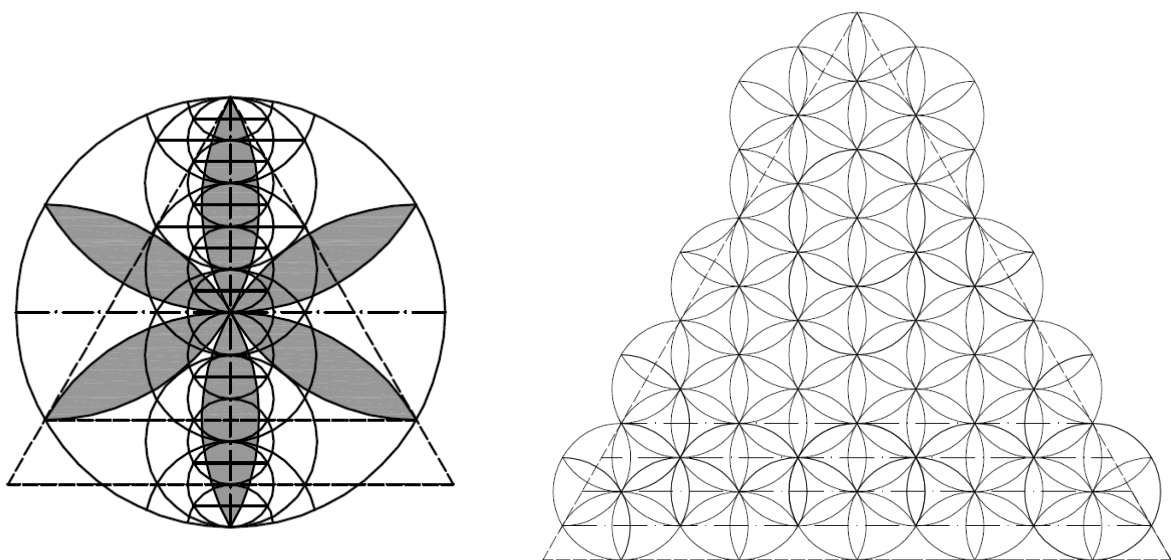Figure 4: Decorations yielded from polygonal shapes

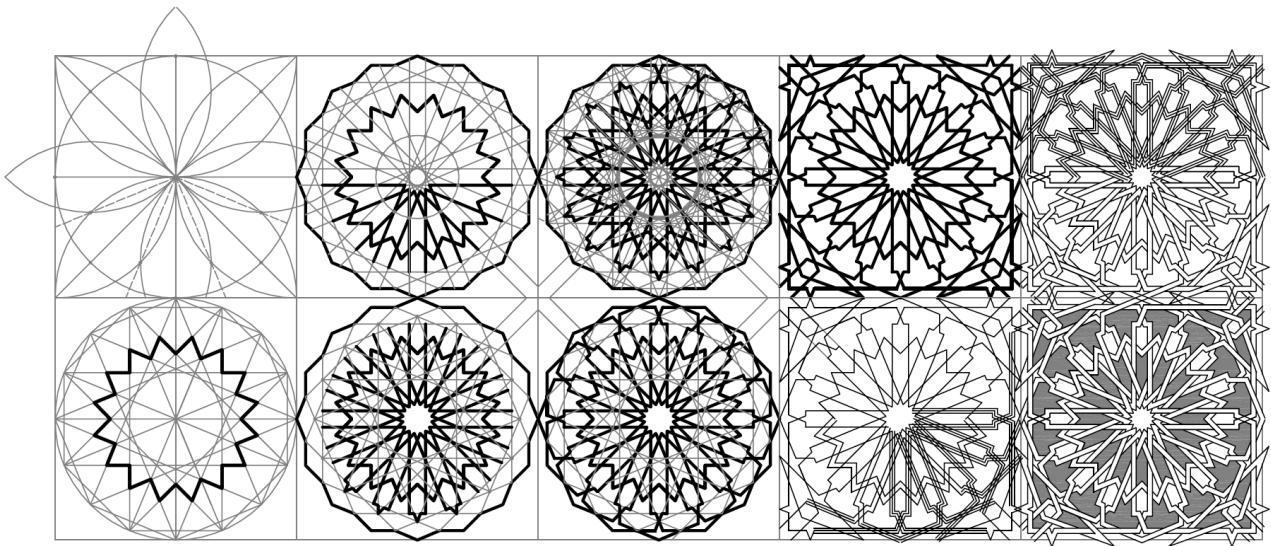Figure 5: Decorations yielded from combining arcs of a circle

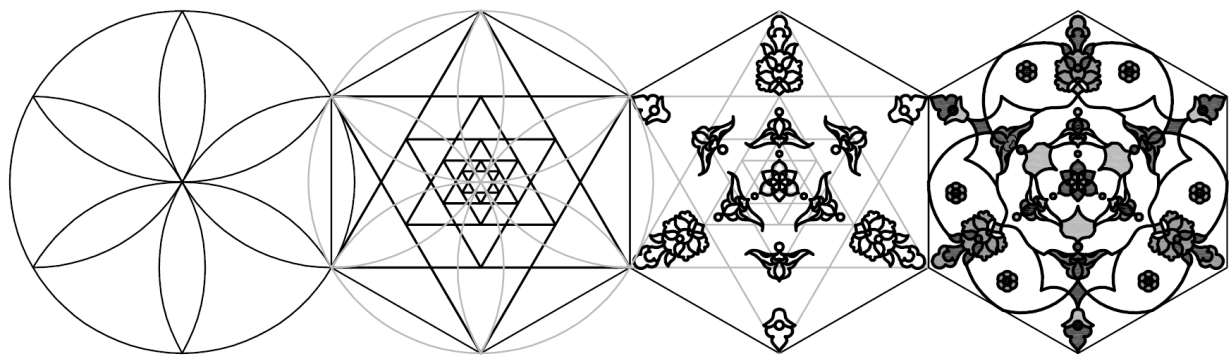Figure 6: Decorations using intertwining

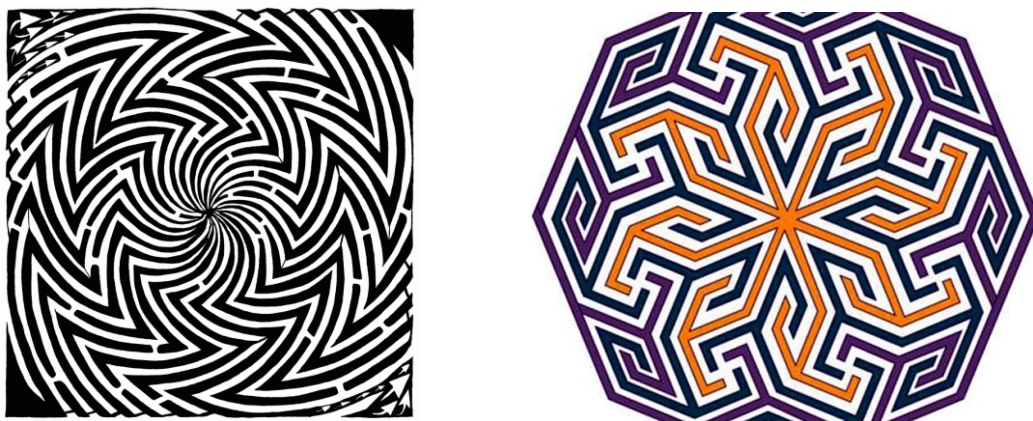Figure 7: Decorations using geometric elements with brushed ones

Figure 8: Illusional decorations

Elements belonging to decorative arts can be encountered in all epochs and cultures. Geometric ornaments represent a climax in Islamic art, though their origin is Persian and Byzantine. The subordination of artistic manifestations to norms coming from religion forbidding the representation of human or animal shapes limited the range of inspiration to geometric, calligraphic and floral elements.

The brushing and recomposition of these elements with a lot of imagination can be specially found

in the decorative trend typical of the Islamic art, namely the Arabesque – Figure 9.

"Arabesque was not invented by the Arabs, but the Muslim artists took it over, perfected it and gave it an unusual extension l – from the adornment or mosques, minarets and palaces to everyday objects, showing inexhaustible fantasy, noble conception and amazing refinement of workmanship" [2].

Not only arabesques could be met: wall were also adorned with mosaics, inlays of multicolour marble or enamelled ceramic, bas reliefs of lace stucco or alternate stone masonry and tinted marble. Colours of preference were cobalt blue, emerald green and complementary red and yellow.
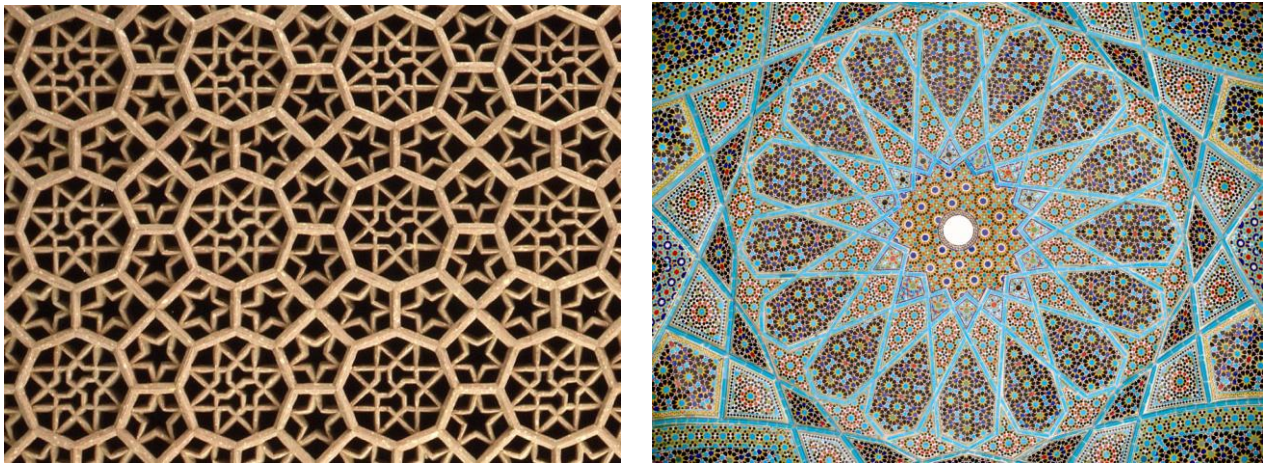

Figure 9: Arabesques

Many decorations have symbolic essences and mystical meanings. A careful analysis shows that the motifs found in decorative arts can be grouped into six major categories [4]:
1. Geometric ornaments;
2. Floral or botanical ornaments;
3. Zoomorphic ornaments and mythical or legendary images;
4. Decorations based on narrative scenes;
5. Decorations based on calligraphy;
6. Decorations with symbolist essence.

The Islamic culture has strongly influenced the decorative arts in the South of the Hispanic Peninsula. In this respect, one of the most original elements of the Portuguese art is represented by the tin glazed ceramic tiles, called azulejos. These elements find their source in Moresque art – Fig. 10 [9], which in turn took it from the Persians artisans. In fact, the Spanish people were the first to have appropriated this art, so Sevilla became a major center for the production of these plates.

In Portugal, they became popular after King Manuel the First used them to decorate the Sintra Palace. In the course of the time, the art of azulejos reached a high level of artistic refinement. The azulejos were and are still used for decorative reasons, to adorn the interior and exterior sides of the palaces, residential houses, religious edifices, public places, gardens, bridges, etc. The Portuguese full plated the rooms to banish the fear of empty spaces, an idea taken from the Moors, the result, from aesthetic point of view, being questionable. They use as traditional colors blue and white. The topics approached for decorating varies from simple geometric and floral patterns, to the historical scenes, and mythological iconography.

Also, the azulejos are used for their special hygrothermal properties - as these tiles are processed in special heat conditions and then are glazed, becoming impervious.

These ceramic tiles are used in other countries such as Italy, Turkey, Iran, Morocco, and so on, but for Portugal remains indisputable a country brand.

Figure 10: Types of azulejos

Geometric elements can also be found in the medieval decorative art of Europe, in both secular and religious contents. The religious content, with much more varied topics, restrained the application of geometric motifs in the decorative art. Thus, the rosettes represent decorative art elements used to adorn the buildings. In Figures 11 and 12 are presented the geometrical constructions of some usual rosaces [7].
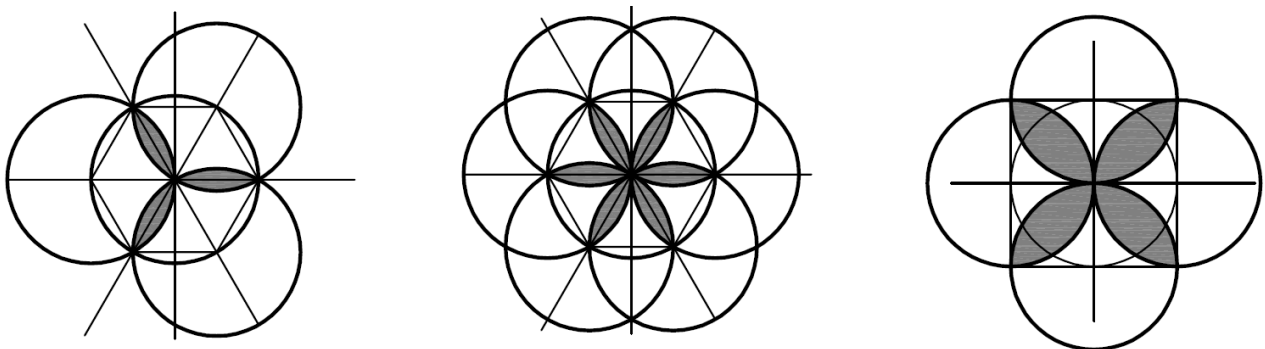

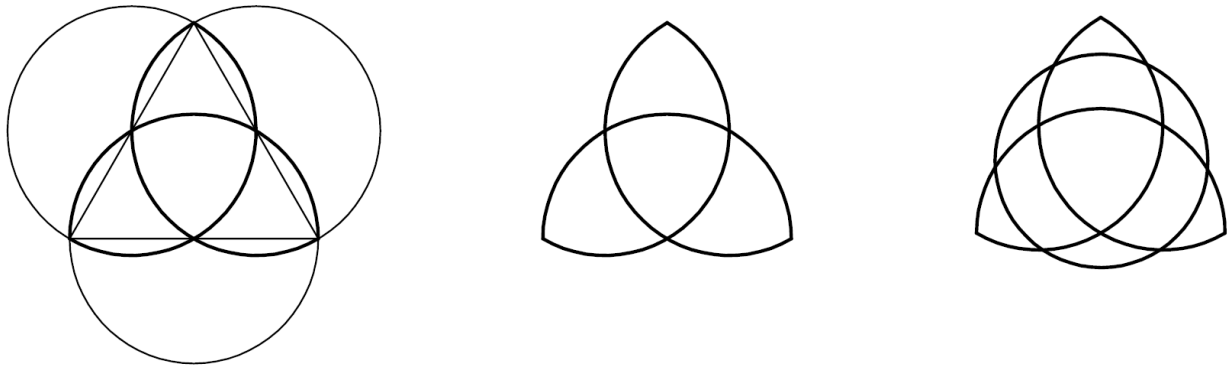Figure 11: The construction of overlapping rosettes.

Figure 12: The construction of triquetra

These rosaces are not simple compositions of circles and lines intersected by certain rules or following a specific geometric matrix. Rosaces represent a metamorphosis of pagan culture symbols (such as the solar cult) in the new Christian religion. Thus, obtaining some figures that are based on the numbers 3, 7 or 12 give a tint of mystery and mysticism to these relatively simple geometric constructions. Furthermore, the realization of these elements based on the circle, enriches the symbols, suggesting the idea of whole and indestructible.

A specific place of application remains the adornment of windows– Figure 13 and the rosaces on the cathedrals front face – Figure 14 [9].
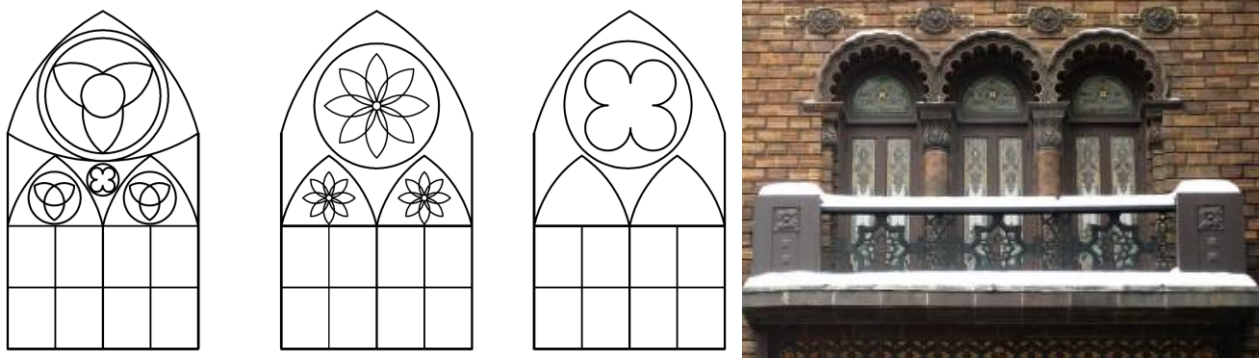

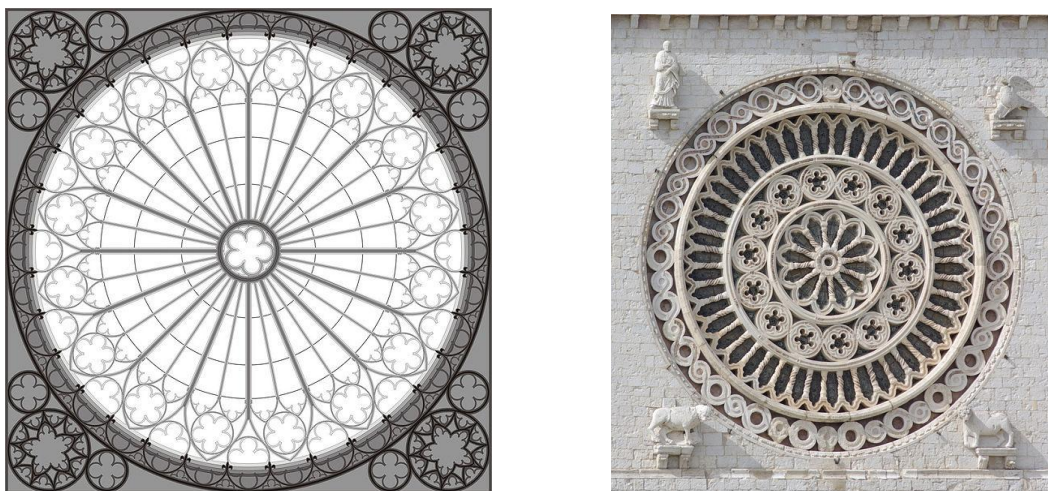Figure 13: Window decorations with geometrical motifs

Figure 14: Rosaces

3. Conclusions

Geometry has been set up as a branch of mathematics that contributed to defining relationships among elements in both plane and space. Metaphorically speaking, we can say that this is a sacred language of the universe perception.

The perspective, axonometry and the orthogonal projection on two planes of projection are systems of representation used by Descriptive Geometry, in itself a branch of Geometry. Among the systems of representation mentioned above, the first two are fundamental for artistic fields, such as painting and scenography. Architecture, also called the art of building, makes use of all the three systems of representation belonging to descriptive geometry. Back to basic geometry, it is important to underline the role geometry has in fields, such as painting, sculpture, architecture and, last, but not least, decorative arts. The use of elementary geometrical figures and of the techniques of recurrence, overlapping, symmetry, translation, weaving etc., opens the way towards a whole universe of graphical and artistic expression. The present paper presents some applications of geometry in the decorative arts belonging to various cultures.

In the end, it is necessary to emphasize that the means of exploring and perceiving plane and space through geometry represent an ever moving process. Thus, one can remind that, in 1975, mathematician Benoit Mandelbrot set the basis of fractal geometry, which admits that the dimensions of the objects can be expressed by fraction or irrational numbers. Hence, the measurement of an entire range of shapes - previously unquantifiable - can be made possible. Any figure can be decomposed into parts similar to the whole. Consequently, one can state that this new field represents a form of nature geometry which opened vistas towards novel space approaches.

4. References

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