Nexus : Journal of Innovative Studies of Engineering Science (JISES)
Volume: 02 Issue: 04 | 2023 ISSN: 2751-7578
http://innosci.org/

Some Questions Architectural Bionics Forms

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Annotation: This scientific article discusses a number of geometric principles for the formation of shells of flora and fauna, which can be successfully used in constructive architectural shells.

Key words: Bionics, constructor, approximation, hyperbole, architect, standard size, living shells, mirror, symmetry, nature, forming, guiding, aesthetic, helical principle, mono diametral, asymptote, shell.

Each architect or designer cannot claim that his design is optimal for the given conditions and requirements, while the forms and design of the flora and fauna are correct. is just that. In nature, building science and architecture take not only constructive ideas, but also forms. In this sense, applied geometry can serve as an intermediary between wildlife and architecture.

Living nature is basically complex systems, difficult to define mathematically with the existing level of mathematical methods of calculation. However, there are, firstly, areas of living nature in which the forms of organisms are distinguished by surprisingly "correct" geometric patterns that can be determined. Secondly, it is possible to find means of generalizing some complex forms, to approximate them.

It should be noted that the shells of living nature are distinguished primarily by aesthetics, inextricably linked with functional expediency. Of considerable interest is the study of forms of wildlife that have the expression of a thin shell (flowers, bird's eggs, mollusk shells, insect elytra, turtle shells, etc.). Nature takes care of the strength and rigidity of its representatives by giving them the most rational forms (rye straw, bamboo palm leaves, walnut, etc.).

In this article, a geometric analysis of some "live" shells is made. The outline of a tulip, for example, is well given by one branch of a monodiametrical hyperbolic hyperbola circumscribed around an asymptotic triangle. This 3rd order curve has the characteristic equation ax2+bx+cx2+dx=0 and, according to Newton, belongs to the 1st class, the second kind. The outline of the line can be approximated by a monodiametrical defective hyperbola, which is also a 3rd order curve related, according to Newton, to the 2nd class, 2nd kind.

Even more often, in the vegetable world, there are "shells" in the animal world, and here they, as a rule, have a more strict geometric classification of the egg; currently, its shape index is used, which is equal to the ratio of the maximum transverse diameter of the egg to its length, multiplied by 100 On the basis of appropriate measurements, it is proposed to approximate the shape of an egg from the chicken family with an oval. Müntzer, which is a 6th order curve with the equation

$$(x^2+y^2)^3-2dx^3(x^2+y^2)+(d^2-r^2)x^4=0.$$

By varying the position of the center of the generating circle on the abscissa axis, you can get the shape of an egg with a different index. This shape can be used both for closed shells and for enclosure shells in the form of a section of the egg surface.

By means of constructions, the outline above the wings of a number of beetle insects was analyzed. It turned out that many of them in a horizontal projection are outlined by one of the Lame curves, the equation of which

$$\left(\frac{x}{a}\right)^m + \left(\frac{y}{b}\right)^m = 1, \text{где } m = \frac{p}{q} > 1$$

where p is even and c is odd. This curve can be used for plans of large halls covered by shells. As you know, for prefabricated architectural shells of coatings, it is very important to divide the surface into elements. And here, geometers and architects can learn from nature. So an interesting example of a breakdown into "standard sizes" is given by a tortoise shell. The elements of the shell, firstly, have curvilinear outlines, and secondly, at the edge of the shell, the elements are smaller in size than in its middle. The constituent parts of the shells in nature (human and animal skulls) are often mated along "sawtooth" lines, which undoubtedly increases the rigidity and strength of their connection. This article analyzes a number of examples of implemented shells, the outlines of which are suggested by one or another natural form.

The study of the geometry of natural forms with a view to their application in architecture can be more fruitful in combination with the study of the origin of these forms and the study of the relationship between the functions of the organism and its form, for example, the relationship of strength properties and forms. Consideration of the shells of flora and fauna allows us to formulate some geometric principles for their design:

a) the absence in the formation of "living shells" of straight lines and planes, as well as geometrically elementary curved lines and surfaces, from which the conclusion suggests itself that the most effective shells are shells of complex shape;

b) the presence of various types of symmetry (mirror, axial) in living shells gives grounds for the assumption that the symmetry of the shell is a positive factor in the issue of its strength and aesthetics; this is confirmed, in particular, in the existing computational shells:

c) the widespread "screw principle" of surface formation has not yet been implemented in architectural shells;

d) the continuity of the form of "living shells", which can be carried out in architectural shells by combining load-bearing and enclosing functions, as well as by the design of supports, directly passing into the shell itself;

e) expediently distributed material, in particular, the variable thickness of the shells, which increases with increasing effort, while the elements of prefabricated shells, as a rule, have a constant thickness;

f) imparting waviness or corrugation, which increases the strength and rigidity of "living shells", is used both in monolithic and prefabricated shells: g) breaking down the surfaces of "living shells" into curvilinear standard sizes, which has not yet been used in architectural clouds.

A geometric analysis of the shapes of some natural shells showed that, due to a certain deviation of individual surfaces from the "averaged" shape, the outlines of a number of shells of living nature are described from a change in one parameter (Münger oval, Lame curve, some curves of the 3rd order, etc.) .

Based on the established regularities, it becomes possible to construct shells in architecture that are close to the shapes of some shells of living nature, and it turns out that it is advisable to use only higher-order curves that approximate "living shells" well as generators and guide lines. In this case, both the structural and aesthetic advantages of the architectural shells will be ensured, although this leads to the complication of the shell itself.

References:

1. Практические методы расчёта оболочек и складок покрытий. Под ред. И.Е. Миликовского. М. Стройиздат. 1970 г.
2. Узаков Х. Дехтярь А.С. Купол наименьшего веса. Прикладная механика АНУССР. Вып.10. Киев, 1974 г. с. 85-89.
3. Узаков Х., Абдуманнонов М.. Методы формирования оболочек покрытия с толщиной. Многомерная дифференциальная геометрия. Самарканд 1991 г.
4. Узаков Х., Ширинкулов Ш., Раззоков С., Абдуманнонов М.. Внедрение оболочек покрытия в действие учреждениях г.Самарканда Плакат ЦНТИ. Ташкент - 1985 г.
5. Узаков Х., Абдуманнонов М. Проект строительства колхозный рынок "Гузалкент" Самаркандской области. "Опалубка, сетчатый каркас изготовления". Строительство Самарканд 1989 г.
6. Suvonov Obidjon Shukurullaevich, Qosimova Farog'at teacher, Samarkand state architectural and civil engineering institute, Modern Journal of Social Sciences and Humanities, Elements of Information Modeling in Classic Engineering and Computer Graphics Courses, https://mjssh.academicjournal.io/index.php/mjssh/article/view/354