

КОМБИНАТОРИКА КАТО ПРИЧИНА ЗА ПРОЕКТИРАНЕ И КОНСТРУКЦИЯ, ИЗПОЛЗВАЩИ КОМБИНАТОРИКА

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COMBINATORICS AS A REASON FOR DESIGN AND CONSTRUCTING USING COMBINATORICS

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Abstract

The continuous development of the industry imposes conditions for unification, typization and serial production of pieces of furniture and other design products. Due to the nature of the production itself, it is also necessary to have the shapes maximally simplified and adjusted according to industrial technologies.

The need for such a dynamic, intellectual and creative activity had come from the past, and today it results with numerous objects that have different applications in human everyday life.

Combinatorics is a mechanism that, according to certain rules and laws, generates a variety of forms with given properties. As a method of shaping in the design, it is based on the use and application of laws according to different variations of spatial, constructive, functional and graphic structures of the object, as well as the methods for designing objects consisting of typified elements.

Key words: *combinatorics, shaping, design*

The essence of the constructive activity with combinatorics

The basis of the complex characteristic of the constructive activity is the possibility of including the individual and its character in various forms of work. The constructive activity includes itself dynamic, impartial and independent unity of intellectual and practical work, and also activity with a creative character.

Constructing as a process of creating new objects and elements; the creation of structures and forms with defined functional significance, due to its creative character, provides favorable educational possibilities for including the designers in the competitive business, for their intended inclusion in problematic situations and solving tasks of different character.

The content of the activity includes the overall process of the creative activity-formulation of the problem, through design, to the construction of a prototype, model or real object.

Structure, construction and shape

Form and form-shaping are subject of study of all sciences-natural, social and humanistic and in each of these areas of study, the form as a term has been known with different names. Unlike art science, in which the theory that studies the shapes

is called theory of form-shaping, in many other areas the same theory is known under the name morphology. The terms: structure, construction and form are closely related to the science “Tectonics” that represents the science of organizing, structuring and constructing the matter in certain forms.

The **structure** of an object is a set of internal connections between its elements and the laws of these connections, ensuring the integrity (whole) of the system. Also, the structure is an arrangement and organization of interrelated elements in a material object or system, or the object or system so organized. Structural types additionally are being concretized in constructive types. One same structure can be realized through different constructions.

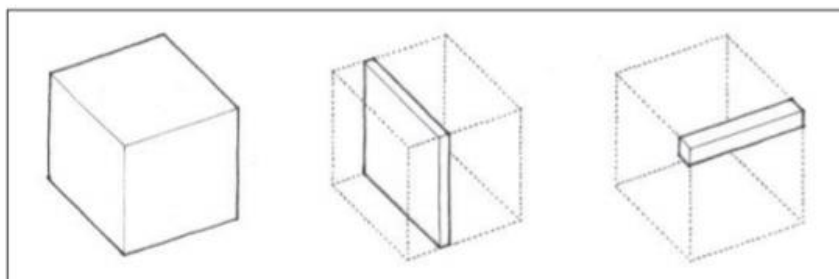
The term **construction** comes from the word “construct” which means “to build”. In design, the term construction means the activity of joining together different elements, using a detailed design and plan in order to create a structure for a particular purpose. Objectively, the construction is conditioned by the function of the object i.e. in other words, the choice of structure and construction in a design depend on the purpose and the function of the designed object.

For example, in furniture, depending on the function, are specific different design variants, such as:

- constructions in seating furniture;
- constructions in storage furniture;
- constructions in upholstered furniture, etc.

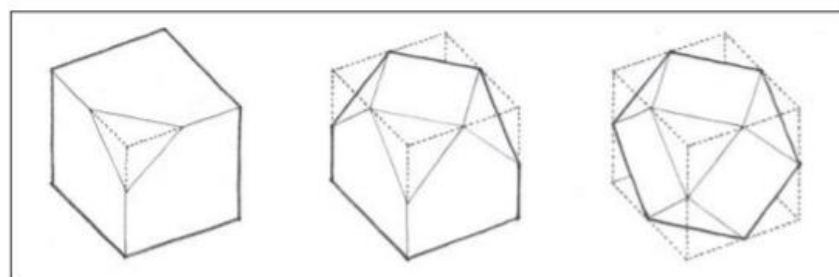
The form represents the structure of things, the character of their internal connections, the way of organizing the parts of which is composed, the quality of the content, the way the subject exists in space. The term “form” comes from the Latin word “Forma” which means: appearance, shape, picture, contour, figure, pattern, structure, configuration, profile and silhouette. In visual arts, form is a flat closed surface created with lines, textures, colors or it refers to a surface that is closed by other shapes like triangles, circles and squares. Forms in space can be created in several ways:

- with **dimensional transformation** - by changing one or more of its dimensions;



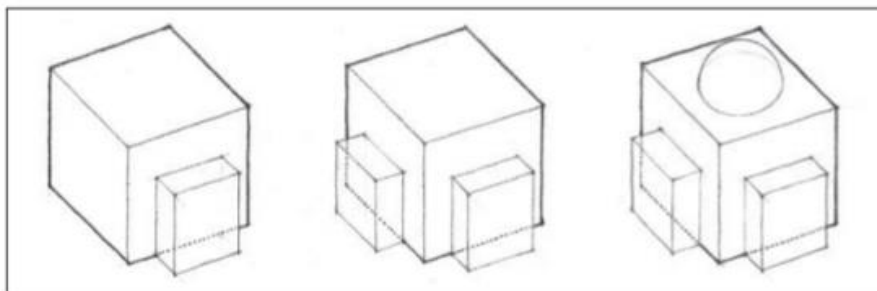
Picture 1 Dimensional transformation

- with **subtractive transformation** - changing the shape by subtracting part of its volume;



Picture 2 Subtractive transformation

- with **additive transformation** - changing the shape by adding elements to its volume.



Picture 3 Additive transformation

History and genesis of artistic-constructive activity with combinatorics

The term “combinatorics” comes from the Latin word “combina” which means “to connect”, “to compose”. As a science, combinatorics dates back to the 16th century. The advancement of human thinking is a hallmark that is determined by the development of the two mutually related parts of social progress, theory and practice, whose main characteristic is the science that is essential basis on which specific branches of scientific knowledge are created. Every significant problem that is interesting and exciting for a person, should match that criterion that provides him permanent presence in the entire history of human cognitive activity and also allows actuality in each time period.

Combining is one of the elements of psycho-practical activity of man, which contributes to the creation of the most diverse objects that have different applications in the human everyday life, thanks to the unique human abilities to connect the elements of matter in such a strict logical sequence, that results in unrepeatable individual solution.

From a modern point of view, the process of combining can be considered as a sequence of changes, characteristic for the development of combinatorial possibilities as a set of successive phases that represent a single line of development, direction and movement of elements, their development in the given order / process.



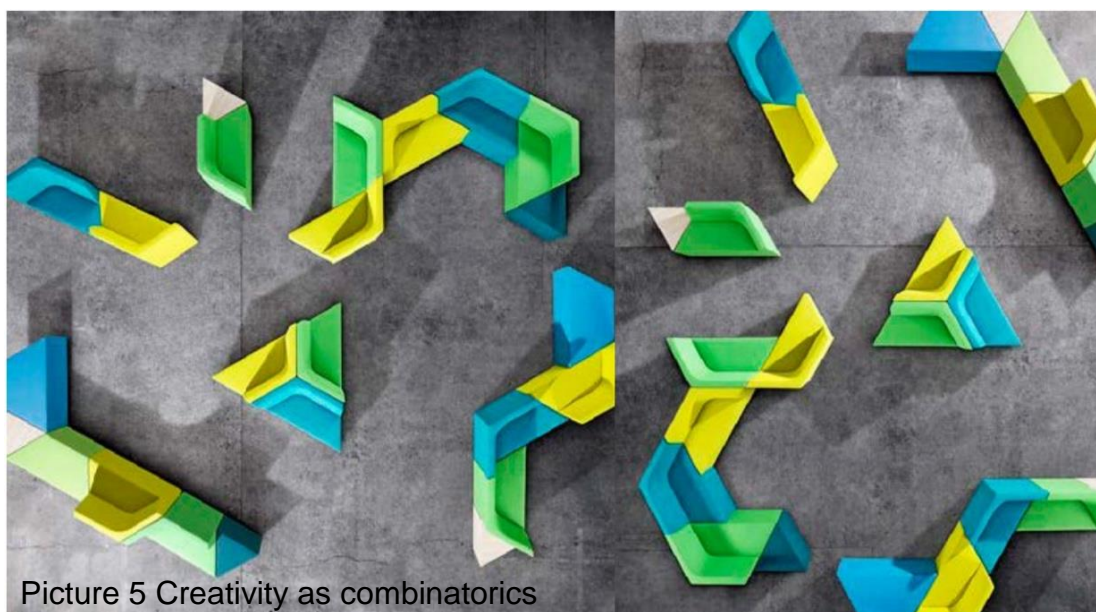
Picture 4 Form - shaping in human creativity - Stonehenge (left),
Palmanova - city 1593 (right)

Creativity as combinatorics

To get into the essence of creativity, it is important to understand its nature, its dynamics as a process, the attitude of the artist to the artistic activity and the activity of creating something new. In the creative process, new products are not created out of nowhere, but through the transformation of things that exist in the objective world, by changing their form, composition, structure, relation, by combining a new system of elements that previously belonged to another system, either by means of regrouping or a new way of connecting elements of the same system.

Nature and matter first appeared, and man is the product of their development. In that direction, the whole variety of things in nature is a combination of a limited number of elements. The artificial environment - the second nature, arises as a result of the combinatorial transformative activity of man. All of its subjects are essentially new combinations of already existing items, objects, phenomena.

In order for a person to successfully handle functions, to discover something new, to create, develop his knowledge and to perceive the possibilities, he must necessarily have a constructive and destructive activity, that is, to create or to destroy (disassemble).

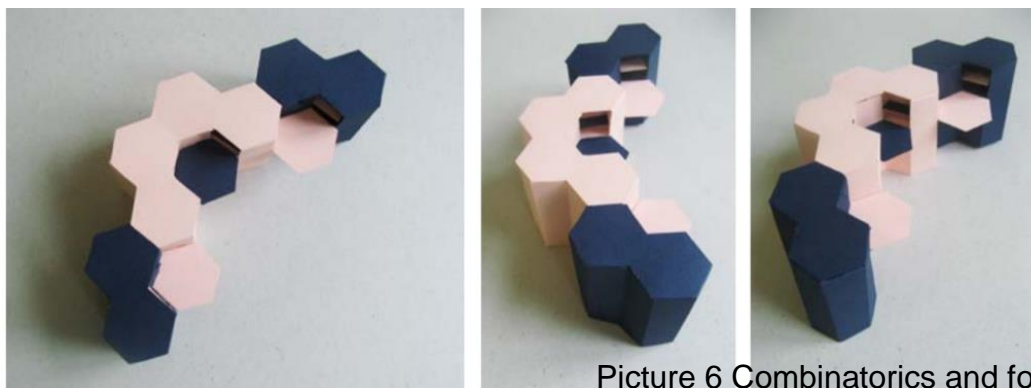


Picture 5 Creativity as combinatorics

To express the philosophy of creativity, the "new" must be thoroughly analyzed on the basis of the "old". It is considered that an important feature of the "new" that separates it from the "old" is a certain set of possibilities in which the new elements prevail.

The "old" and the "new" in the creative process can be presented as an ability to fight time and space. Or in a wider sense, we can conclude that the creative work and the material values of the past and the present, that are adopted and qualitatively changed by one subject, accelerates the movement of time to the point that in a year we managed to achieve so many things that the original man took it thousands of years.

By itself, the visualization of new systems is not considered as a creative work. Creativity is actually a form of activity and the action of a particular subject, person, social group or society. The person who creates, should respond to many requirements: the ability to accept the task, the speed of thinking, originality, the ability to variate, the understanding of combinatorics, analogy and synthesis.



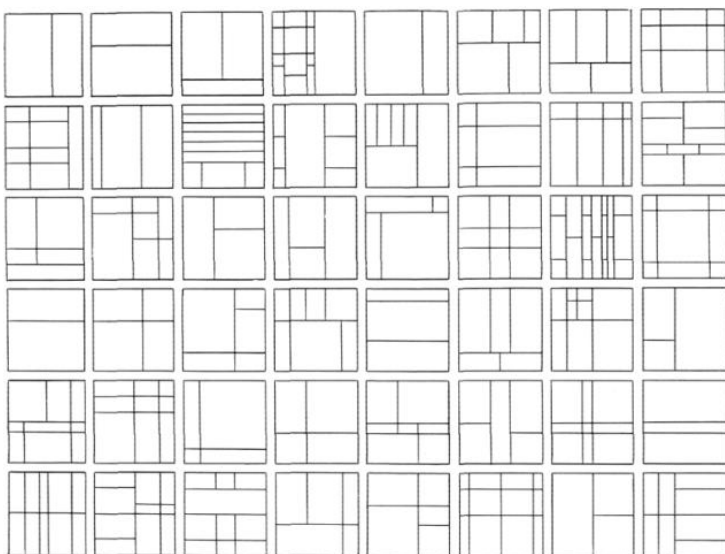
Picture 6 Combinatorics and form-shaping

Combinatorics and form-shaping

Combinatorics is a part of mathematics in which are studied and calculated questions about choice and layout of the elements of the final sets. The most common understanding of combinatorics and its meaning is as a method of organizing, structuring and constructing matter in a particular form. It is often considered as an artistic expression, which is related to the material-constructive basis. Regardless of the interpretations of the science and the differences that arise in individual interpretations, thoughts turn into an aesthetic orbit, or more accurately it refers to the connection between combinatorics and the aesthetics of form-shaping, combinatorics, and beauty. Its main goal is to determine the degree of artistic expression of a particular construction, and at the same time to be a mechanism that regulates the form and content of the designer's creation.

The term is actually a mathematical term that had been borrowed by the theory and practice of artistic design. Combinatorics is a special creative approach of shaping and creating forms that is based on the research and study of patterns of variations in the structures of space, as well as it refers to the ability to direct the design of the objects of applied art that are consisting of typed elements.

Fundamentally new solutions in terms of combinatorial composite solutions are obtained by using the following techniques: splitting a certain object into several independent subgroups (blocks), creating new compositions from blocks, inserting empty spaces between the blocks, complementing the compositional constructions and their regrouping.



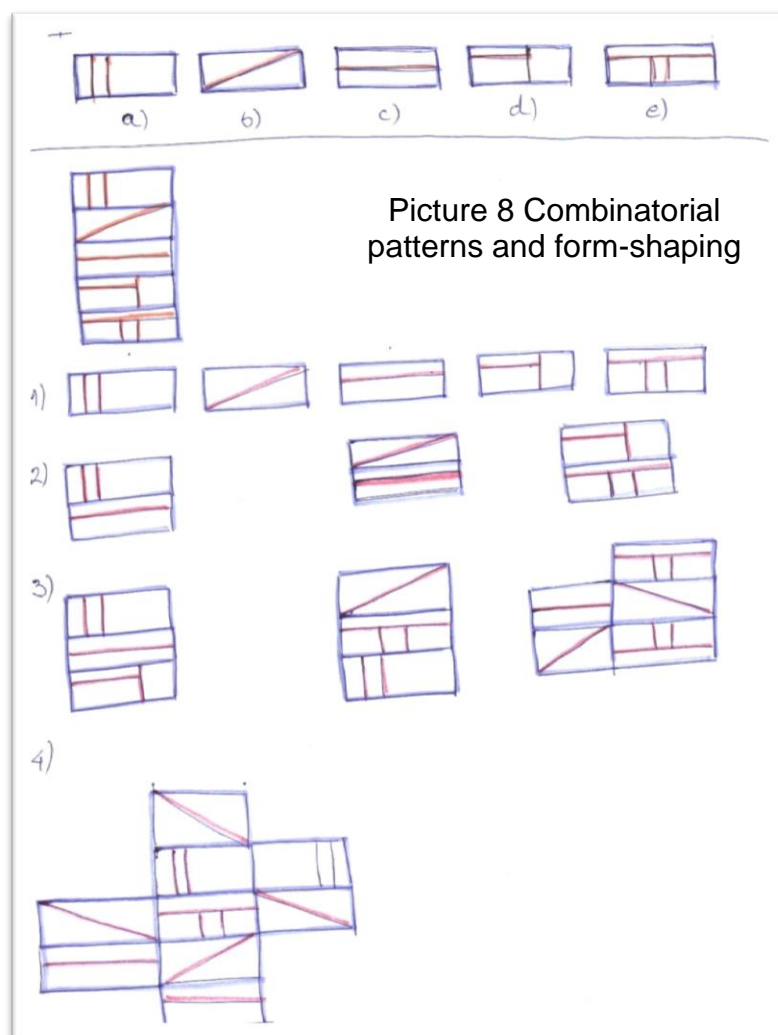
Picture 7 Module systems in design

When using combinatorics and combinations, the designer should keep in mind that all compositional solutions will not have high enough aesthetic and functional qualities. As a rule, the composition and the ergonomic requirements introduce additional constraints, whose consideration leads to reduction in the number of acceptable compositional solutions.

If we go beyond the abstract interpretation of the combinatorics and turn to a more specific consideration, we will conclude that combinatorics is a science of shaping, a science general and fundamental to many other sciences which as the object of their activity have the form.

The main subject of "Form-shaping" science is the processes of self-shaping forms in the physical and material world, as well as the creation of forms inspired from living organisms, regardless of the existence of man and his relationship to the world, the overcoming and organization of the chaos.

To clarify the history of form-shaping, we have to go back hundreds of years back and make a brief historical overview. It is interesting that the oldest methods of form-shaping are found in the principles of the most ancient games and various spatial puzzles. The abundance of the various types of decorations, regardless of their application to facades, fences, mosaics or furniture, are also a product of form-shaping.



This science studies the essence of objective forms and spaces, i.e. gives theoretical bases and knowledge for the form and space categories as objective physical phenomena. Due to the fact that form - shaping is considered as a process of organization, the basic concepts of form - shaping science are organization, system, structure, construction and form, and the basic categories are "symmetry" and "rhythm".

In addition to this, the specifics of form-shaping in terms of industrial design and

combinatorics are also being considered. An overview of the methods for the rational construction of forms is made through concepts such as: permutations, combinations, re-combinations, transformations, etc.

Conclusion

Combinatorics is part of the mathematics in which the combinatorial configuration is studied and the various types of subdivisions that can be formed from the elements of a single set. The multiple application of the combinatorics as a means of design resulted from the great diversity and synthesis in the techniques of the genres of various arts - painting, sculpture, applied arts (mosaics, fabrics, ceramics, wood carving, metal processing), architecture, graphics.

The combination of combinatorics and form-shaping allows the design elements to be used multiple times and for various purposes.

A specific feature of the combinatorics that is very close to form-shaping is the possibility of multifunctional use of the designed objects and their repeated arrangement in a variety of ways. This feature is directly related to unified mass production.

Thanks to this science, the world of shapes around us is not only infinitely varied, but also economically mediocre, since most of the objects are obtained by a combination of the same elements.

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