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COMBINATORIAL TECHNIQUE AND MEANS OF INTEGRATING NATURE INTO AN ARCHITECTURAL FORM

TECHNIKA KOMBINATORYCZNA I ŚRODKI INTEGRACJI PRZYRODY Z FORMĄ ARCHITEKTONICZNĄ

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ABSTRACT

In the article, based on the author's methodology, the combinatorial method of form making is analyzed, its principles and features of interpretation in the nature-integrated architecture are defined. The basic methods of using vegetation combinatorics in nature-integrated architecture are identified: combinatorics of vegetation on the facade planes; layer-by-layer modifications of combined plant and artificial pseudo-grid elements of architectural form.

Key words: nature-integrated architecture, methods of architectural form making, combinatorial method (combinatorics).

STRESZCZENIE

Zidentyfikowano podstawowe techniki wykorzystania kombinatoryki roślinności w architekturze zintegrowanej z przyrodą: kombinatoryki roślinności na płaszczyznach elewacji; modyfikacje warstwa po warstwie połączonych elementów roślinnych i sztucznych pseudosiatek o formie architektonicznej.

Kluczowi słowa: architektura zintegrowana z przyrodą, metody formowania architektury, metoda kombinatoryczna (kombinatoryka).

1. INTRODUCTION

The architecture of the late twentieth - early twentieth centuries is developing in line with the ecological paradigm. New directions are emerging such as «sustainable architecture», organic, «green», «earthy», etc. These directions are based on the ideology of sustainable development of systems, observation and use of patterns of natural environment development, use of natural materials and landscape components that were not previously considered to be the structural basis of construction facilities. Natural components such as water, soil and vegetation are highly demanded "building" materials that have a number of positive qualities, serve not only to improve the sanitary and hygienic state of the urban environment, but also to improve the health and psycho-emotional state of man (Kuznetsova Y., 2014).

The integration of landscape natural components into the structure of buildings is not entirely new in architecture. However, natural components have never been used so actively, completely changing the architectural form and creating a new image of modern architecture. The empirical basis of the research is the work of modern architects, who use natural components in architectural form making: Toyo Ito, Kengo Kuma, Shuhei Endo (Japan); Emilio Ambasz (Argentina), Michael Sorkin, Peter Eisenman (USA); Massimiliano Fuksas (Italy), Ken Yeang (Malaysia); Friedensreich Hundertwasser (Vienna); Oleg Drozdov (Ukraine); Marek Budzynski, Zbigniew Badowski, Przemek Lukaszuk, Lukasz Zagal, Przemek Olczyk (Poland); architectural office FAAB (Poland), landscape and architectural company Hadart (Poland), design studio Superhelix (Poland), architectural company Mobius Architects (Poland), etc. Projects of the following architectural groups and offices have been studied: Green Over Grey, Fytogreen, Ian Simpson Architects, Skylab Architecture, MVRDV, WOHA, GuzArchitects, Mass Studio, Aedas, A+A, Galabau, florafelt, Wall of flowers. More than 400 architectural objects and projects have been analyzed.

In the post-Soviet architectural theory, the terms "nature integrated architecture" (V.M. Logvinov) and "nature-integrated architectural objects" (Y.S. Gordienko) were applied to denote buildings in the formation of which components of the natural landscape (water, soil, plants and their combinations) were used.

At the global level, the philosophy of such architecture is shaped by its most prominent followers - architects P. Vetsch and E. Ambasz, the former stated that architecture should not dictate to and suppress nature, it should cooperate with it, and the latter in his book "My credo" (Ambasz E., 1991) emphasized the principle of "the disappearance of architecture": "Architecture has disappeared. Only the land remained. I can say that with such a technique I rhetorically excluded architecture as a cultural and historical phenomenon and returned to the original understanding of housing."

The research is based on works dealing with the study of nature-integrated architecture objects, aspects of the interaction between architecture and nature, the classification of techniques for the use of natural components and the consideration of individual techniques: V. Logvinov, N. Kryzhanivska, H. Osychenko (Osychenko H., 2009), O. Pavlenko, Y. Gordienko, O. Smirnova, O. Karasiova, D. Chyzhymak (Ukraine); B. Tomkovich, M. Gala-Valchovska, E. Kusinska, V. Tseladin, P. Haupt, M. Kmych. M. Furtak and M. Moetska, M. Zhezotarska-Palka (Rzeszotarska-Palka M., 2015) (Poland); N. Titova, V. Nefiodov (Nefedov V. 2012), A. Zaslavska, Y. Yankovska (Russia); R. Sterling (Sterling P., Ellison T. 1983), Kelly Lockett (Lockett K., 2009), Ronald Thomas (Thomas R., 2006), Alison Know (Know A., 2007) and Walter Grondzik.

Despite the careful attention of researchers to nature-integrated architecture, there is a lack of understanding of its compositional aspect and methods of architectural form making. The composition is the basic component of an architect's professional thinking, the development of the theory of architectural formation makes it possible to increase the professional and creative level of a modern architect.

The general purpose of this study is to analyze the combinatorial method of architectural form making and its interpretation in nature-integrated buildings. *The object of the study* is nature-integrated buildings and structures; *the subject of the study* is the consistency of the formation of nature-integrated architecture based on various combinations.

2. ANALYSIS OF RECENT PUBLICATIONS ON THE SUBJECT

The works of theorists from the former Soviet Union, united by a unified theory of architecture, were considered and analyzed. In the Soviet Union as early as in the middle of the twentieth century the composition, which was ideologically fixed, became the cornerstone of an architect's creative activity. Since the 1940s a considerable array of knowledge in the field of composition, its means, methods of formal formulation has been created, it includes both classical ordering principles and modernist formations of the twentieth century. General questions of architectural form making which reflects the technical level of construction, social and class ideology, socio-economic development of a certain society and historical period, etc. are dealt with in the works of G. Rappaport (historical and theoretical substantiation of the problem of form making), I. Dobritsyna (philosophical understanding of the idea of nonlinearity in architecture), O. Remizova (logical structures of the compositional language of architecture, the concept of the polylogical construction of modern compositional thinking), I. Azizian (questions of composition and form making in different historical eras).

Among the works devoted to the direct study of the methods of form making the following should be mentioned: O. Kashchenko (form making in design and architecture based on the modeling of bioprototypes); Y. Lebedev, V. Rabinovich (bionic method of form making); E. Pronin (combinatorial method); N. Shapoval (classical method, method of overhead facade, figurative and structural methods); H. Osychenko (Osychenko H., 2015) — generalization of methods and techniques of architectural form making; I. Dobritsin (nonlinear method, deconstruction method). Studies of the combinatorial method in nature-integrated architecture are based on the work of E. Pronin.

Western architecture theory existed under ideologically less defined conditions, and as early as the 1960s various architectural trends and authorial methods of form making began to develop. The idea of developing the western architectural theory toward new form making was defined by J. Fraser (algorithmic nature approach), N. Oxman (the natural principle of formation from material), and finally by Z. Hadid and P. Schumacher in the manifestation of parametric architecture.

Traditional classical methods of form making have received the most coverage in architectural theory and practice, but it is already clear that they cannot cover the contemporary needs for the development of architectural form making and harmonization of architectural forms.

3. RESEARCH METHODS

The study was carried out using common scientific methods: comparative analysis; synthesis; abstraction; methods of formalization and modeling; systematization. Composite-formal method of analysis of buildings (Winckelmann, Gabrichevsky, Stepanov, Tits) was applied. The authors developed a structural model of a building as a system that includes subsystems (spatial, structural, engineering, communication, functional-planning subsystems, a subsystem of external fences, details and decor of the building), which are interconnected and determine the external shape of the object (morphology). The description of the architectural form¹ was expanded from morphology to archetypal and semantic structures. Features and levels of visual perception of buildings are taken into account as scale levels of an architectural form (at the level of the form as a whole, at the level of elements and details) when decomposing it.

The analysis of the methods already selected by previous researchers allowed the authors to establish that the methods of architectural design of buildings are determined by: a) the establishment of certain rules and principles of interaction between subsystems of buildings; b) dominance of a particular subsystem (or subsystems) with its (their) display and articulation on an external form; c) presence of characteristic methods of form making (defragmentation, grouping, transformation,

¹ For the term "Architectural Form" we use the definition of A. P Marder (Architecture. Short Dictionary Handbook. 1995). Part of an artificially created or transformed object-spatial environment of human activity that organizes a more or less autonomous functional process. The architectural form has substantive spatial and embodied characteristics. Note: authors consider the architectural form at the volume and urban levels.

shaping, twisting, anti-gravity, combination of forms, etc.); d) establishment of certain rules and principles for the interaction between the elements of the form.

Generalizing the existing methods of composite analysis of an architectural form (F. D. K. Ching (Ching F., 2007), Y. V. Ivashko (Ivashko Yu., Shuan Li, 2015) the authors developed an algorithm for the analysis of architectural form making of nature-integrated buildings (Fig. 1.), which allowed to clarify and determine the features of the use of existing methods of form making, to identify new methods specific to nature-integrated architecture, to identify combinatorial method in the formation of nature-integrated buildings.

4. COMBINATORIAL METHOD OF BUILDING FORM MAKING

The combinatorial method (combinatorics) of form making is considered by E. Pronin quite broadly, sometimes competing with the general concept of composition in post-Soviet theory (Pronin E., 2004, p. 43). It is defined as a method of creating a form by combining each of the possible connections of these ideas, images, values, as well as material elements and physical properties of an architectural form. Combinatorics involves a combinatorial cycle, i.e. a set of certain procedures that provide possible options of the form or part of it. Among combinatorial procedures, E. Pronin distinguishes the change in geometry and size of the general form, the composition of its elements and details, the creation and change of combinations of the original elements. Combinatorics brought to life numerous developments of directories and "constructors" of forms from a limited and predetermined set of initial elements. Many of these directories are very widespread in practice, but most often have local implications for the overall development of the formal language of architecture. There are different types of combinatorics: combination of morphotypes, combinatorics of typical, individual and random forms, combinatorics with similar forms of different sizes, metrorhythmic combinatorics, combinatorics of spaces.

As examples of combinatorics in architectural form, Pronin cites architectural projects (mostly western) of the 1960s – 1980s related to the ideology of structuralism, namely W. Netsch, P. Maillard, L. Tissier, G. Candilis, J. Zeitoun (1984), R. Bofill. One of the most common methods of combinatorics is the use of flat and spatial grids, which ensures the orderliness of the building structure; enables you to get a variety of plan and volume options on one generating basis; creates an effective way of providing a set of recurring elements and connections that can be subordinated to a certain pattern that follows from the grid properties. It should be noted that the architects of the twentieth century continued the logic of Jean-Nicolas Louis Durand combinatorics (Durand, J., 1840), who proposed in the early XIX century to decompose the building into architectural elements and freely combine them within the grid. E. Pronin gives examples of objects on spatial, simple and combined grids, proposes a theoretical model of joint grids, gives the characteristics of pseudo grids, and also determines the methods of their collage (object on several adjacent grids), "layer-by-layer modification» at the level of form and individual facade of the building (window openings, roof layer, etc.), gaps or incomplete grids, "coloring" (from providing its elements with a specific purpose to the literal coloring, the work of G. Candilis (1979), R. Bofill, L. Tissier, A. Mayor, scaling, combining grids with irregular elements (embedding of broken or curved lines, picturesque elements in the grid, blocking parts of the object using a pseudo grid).

In this period combinatorics used the capabilities of computer-aided design (CAD) systems, with the development of modern architectural programs further development in the field of architectural combinatorics is possible. Highlights of combinatorics of the original period are: Habitat 67, Montreal, arch. M. Safdie, 1967. (Fig. 2 c); Fuji-TV Headquarters, Tokyo, K. Tange, 1967 (Fig. 2d); Takagin capsule tower, Tokyo, K. Kurokawa, 1972. (Fig. 2 a); residential building "La Muralla Roja", arch. R. Bofill, Calpe, Spain, 1973. The plan of the house "La Muralla Roja" is built on a simple orthogonal grid where the size of cells corresponds to the size of the room. Lines and grids have materialized into the system of load-bearing walls, that is, the grid has a constructive meaning. The overall outline of the house plan is also dictated by the grid. A cell - apartment acts as a module of the planning composition of the building blocks, cell and block system is reflected in the external form of the building. In design, combinatorics also operates on certain principles of combination:

permutation, grouping, upheavals, organization of rhythms. Combinatorial (variant) shaping methods are used to identify the greatest variety of combinations of a limited number of elements.

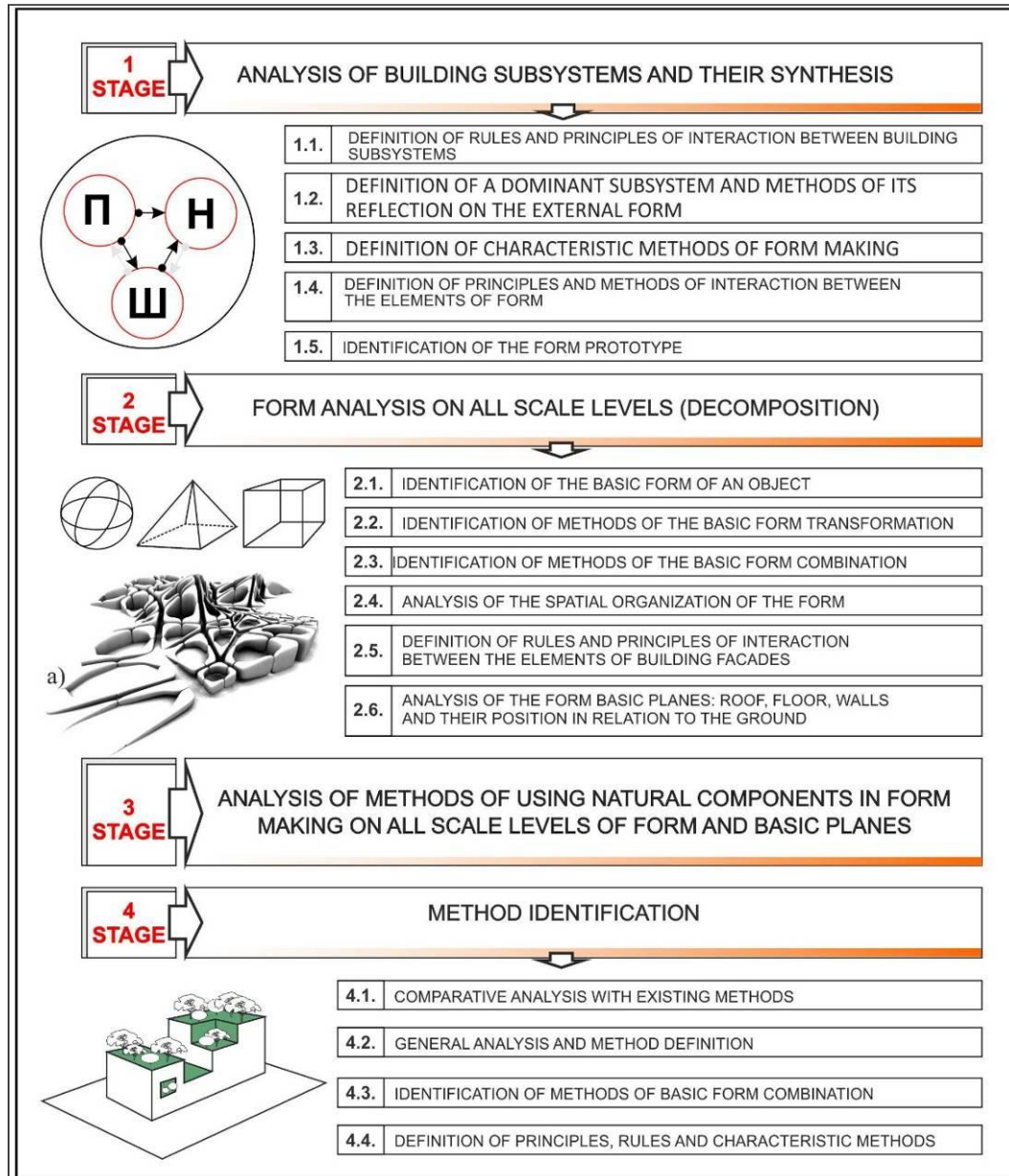


Fig. 1. An algorithm for the analysis of architectural form making of nature-integrated buildings.
Source: author's own resources, except a) Source: Zaha Hadid Architects

The basic techniques of combinatorial form making include combining elements on a plane when creating compositions of facades; connection of standard elements (modules) in a single integral three-dimensional form; combining details, proportional articulations within the form.

In addition to the analysis of combinatorial form making in architecture, the authors found:

- equivalence of the functional, spatial and structural subsystems of the building, the interaction of which is reflected in a three-dimensional form (in objects - representatives of the method);

- communication subsystem, vertical communications in the first place, come out of the forms, articulate and create large plastic of buildings;
- modernism buildings of the 20s-30s of the twentieth century are prototypes of architectural forms, which also determines the complete rejection of ornament and decoration in the method;
- elementary geometric forms are used as basic forms;
- classic base planes of architectural forms (wall, roof, floor) are preserved;
- the main principle of form making is modularity, which defines the property of an architectural form connected with the possibility of its decomposition into a number of internally interconnected modules;
- main methods of form making are combination of identical or similar elements, grid and layer combinatorics of elements of facade planes;
- at the level of the spatial composition, the focus of form making is on securing and identifying connections between modules and individual elements that provide clarity to the structural construction of a building.



Fig. 2. Combinatorial method of the modernist paradigm of form making (photo a, b, c, d): a) Takagin capsule tower, Tokyo, K. Kurokawa, 1972. Source: «Architect News»; b) Shizuoka Press and Broadcasting Center., Tokyo, K. Tange, 1967. Source: Peter Shmidek's photo; c) Habitat 67, Montreal, arch. M. Safdie, 1967. Source: «Special architecture. Habitat 67»; d) Fuji-TV Headquarters, Tokyo, K. Tange, 1996 Source: Pragmatika. The father of modern Japanese architecture. Combinatorial method of form making of nature-integrated architecture (projects e, f, g, h): e) Elastic Woodscraper II, arch. office Weingartner Architects, project. Source: «Architime. Special architecture»; f) 18-storey building, Canada, arch. office Penda, project. Source: «Architime. Special architecture»; g) Residential buildings «Coral reef», V. Callebaut, Haiti, project. Source: «Home. Architecture. Apartments»; h) Mountain towers, Paris, V. Callebaut, project. Source: «Pinterest. New ideas on futuristic architecture».

5. COMBINATORIAL FORM MAKING OF NATURE-INTEGRATED BUILDINGS

Object analysis has identified a small number of nature-integrated buildings with combinatorial shaping (about 20), and this is natural. Most researchers note that the complexity of an integral architectural form that meets many requirements - functional, structural, aesthetic, etc., complicates the creation of developed combinatorial systems "in their pure form." Even with traditional twentieth-century architectural features, combinatorial form making is not widespread, excluding the design of urban facilities. In nature-integrated architecture, the most common is the use of combinatorics at the level of the facade plane (Fig. 3.). Most of all natural components are used vegetation. The presented method may use a water component, but no such objects have been identified.

The most common methods of plant placement are vertical greening on facades and gardens on the rooftop.

Various methods of using plants and their variations in the form making of nature-integrated architecture at the level of the facade plane and its elements are systematized:

Combinatorics of vegetation: 1) a combinatorial element is the same type of plant material of a certain tone, combinatorial operations include selection of different numbers of grid elements, resizing of "green applications", their configurations, their position on the grid; 2) combinatorial element is the plant of the same shape and size with different color shades, combinatorial operations may include selection of the number of elements, finding the position on the grid (Fig. 3a) similar to layered modifications, when multiple pseudo- grids of different color elements are combined and can be read in layers; 3) combinatorics of the tone and texture of different plants when creating so-called vertical or horizontal farms;

- Layered modifications of the combined plant and artificial shape pseudo grids (Fig.3 b). Combinatorial operations include selection of the number of elements of different grids, their combination, change of geometric characteristics in connection with the parameters of different grids: 1) combinatorics of artificial elements on the facade with a uniform intersection of homogeneous "green spots"; 2) a combinatorial grid of artificial shell is placed on the combinatorial grid of vegetation which is situated on the facade plane; 3) artificial combinatorial elements are recessed balconies obtained by defragmentation of the facade plane, followed by landscaping (Fig. 3 c); 4) accentuation of the artificial protruding pseudo grid with similar elements of vegetation due to the complete coincidence of the grids.

The degree of manifestation of changes in the elements has a fairly wide range, from minimal changes to a wide range of means to achieve the combinatorial "effect". The analysis of combinatorial form making of nature-integrated buildings at the object level as a whole made it possible to determine its features: the spatial composition of the object coincides with the functional-structural subsystem of the building (form structure); various prototypes are used; geometric as well as nonlinear shapes can be used as the basic object shape; the lower horizontal reference plane remains at ground level or has tactile interaction with it; when using nonlinear shapes, the base planes are aligned. The main combinatorial element is the three-dimensional form - a complete functional - planning module. The main combinatorial operations are selection of the primary figure and its configuration; selection of the number of shapes that determine the combinatorial complexity of the object; resizing figures, their position in space (positioning) or gravity; search for options of spatial organization and grouping of figures (rhythmic organization, metric series, depth-spatial, rotation detection, positioning of elements on the grid, etc.).

The primary module can be changed by transforming the shapes, changing the position in space; attachment to the original figure of minor figures; twisting, shaping forms, etc.

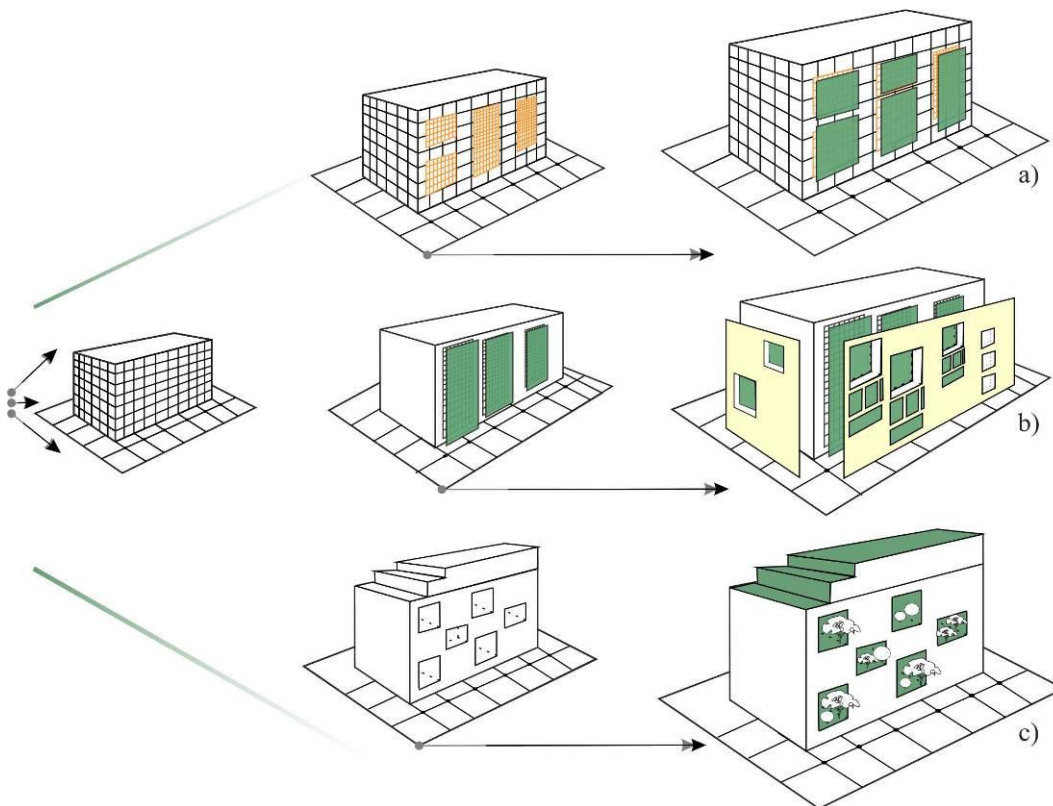


Fig. 3. Combinatorial method at the level of façade planes. Source: author's own resources.

Types of combinatorics at the level of object as a whole were systematized (Fig. 4 a):

- Combinatorics of identical figures in shape, size and configuration into a single complex: 1) combination of combinatorics of identical figures and combinatorics of elements of facade planes in all its types and variations, but combinatorial systems are independent of each other; 2) combination of combinatorics of identical figures with greening of roofs and combined base planes;
- Combinatorics of similar figures of different sizes, including such combinations of similar figures and forms - frontal placement, layering, linearity, depth of space, central, axial or mirror symmetry, stepwise organization with the reduction of the size of elements in height, etc.: 1) combined with combinatorics of facade planes in all its types and variations; 2) combined with landscaping of roofs and combined base planes
- Ascending combinatorics - spatial combinatorics of identical elements - modules that determines the construction of a combinatorial form of a higher level, that is, the building itself or complex of buildings. Combinatorial procedures additionally include form layout, part-to-element ratios, placement search and module grouping, consistency procedures for the building design, construction, and three-dimensional pseudo-grids.
- Figurative Combinatorial Method - spatial combinatorics of complex nonlinear shapes, involving the construction of high-complexity shapes using algorithms of computer programs with subsequent positioning - finding the relative arrangement of parts and elements in the form, finding the position of figures in the space on the grid. The combinatorial procedure begins with the choice of a natural or bioprototype, composite theme. This approach is close to the figurative method of form making, and combinatorics becomes a means of implementing an idea.

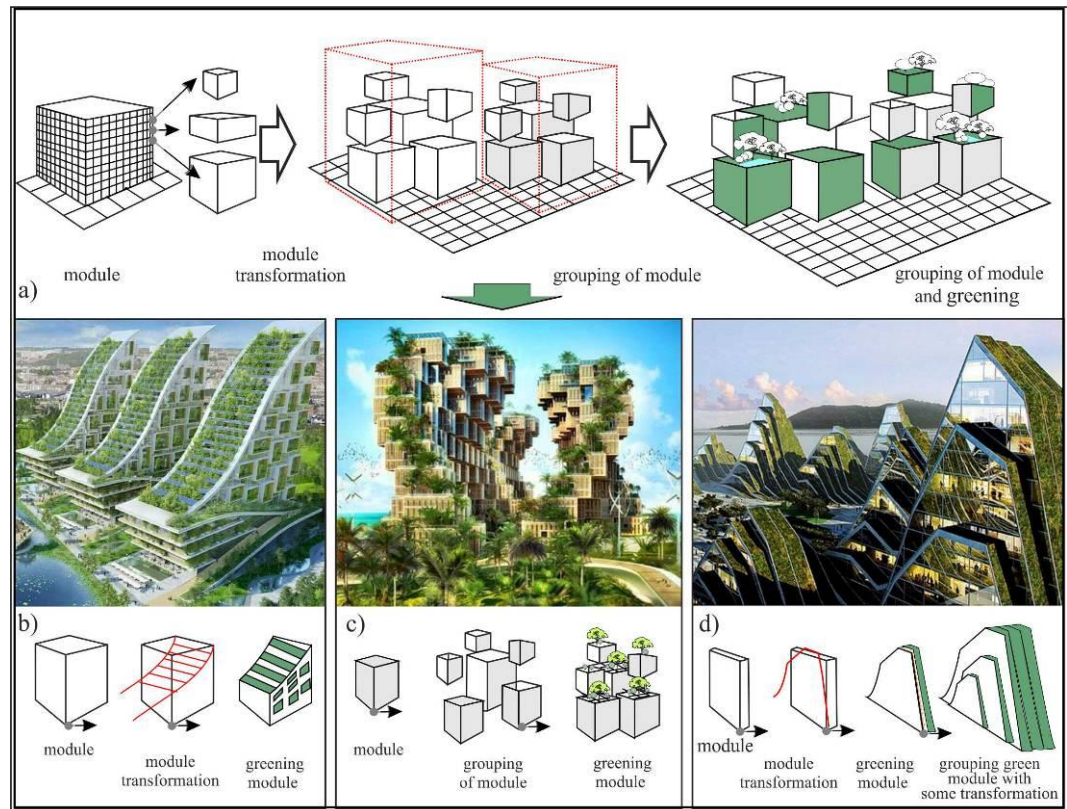


Fig. 4. Combinatorial method of form making at the level of form as a whole. a) Source: author's own resources. b) Residential buildings, Brussels, V. Callebaut, project. Source: «Redeveloper. News».; c) Residential buildings «Coral reef», V. Callebaut, Haiti, design proposal. Source: «Home. Architecture. Apartments»; d) Resort+residential complex, Taiwan, Bjarke Ingels. Source: «Architecture, book reviews, transport».

Methods of using green space in nature-integrated buildings are revealed, among them are landscaping of roofs, terraces, balconies and recessed balconies; vertical greening of buildings; combinatorics of green elements on facade planes: landscaping of combined baselines and combination of techniques.

The main methods among the analyzed objects of nature-integrated architecture is vertical greening of buildings. The implementation of these methods is possible with help of various structural systems and life-support technologies. The authors identified the following systems: vertical greening of walls or green wall; system of green roof, green cover, patchwork greening, applique, slit greening, modular or combinatorial greening; potted gardening, "pseudo- construction".

The project of residential buildings of the architect Vincent Callebaut in Brussels (Fig. 4 b) addresses the challenge of transforming the industrial zone into a modern and environmentally friendly area. The complex of three identical vertical figures of a complicated shape is of interest both from the point of view of combinatorial form making and from the point of view of the availability of green technologies - renewable energy sources, solar panels, etc. Residential buildings "Coral Reef", Haiti (Fig. 4c) by V. Callebaut are created by the allusion of high sea waves, the modularity of construction and the dynamic positioning of the module in space creates the effect of constant motion.

The modules used have rooftop landscaping, which allows each of the apartments to use their own space for growing cultivated and fruit plants. Architectural decisions of V. Callebaut in Paris districts within the framework of the project "2050 Paris smart city" (bamboo nests, farmers' tower, mango, bridge towers; photosynthesis, mountain and anti-smog towers) also develop ideas of formal combinatorics. The expressiveness of the architectural image of the residential and tourist complex

(Fig. 4 d) is achieved by the complexity of the form, the stylization of natural landscape forms, the dynamic zigzag silhouette of each individual module causes a number of associations (with sea waves, mountain landscapes, etc.).

Lima Golf Park Project by arch. office Bernardo Fort Brescia (Fig. 5a) includes a shopping mall, residential towers, a hotel, a conference center and skyscrapers. Simple geometric shapes of the multifunctional complex with the combinatorial grid system on the facades are complemented by the combinatorics of "green" modules, which in the best traditions of abstract painting form a new compositional theme. Project complex of 14 buildings in Istanbul by Ken Yeang (Fig. 5 b) and the Forest City Project (Fig. 5 c) are striking in the scale of the "city in city" approach and demonstrate combinatorial capabilities at the urban level.

6. CONCLUSIONS

The integration of nature into the structure of architectural objects is becoming a powerful tool in improving ecology around the world. Interest in this issue gives rise to whole architectural directions: ecological architecture, "earthy", "green", nature integrated, etc. Contemporary art is dominated by an ecological paradigm that demonstrates the latest technologies and upgrades of well-known architectural tools. The original method of combinatorial form making of the 60-80s of the twentieth century and its interpretation in modern nature integrated architecture are identified and investigated.

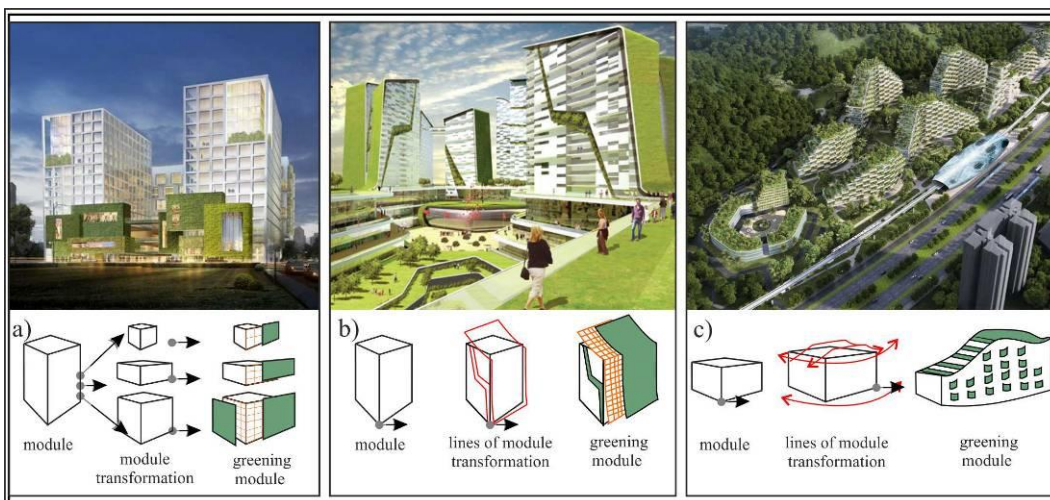


Fig. 5. Combinatorial method. a) Golf park, Lima, arch. office Bernardo Fort Brescia. Source: «ForsPeru».; b) Zorlu Ecocity, Istanbul, Ken Yeang. Source: «Fusion vision».; c) City-forest, China, arch. Stefano Boeri. Source: «HDFashion».

The analysis makes it possible to conclude that the combinatorics of the 60-80's of the twentieth century remained within the framework of the modernist paradigm of form making. This is confirmed by the use of abstract reduced base forms with pure geometry, the removal of ornament and decoration subsystems beyond the architectural form, preserving the archetypes of the basic planes of the building, the presence of a modernist desire for abstraction, versatility and simplicity of forms even with their volumetric complexity ("the smaller, the better" Miss Van de Rohe) and striving for the integrity, balance of elements and harmony of composition. One of the main principles of the method is the correspondence of the spatial composition of the building and the functional-spatial and structural subsystems (form structure).

The combinatorial method of nature integrated buildings form making differs from the derivative method. So combinatorics at the level of facade green elements means the return to architecture of

decoration and ornament in the form of vegetation. Non-linear forms have also begun to be used as basic forms, thus breaking the basic planes of the building: the wall "flows" into the roof, the roof and the wall "become" the floor of an urban space. There is a variety of choice of prototypes in form making, along with geometric forms of historical prototypes there are zoomorphic and biomorphic objects of architecture, allusions of natural landscapes, dynamic water bodies, etc. The complexity of the volumetric - spatial composition of nature integrated buildings was made possible by the transition to modern machine algorithmic form making methods.

But at the same time, the main principle of the original method - modularity (at different scale levels) and the main methods of form making - a combination of identical or similar elements and modules, a grid and a layered combinatorics of elements of facade planes remain unchanged.

Identified types of combinatorics of nature integrated buildings at the object level as a whole are combinatorics of identical figures; combinatorics of similar figures; ascending combinatorics; figurative combinatorial method.

The basic methods of using the natural component of vegetation in the form making of nature integrated buildings are identified: combinatorics of vegetation on facade planes; layer-by-layer modifications of combined plant and artificial pseudo-grid elements of architectural form. They include "application" of plant modules on the facade; defragmentation and filling of cells of a facade grid by green modules or "spots"; green compositions and panels on facade planes; landscaping of external fences, which creates the "green skin" of a building; as well as the functional landscaping of rooftops and the intermediate spaces of balconies, terraces and recessed balconies, which ensures the tactile interaction of a person with vegetation.

Thus, the combinatorics of nature-integrated architecture demonstrates both the diffusion of modern algorithmic methods and methods of form making, as well as the use of techniques of modernist and classical modeling of forms, which testifies to the constant development and improvement of architectural form making methods. Rethinking of methods is a constructive step towards the development of the theory of architectural form making.

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