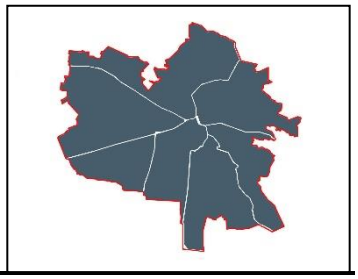

DOI: 10.21005/pif.2019.38.C-03

INTERDISCIPLINARY APPROACHES TO THE STUDY OF MORPHOLOGY: THEORETICAL AND METHODOLOGICAL ASPECTS. INTRODUCTION TO CITY MORPHOLOGY

INTERDYSCYPLINARNE PODEJŚCIE DO BADAŃ MORFOLOGII: ASPEKTY TEORETYCZNE I METODOLOGICZNE. WPROWADZENIE DO MORFOLOGII MIASTA

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ABSTRACT

The study attempts to identify the main theoretical and methodological positions of morphology. These positions are formulated in the natural sciences (biology) and humanities disciplines (linguistics) and can form the basis for studying the morphology of the city. Morphology has the status of an independent school of science and is a fundamental teaching in biology and linguistics. The choice of the outlined above scientific fields is made due to the similarity of morphological guides. They can be compiled into the description of tasks, the study of the conceptual apparatus, the classification of forms and the processes of mastering which are related to the formation.

Key words: interdisciplinarity, morphology, city.

STRESZCZENIE

W badaniu podjęto próbę określenia podstawowych teoretycznych i metodologicznych stanowisk morfologii sformułowanych w obszarach wiedzy przyrodniczej (biologia) i humanitarnej (językoznawstwo) jakie mogą stanowić podstawę do badania morfologii miasta. W biologii i językoznawstwie morfologia ma status niezależnego kierunku naukowego i podstawowego nauczania. Wybór wyżej wymienionych gałęzi naukowych wynika z podobieństwa ustawień morfologicznych, które można ogólnie podsumować do zadań opisywania, badania aparatu pojęciowego, klasyfikacji form i opanowywania procesów związanych z kształtowaniem.

Słowa kluczowe: interdyscyplinarność, morfologia, miasto.

1. INTRODUCTION

From the beginning of the twentieth century European scholars have insisted on the barrier between different scientific disciplines to be eliminated. Because of this, scientists urged professionals to use the experience of related disciplines by combining the methods of various sciences. Over time, this approach was called "interdisciplinary" and began to share to different and completely non-related scientific branches and theoretically unrelated concepts.

The phenomenon of interdisciplinarity was commonly recognized in the middle of the twentieth century. The symbiosis of various schools of science is evidenced by this: biology with geography, biology with physics, economics with geography, linguistics with mathematics, semiotics with logic, etc. So, interdisciplinarity has become a prerequisite for the researching in natural sciences and humanitarian disciplines.

Today, the novelty of the interdisciplinary situation is not so much in the fact that other sciences “borrow” methodological principles and methods of research, but in the fact that the object of study has become now polydisciplinary.

The aim of the study is to determine the theoretical and methodological foundations of morphology, which were formulated in various fields of knowledge and can form the basis for the morphology studying of the city.

The scientific hypothesis of the study is that it is possible to apply concepts and methodological techniques for the study of the morphology of the city. These concepts are based on the interdisciplinary possibilities of natural sciences (biology) and humanitarian disciplines (linguistics). In this case, morphology has the status of an independent scientific field and fundamental doctrine. The choice of all above scientific fields is made due to the similarity of morphological guidance. They can be summarized to the description tasks, the study of the conceptual apparatus, the classification of forms and the mastery of the processes of morphogenesis that take place at all levels of the structural organization.

The moment of involving interdisciplinary knowledge and approaches in order to study the morphology of the city is connected with the lack of knowledge of this phenomenon in urban planning. Moreover, there is a lack of a scientific, theoretical and methodological base.

The methodological basis for the research are the philosophical and ideological [16, 30, 31] and interdisciplinary [24] approaches. The philosophical approach formed the scientific position concerning the subject of the study. Interdisciplinary approach allowed to determine the theoretical facts and applied morphology aspects in the natural and humanities fields of knowledge.

Fundamental works that make up the theoretical basis of the research and concern such *issues as philosophy and methodology of the science* (V. Budanov, V. Kasyan, B. Nicolescu, A. and D. Novikov, G. Ruzavin, A. Tararoyev, U. Urmantsev, A. Fomin, A. Tsophnas, V. Yudin, etc.); *theoretical and applied aspects of the study of the morphological characteristics of architectural and urban objects* (G. Osichenko, A. Timochin, G. Curdes (Germany), E. Raith (Austria), S. Muratori (Italy), MRG Conzen (Great Britain), G.Caniggia (Italy), etc.). There is a clear need to develop new approaches for expanding and deepening knowledge about the formation of the material and spatial environment of the city despite the thorough and comprehensive study of morphology of the city.

Several notions can be singled out of the concept of interdisciplinarity [5]: the harmonization of the languages of related or distant disciplines, such as the transfer of heuristic models from one science to another, as the interaction of several disciplines in solving certain problems (environmental, social, AI, etc.), as self-organizing communication. These values are complementary. They allow defining various aspects and manifestations of interdisciplinarity.

In this study, the subject of multidisciplinarity should be understood as the results of a comprehensive study of the phenomenon of morphology. These results are based on the generalization of knowledge that is related to the different branches of science. Moreover, it is necessary to underline that this knowledge is at the junctions of various sciences, on the principle of complementarity and synthesis at the philosophical and methodological level.

Any interdisciplinary research is aimed to identify new relationships between the concepts of the original disciplines, to establish a new system of laws that is associated with them and to synthesize the paradigm of solving new ever more complex tasks. At the same time, knowledge of the initial disciplines can remain unchanged. They can be included completely (or partly) in the new hierarchical structure or undergo modifications. They can develop through the processes of exchange of paradigm guidelines, concepts and methods of various sciences (nonlinear interdisciplinary interaction) [20].

2. ACTUALITY OF THE APPLICATION OF THE INTERDISCIPLINARY APPROACH IN THE MORPHOLOGY STUDY OF THE CITY

Today, morphology is a science. It exists in various spheres of human life and is an elementary tool for describing the form of the nature as a separate unit. It may also apply to the architectural and urban area. Currently, there is no clear definition of the concept of morphology of architectural and urban form in Ukrainian science and abroad [33]. Moreover, there is no scientifically based methodology for describing this phenomenon. That is why it is advisable to develop a new scientific direction which is called "morphology of the city". Here it is important to reveal morphological features and conduct researches concerning the evolution and functioning (morphological characteristics) of the urban form. They can be based on traditional approaches and key concepts of other scientific disciplines. This will open up a new reality and form a new system of concepts and definitions (Fig. 1).

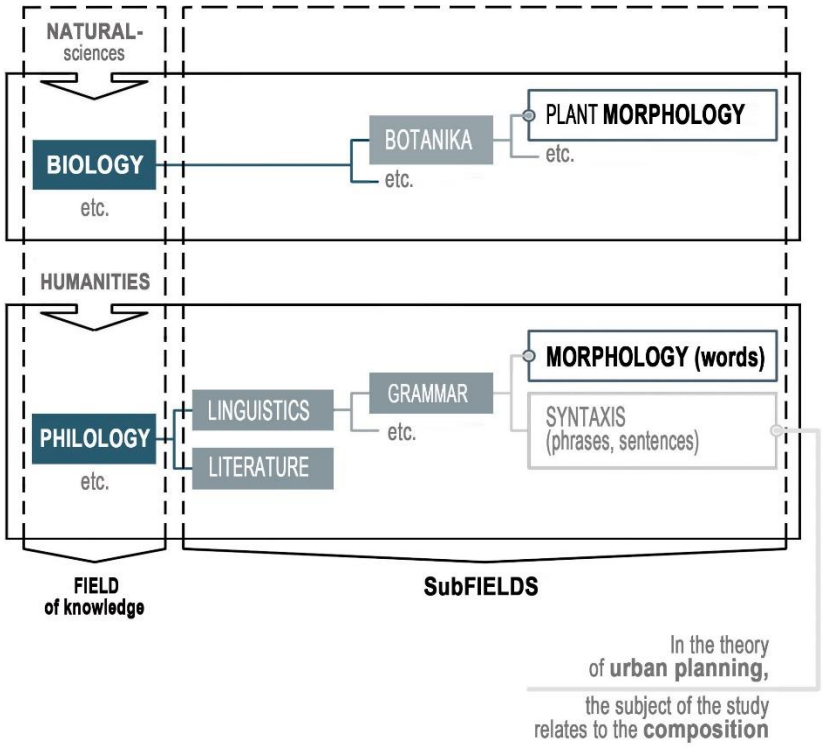

Fig. 1. The place of morphology in the structure of modern natural sciences and the humanities. Source: the author

Ryc. 1. Miejsce morfologii w strukturze współczesnych nauk przyrodniczych i humanistycznych. Źródło: autor

One way to change the typical approaches to researching architectural and urban facilities is to use informal interdisciplinary approaches. Here we can expand the traditional disciplinary methodology. Interdisciplinarity may *have different forms of manifestation*. It can be varied both in architecture and in urban planning: *the application of new concepts, the formation of new methods, the development of classical theories, etc.*

Theoretical and methodological foundations of morphology as a general scientific doctrine did not form immediately. The process of formation is associated with a description of the phenomena, things, objects, and etc. Over time this approach has changed. Theories developed on the basis of the description. They were aimed at identifying the characteristics, explanation of properties and their practical application.

The phenomenon of morphology is closely related to botany. Therefore, biological research becomes the main importance in its study.

The terminology of morphological plants description was formed mainly in the XVII century. At the same time, the first attempts to theoretical generalizations of different types of plants by their appearance and structure were made. However, the formation of the morphology of plants as an independent scientific doctrine is referred to the beginning of the nineteenth century [14], with the scientific work of I. Goethe "The Metamorphosis of Plants" (1790) [13].

A. Morphology in natural science. The extraordinary diversity of the system of biological sciences exists due to the diversity of manifestations of life, its forms, methods and purposes of the study of living objects and the study of living forms on different levels of its organization. Botany, as a separate branch of knowledge, was formed as one of the first among the biological sciences. Different directions in the field of scientific study of the plant world initially led to the accumulation of data about all plants and subsequently led to the forming the independent scientific disciplines: anatomy, morphology, taxonomy, physiology, plant embryology, geobotany, paleobotany, etc. [34, 7, 33].

The basic scientific directions are the systematics and morphology of plants. A large number of scientific and educational literature may be noticed as an evidence of this fact. These two scientific fields take the dominant position in determining the main directions of research in botany and have a great significance for its further development.

The main task of pre-evolutionary taxonomy of plants was the grouping of plants by general similarity and determining the diagnostic features for taxa creation. Ideal features were considered to be the most obvious features of the external structure of plants, which were directly and visually perceived by researchers.

Solving this problem led to the creating of descriptive morphology. It should be underlined that quite significant results were obtained long before the very concept of "morphology". The necessity of plant diagnostics and compilation of key determinants determines the existence of descriptive morphology till nowadays [26].

As a rule, morphology in botany is opposed to physiology, which deals with the study of functions.

According to some scientists [9, 37], the key component of the morphological study is the homologation of the objects being under study. It is the process of determining the homology similarity caused by the origin of the general predecessor [2]. It is necessary to have special criteria in order to identify such similarity. Their development forms a significant part of theoretical morphology [22, 28], which essentially develops a method of comparing objects when it is necessary to detect their essential properties and separating random [36].

Theoretical and methodological foundations of the study of plant morphology. Morphology in biology refers to the general aspects of the biological form and the location of parts of

living organisms and forms an initial and necessary basis for all other botanical disciplines. In this regard, the study of the botany begins precisely from morphology [7, 27].

The term anatomy also refers to the study of the biological structure. Still, the theory usually involves the study of microscopic components or parts [1] that are visually imperceptible (hidden). However, in practice these two terms are used almost as synonyms [32].

As a rule, *morphology* in botany *is opposed* to physiology, which deals with the study of the *functions* of organisms and their parts.

The methodological basis of morphology is the method of comparison, which consists in establishing, evaluating the quality and classification of similarities and differences between objects. In this case, the main task is to find similar features, which helps to combine objects into groups. But similarity and resemblance have different meanings. In the morphology of living creatures usually distinguish the resemblance of the structure inherited from common ancestors (homology), and independently acquired similarity (analogy) [22].

An important feature of morphology, as a separate scientific direction of biology, is the study of living organisms that are *perceived directly by the human eye*. Sometimes it is associated with *structural botany*, because the main task of morphology is giving the name and description of botanical structures. Organisms that are studied with the usage of additional and special tools (magnifying glass, light or electron microscope) and are the object of studying another botanical discipline - *anatomy of plants* [3, 4, 17].

The process of developing morphological structures of organisms is called morphogenesis. The second half of the nineteenth century was the time the term morphogenesis appeared precisely in biology for the first time. The term "morphogen" appeared a little bit earlier (Germany, 1874; France, 1862). Today, the concept of morphogenesis is used in many other disciplines, among them: geology, philosophy, sociology, engineering, urban planning and architecture. In geology this term was adapted in the twentieth century. [21, 29].

The main methods of morphological research are: *descriptive* (description of organs forms and their systems), *comparative* (classification of descriptive and experimental materials) includes comparative and ontogenetic, comparative and phylogenetic, comparative and ecological methods, *experimental* (the objects are studied in specially modified external conditions), *phylogenetic* (the defining of historical development of various systematic groups of plants) [23].

The process of division is a characteristic morphological feature of higher plants: vegetative organs (root and sprout, which consists of a stem, leaves and buds) and generative organs (flower, fruit (fetus) and seeds). Vegetative organs provide the individual existence of plants, perform functions of nutrition and metabolism and interact with the environment. Generative organs are responsible for reproduction. Taking into account the peculiarity of the structural organization of the material structure of the city and identifying it with a living organism, the greatest similarity can be observed in the structure of vegetative organs of tree plants.

The role of morphology in modern biological science is not unambiguous. Here we have several reasons. If morphology is regarded as an applied science that serves the needs of taxonomy, then it has the status of the method; if it is regarded as a theoretical discipline, it causes the necessity to have its own subject of research, not related to the solution of axonometric problems [36].

Taking all into account, it is most important to involve theoretical and methodological provisions formulated in the morphology of plants in order to deepen the notions of morphology. Here it is said about the study of the terminology apparatus - morphology, metamorphosis, morphogenesis and scientific and practical approaches to the study of biological forms of tree plants. Complex methodological bases for the study of *morphological signs*

of plant life forms are valuable for research. It is not complete without general information about *morphology as a scientific direction*, in particular: *tasks* (description and giving names of organs of plants, studying the processes of formation of plant organs (in order to establish the laws of their morphogenesis). It is important both in the individual and in the historical development of plants; *directions of research and methodology* (principles, approaches and methods).

B. Morphology in humanities disciplines. The term morphology extended to linguistics as the definition of the branch of science in the nineteenth century. It has the meaning of language learning of the words forms. It firstly was introduced in 1859 by the German linguist A. Schleicher in the linguistic sense. He wrote: "For the doctrine of the word forming, I choose the word "morphology "[35].

Grammar, as a structure of language, is a set of rules typical for a specific language. Here words are combined into meaningful phrases and sentences. Words assume proper functions in the sentence and subject to the rules of the sentence formation.

Morphological units, categories and forms, syntactic units and categories, word-formation units and variations of word-formation are distinguished in the grammar of the language. Grammar of a specific language, in contrast to its vocabulary, is relatively stable, but it also can change over time under the influence of various factors under the general laws of language development.

Traditionally grammar is divided into *morphology* (word grammar) and syntax (phrase, sentence grammar). However, this division is not unambiguous and was denied by some scholars. Such division is mostly important for the languages with a clear structure. Therefore, in the description of languages with poor morphology (English, modern Chinese, etc.), *morphology,* as a grammar unit, goes back to the background. For amorphous ("root") languages (ancient Chinese, modern Thai, Vietnamese, etc.) it is more important. Methods of syntax describe linear arrangement of constituents more adequately than the traditional methods of morphology [6, 18].

Syntax often relates to composition in the theory of urban planning. G. Osichenko uses the term syntax in determining the compositional structure of the city, its location, method and nature of the relationship between the elements [25].

Morphology of language is a unit of grammar, which includes all phenomena associated with the word, its forms (paradigms) and abstract grammatical meanings. Morphology classifies words according to its morphological categories, lexical and grammatical categories. The maximum unit of morphology is a word. At the same time it is a minimal unit of syntax. The minimum unit of language that matters is a morpheme. The two main types of morphemes are root of the word and affixes. Words and word forms are formed on the basis of morphemes.

The discreteness of the word form to the smaller sign units (morphemes) is the main reason why morphology is concerned as a special unit of grammar.

Morphology is subordinated to syntax. It plays a crucial role in the functional specialization of morphological and word-formation phenomena.

The notion "morphology" is interpreted by linguists in different ways. Morphology extends to the structure of grammatical units according to one of the most famous concepts. It does not go beyond the word, in contrast to the syntax. Some linguists deny the traditional division of grammar into morphology and syntax [39].

The object of morphology is the morphological word. It means the system of all its forms and their grammatical meanings. *The subject of morphology* are the word the as a part of the language, the categorical meaning of the word, the morphological categories of the word, the lexical and semantic category of the word, the morphological form of the word (word forming), the morphological category [10, 19, 39].

The word is the maximum and the main morphologically significant unit in the grammatical system (the construction of the unit, because it consists of smaller units -morphemes), and the morpheme is minimal [19, 37] (Fig.2).

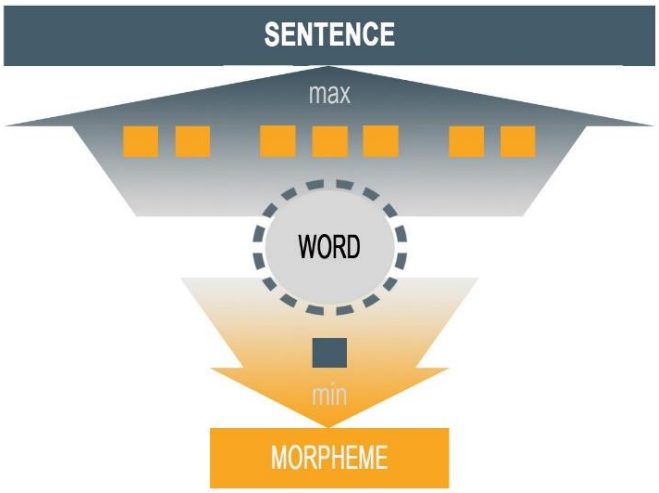

Fig. 2. Morphological unit of language. Source: the author

Ryc. 2. Morfologiczna jednostka języka. Źródło: autor

I. Vakhovets [37] believes that morphology as a science resolves such problems: the definition of the dismemberment principles of lexemes into word forms and the association of word forms in tokens; explanation the semantics of the word as a morphological (grammatical meaning); a substantiation of morphological categories and their origin; a description of formal means, fixed in the proper parts of the language and their morphological categories.

There was the development of the study of grammatical phenomena in terms of their functional specialization in the second part of the 20th centuries. The notion of functions of language and grammatical units are central to the functional grammatical direction. Functional morphology studies the functions of morphological units and categories, primary and secondary functions of morphological forms [38].

The study of the theoretical positions of morphology in linguistics has allowed developing a conceptual apparatus, to intensify the specialization of concepts, to increase their information field and to deepen the content.

Theoretical and methodological principles of morphology in biology and linguistics allow to expand scientific tools in morphological studies of urban planning.

C. The morphology in the theory of urban planning. The city morphology be considered as the basic level of formal properties study, which are related to the city's form and structure [36]. The basic research tools of the city's morphology are the principles, concepts and categories that reveal the fundamental positions of morphology as a general scientific doctrine. They are at the interdisciplinary level and determine the essential features of the city's material manifestations. Principles of the city morphology are divided into two groups. The first group is related to the essence of the morphology of the city as a scientific doctrine. This is the principle of *systemicity* and *interdisciplinarity*. The second group of principles is related to the recognition of the object of studying the city morphology: *integrity* and *discreteness*.

Linguistics and biology formed the conceptual-categorical apparatus of morphology as a general scientific doctrine. Despite the difference in the objects of study the apparatus is effective for studying the city's morphology. The concept of the city morphology can be divided into two types: general and special. General concepts are general philosophical categories (substance, quantity, quality, space and time). Special concepts are concepts that are related to the form and structure of city-planning objects ("morpheme", "morph", "morphotype", "morphological unit", "morphological sign", "morphological structure").

Both the form and the structure of the city are manifested in the substantive level of the city-planning system and consists of two interrelated phenomena – "territory" and "structures" [8, p.12]. They can be specified by the concept of "physical structure of the city" (Fig. 3) [12].

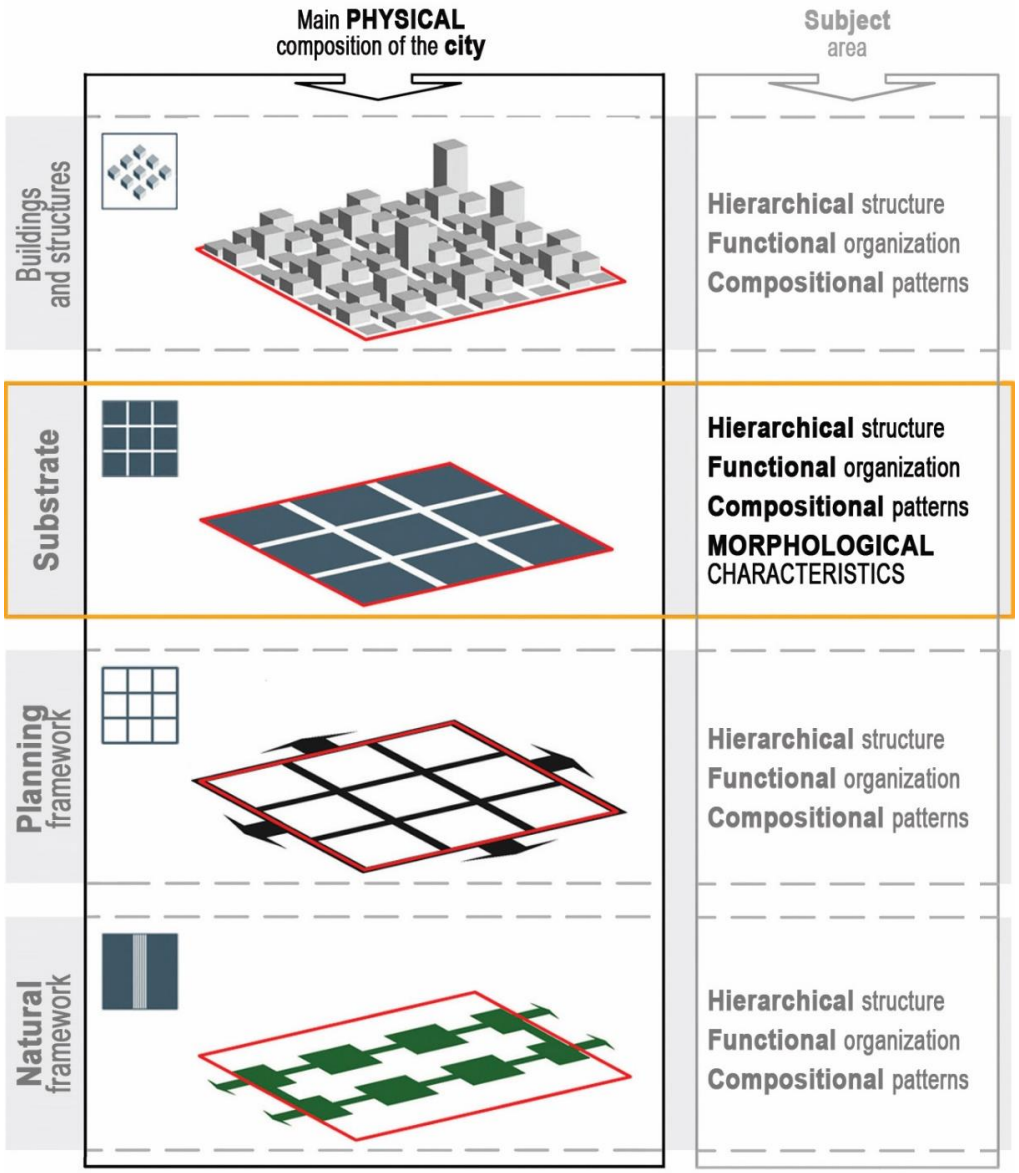

Fig. 3. Detection of morphological characteristics. Source: [12]
Ryc. 3. Wykrywanie charakterystyki morfologiczne**j**. Źródło: [12]

Study of the form of the physical structure of the city is aimed at determining the formal features of the material manifestations of the city and its components as an object of design. Output concepts in the analysis of the form is the configuration – the overall outline of the territory; the form of the border is the character of the boundary of the total territory of the city, fixed on the legislative level, geometric (or quantitative) characteristics and degree of dismemberment.

The structure of the city is a reflection of its inner form. Its meaningful limits is a plurality of parts that are in interaction and specific order in a specific territory. Detection of the structure of the city is carried out decomposition on the basis of planning. The basic concepts in the analysis of the city structure are the density and texture.

Studies of similar content are also present in the study of the compositional patterns of urban-type objects, and so on (Fig. 4). However, they have a significant difference: morphology considers objects that have a physical integrity and are categorized on a systemic basis; the composition is aimed at combining elements into a integral structure on a subjective basis. At the interdisciplinary level, the composition is identified with the syntax.

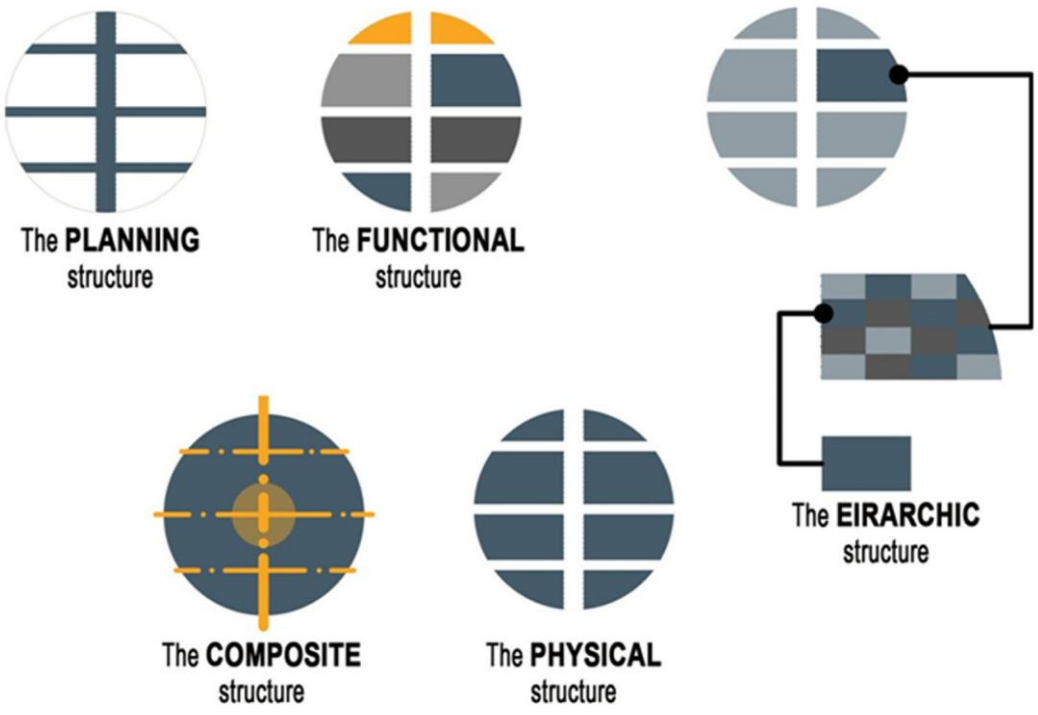

Fig. 3. The properties of city structure in urban planning. Source: [12]
Ryc. 3. Właściwości struktury miasta w planowaniu urbanistycznym. Źródło: [12]

The city's morphology, in the context of general theoretical discourse, has ontological and gnoseological principles of philosophical comprehension of reality and is an integral part of it. The questions of ontological foundations are related to the components of the city morphology (methods, principles and means), which are methodological tools for mor-

phological research. Gnoseological principles recognize the city morphology as a sphere of scientific knowledge, that is, the doctrine of form and structure [15]. Thus, the city morphology can solve the problems of the methodological (for example, determining the characteristics of the physical structure of the city) and theoretical aspects (for example, revealing the city's form as a morphological) and generalize object characteristics (but not phenomena) according to characteristic morphological features.

3. CONCLUSION

Morphology, using the experience of different researches accumulated in various fields of knowledge, seeks to follow the characteristic features (integral and capable for division) in material and visual forms of their manifestation. Morphology is a relatively developed system of theoretical knowledge about form in its content. As a branch of specific knowledge (since not all phenomena and objects of the world can be the object of its study), morphology has an ordered system of interconnected and interacting concepts and philosophical categories. These categories are defined by the essence and content of the subject in a certain science and at the same time reflect the organization of knowledge of the object being studied.

It is necessary to put the theoretical and applied aspects of morphology defined in the natural sciences (biology) and linguistics. It is necessary to do because they lay in the heart of morphology of the city as a doctrine of the form and structure of its physical substance.

The theoretical and methodological foundations were developed in botany and linguistics. Here morphology has reached a high level of development and covered the entire spectrum of possible knowledge (specific for certain knowledge of objects being under study). Morphology has also reached a high level in the study of form, its structure and includes: a system of morphological concepts, categories, abstractions, methods and methodologies, special and general theories.

The analysis of theoretical and methodological principles of morphology in various fields of knowledge has shown that not all subjects and phenomena of the surrounding world can be interested for morphology.

The study of the plants morphology made it possible to get acquainted with the complex methodological basis for the study of morphological features using the examples of life forms of plants. It was also possible using general information about morphology as a scientific direction, particularly: tasks (description and giving names of organs of different plants, studying the processes of plant organs formation – individual and historical development of plants), directions and methodology (principles, methods and techniques) of morphological research.

The study of morphology in linguistics has allowed deepening and developing the conceptual apparatus. It was possible to strengthen the specialization of concepts and to increase the information field and to deepen the content.

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