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METHODOLOGY OF SCIENTIFIC RESEARCH IN ARCHITECTURAL AND URBAN PLANNING OBJECTS

LECTURE NOTES

(for applicants of the second (master's) level of higher education full-time study in specialty 191 – Architecture and urban planning)



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The lectures is made for the purpose to help students of architectural and urban-planning specialties of high educational level in preparation for lessons, tests and examinations from the section "Methodology of scientific research in architectural and urban planning objects" of the theory course.

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INTRODUCTION

Before starting their master's thesis, which is a scientific research project, future master's students must master the methodology and methods of scientific work as a specific type of activity. The methodology of scientific research is considered in this discipline as a set of methods, techniques, and research techniques used in modern science in general and in the field of architecture in particular. The content of the discipline includes consideration of the structural design and sequence of master's research. The course is adapted as much as possible for its assimilation and use by students majoring in 191 – Architecture and Urban Planning.

The materials are presented taking into account interdisciplinary connections, as well as time allocation standards for theoretical and research work of students in accordance with the regulations of the working programme of the academic discipline. The discipline includes two substantive modules:

CM1. The role of scientific research in the field of architectural and urban planning activities.

CM2. Methods of pre-design analysis of architectural and urban planning objects.

CM3. Methods of modeling and quality evaluation of design solutions of architectural and urban planning objects.

The purpose of the course is to provide master's students with knowledge, skills and abilities in the field of scientific research in architecture and urban planning.

The objectives of the discipline are:

– to provide the content and scope of knowledge and skills that will enable master's students to independently identify problematic situations in the field of architectural activity, formulate and solve scientific research problems.

– to implement the results of scientific research into the practice of designing architectural objects;

– to write an abstract of the master's thesis.

Upon completion of the course, students should know: the role and place of scientific research in the field of architectural activity; the main components and elements of scientific research; the basic definitions of scientific research methodology

concepts; the structure, content and scope of the scientific part of a master's thesis. Students should also be able to: identify and describe problematic situations in the field of architectural activity; formulate a research topic and assess its relevance; describe the object of research and formulate the subject of research; formulate the goal and define the scope of research; formulate research tasks in a logical sequence; build a research methodology based on the reasonable and appropriate use of specific methods; determine the scientific novelty and practical usefulness of the research results; systematise practical and theoretical experience on the research topic; use the basic methods of scientific research: empirical, theoretical, general scientific and specific, purely professional.

To solve any problem in the field of architecture today, more than ever before, specific, special measures are used throughout the world, namely scientific research methods, i.e. scientific research methodology. The complexity of the tasks solved by a master of architecture is determined by the insufficiency of standard, algorithmic techniques for solving a specific design task and the need to possess and use scientific research tools to solve the problem. This is the focus of the lecture course on the methodology of scientific research of architectural and urban planning objects.

CONTENT MODULE 1
THE ROLE OF SCIENTIFIC RESEARCH IN THE FIELD OF ARCHITECTURAL AND URBAN PLANNING ACTIVITIES

1 Purpose, objectives and structure of the discipline. Contemporary issues in the formation and development of architectural and urban planning objects and the role of science in solving them

It is known that the first level of training for an architect is a bachelor's degree. Those who have obtained a bachelor's degree must be able to solve standard professional tasks of designing architectural objects, according to known algorithms, limiting themselves to regulatory requirements, or following the instructions of their supervisor. Usually, a bachelor of architecture works under the guidance of a more highly qualified specialist – a master of architecture. Obtaining the title of master of architecture, which is the next, higher level of professional training, is only possible upon completion of a master's thesis.

The first step in completing a master's thesis as a scientific research project, for applicants seeking a master's degree is to familiarise themselves with the methodology and methods of scientific work that will be covered in this discipline. It consists of a course of lectures, practical assignments and assignments for independent work.

The first lecture is devoted to familiarising students with the structure and objectives of the discipline, as well as the algorithm for conducting scientific research in the field of architecture and urban planning.

The purpose of the discipline 'Methodology of Scientific Research of Architectural and Urban Planning Objects' is to provide students with knowledge and relevant methods of applied scientific research in the field of architecture and urban planning. Upon completion of the course, students should be familiar with the goals, objectives, other components, stages, and methods of applied scientific research in the field of architecture and urban planning and be prepared to apply relevant methods and techniques of applied scientific research in their professional activities.

To achieve this goal, the discipline structure includes three *structural* blocks aimed at solving the following tasks:

– familiarisation with the specifics, content, subject and organisation of scientific research in the field of architecture and urban planning;

– mastering modern methods of scientific research in the field of architecture and urban planning, which are used in master's theses;

– familiarising and mastering the methods of pre-project research of architectural and urban planning objects as an important component of scientific applied research.

These structural blocks correspond to the three content modules of the discipline and include components of lectures, practical classes and independent work by students.

The discipline provides master's students with specialised (scientific) tools for solving contemporary problems in the formation and development of architectural and urban planning objects. The composition of these tools and the sequence of their application in the course of work constitute *the methodology of scientific research* in the field of architecture and urban planning (fig.1).

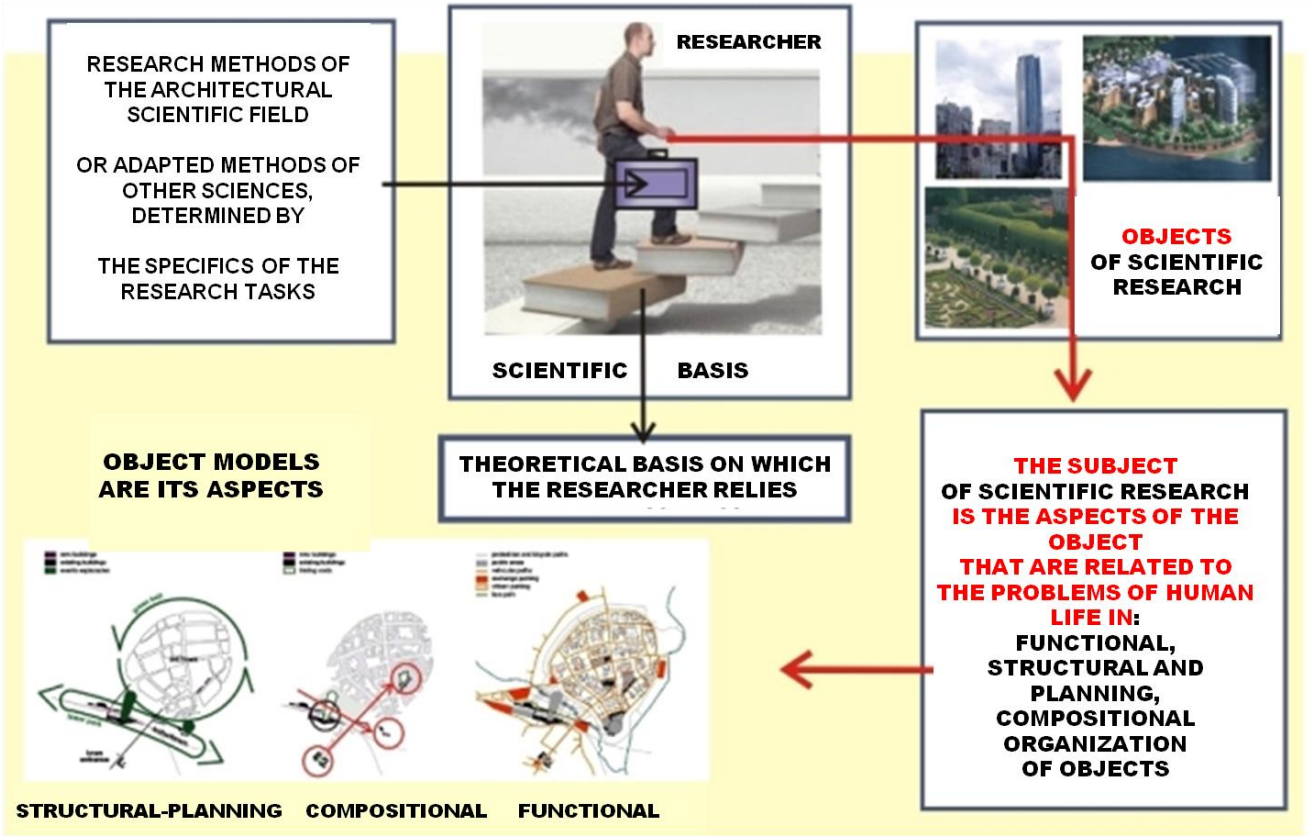


Figure 1 – Methodology of *scientific research* in the field of architecture and urban planning

By definition, scientific methodology (rp.methodos – method, approach and logos – science, knowledge) is the science of research methods, a system of methodological and methodological principles and techniques, operations and forms of constructing scientific knowledge.

Thus, the *methodology of scientific research of architectural and urban planning objects* is considered in this discipline as a set of methods, techniques, and research techniques used in the modern scientific field of architectural and urban planning activities to solve pressing problems.

Method (from the Greek methodos, meaning ‘way to something’) generally refers to a means of achieving a goal, a way of studying a phenomenon that determines a systematic approach to scientific knowledge and establishing the truth. A method is a kind of route that students follow in their research to achieve a specific goal in their work.

Research methodology is a system of rules for using methods, techniques and approaches to conduct any research. The conscious application of scientifically sound methods should be considered the most essential condition for obtaining new knowledge. A researcher who is well versed in research methods and their application expends less effort and works more successfully than one who relies solely on intuition or trial and error in their research.

The research methodology can be presented as a set of specific instructions, unfolded over time, that guide the researcher's actions during the work, step by step, towards achieving the goal of the work.

The purpose of research work is *always aimed at solving a specific problem*. In general, a scientific problem is an issue that requires a scientific solution. For architects, most problems are related to the improvement (preservation, transformation, development) of architectural and urban space – its elements and components. Problems usually ‘manifest’ themselves as a mismatch between the functional, structural-spatial, aesthetic, or environmental and humanistic characteristics of architectural and urban planning objects and the needs of society (large and small social groups). Architects often learn about this from the results of sociological studies or from the content of

decisions made by state institutions and manifestos of public organisations, which point to the need to bring the parameters of the material and spatial environment into line with the requirements of the population or to improve the conditions for the existence of natural elements in the structure of urbanised spaces. For example, today's pressing issues include those that contribute to improving the lives of low-mobility population groups by creating a barrier-free environment and ensuring the preservation of natural elements in the structure of urbanised space by forming a landscape and ecological framework for cities.

To solve any problem in the field of architecture and urban planning, it is necessary to define the object, subject and purpose of the research.

The logic, or algorithm, of conducting scientific research in the field of architecture and urban planning is presented in fig. 2.

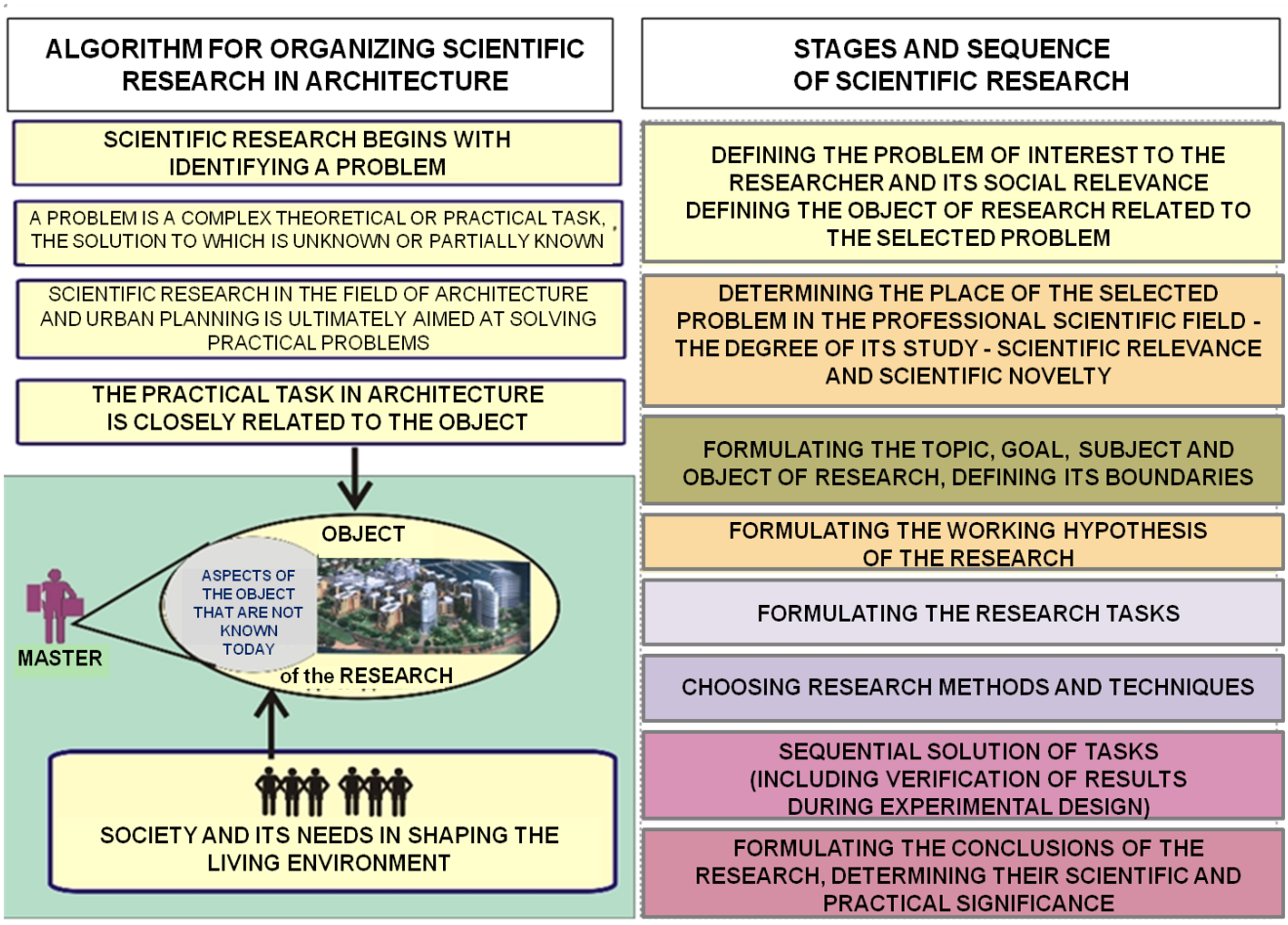


Figure 2 – Algorithm for conducting scientific research in the field of architecture and urban planning

2 Problems, objects and subjects of modern applied scientific research in the field of architecture and urban planning

Scientific research in the field of architecture and urban planning is mostly applied in nature. Applied research, by definition, is aimed at achieving a specific, predetermined practical goal. This means that the results of such research can be directly used in the practice of designing and developing elements of architectural and urban space. Defining the specifics of the objects and subjects of modern applied scientific research in the field of architecture and urban planning is very important for the organisation of scientific work. Considering the peculiarities of this professional field, the following definitions can be formulated.

The object of research, by definition, is a process or phenomenon that generates a problem situation and is selected for study. For architects, *the object of research* is a real material and spatial environment that needs improvement and development, and for which research is conducted. These are specific architectural and urban planning objects, which are characterised by their large number and considerable diversity. To navigate this diversity, the objects of study are divided into groups: urban planning, architectural, and architectural environment design objects.

Urban planning objects of research and design have a *hierarchical structure* that corresponds to different levels of urban planning space (regions, territories of united territorial communities, individual settlements (cities, villages, settlements), functional zones, urban complexes) (fig. 3).

Architectural objects are primarily distinguished by their functional characteristics: residential, industrial, multifunctional, public services, etc. (fig. 4).

Architectural environment design objects are present in both urban planning and architectural objects (landscape design of open green areas, interior and exterior design of buildings).

The subject of research is defined as that part (aspect) of *the object of research* that is subject to special study and transformation. This is what the research goal is aimed at (fig. 4). It is the goal (purpose) of the research that determines its subject. Since there

can be many objectives of research, it is possible to identify many subjects of research for the same object. Thus, when distinguishing between the object and subject of research, it is important to understand that the object is broader than the subject.

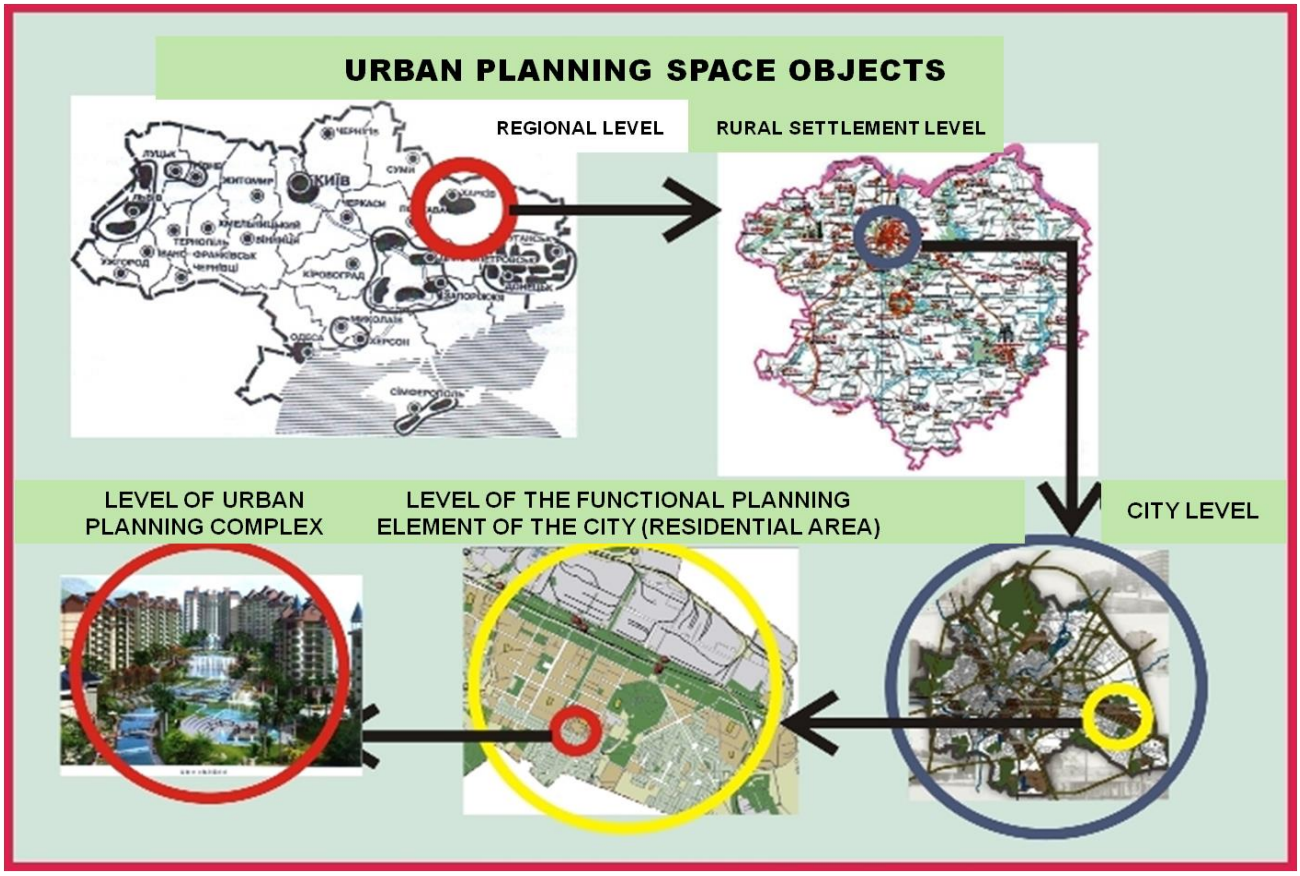


Figure 3 – Hierarchical structure of urban development objects subject to research

It should be emphasised that many specialists from various scientific and practical fields are involved in the study and transformation of architectural and urban space together with architects (fig. 5). Each has own goal and, accordingly, own subject of research and design. For example, a residential area can be considered as an urban planning research object. The subjects of its research may include the functional organisation of the residential area; the planning of pedestrian traffic, transport services, and cycle paths in the area; the creation of green spaces for shared or common use; and the compositional organisation of the residential area. An apartment building, for example, can be considered as an architectural object of study. However, there may be several subjects of study: the structural and functional organisation of the building, the structural system of the building, or the compositional design of the building.

An apartment building, for example, can be considered as an architectural object of study. However, there may be several subjects of study: the structural and functional organisation of the building, the structural system of the building, or the compositional design of the building.



Figure 4 – Different types of architectural objects subject to research

An apartment building, for example, can be considered as an architectural object of study. However, there may be several subjects of study: the structural and functional organisation of the building, the structural system of the building, or the compositional design of the building.

At the same time, the subject of a sociological study of a residential area or residential building may be the social composition of residents, while the subject of an environmental study may be the characteristics of the heating system in these buildings.

The interior of a public building or the landscape design of a city park can be considered as objects of study in architectural environment design. The subjects of their study can be defined as: the colour scheme of the interior, or the design of small architectural forms, lighting of the park environment.

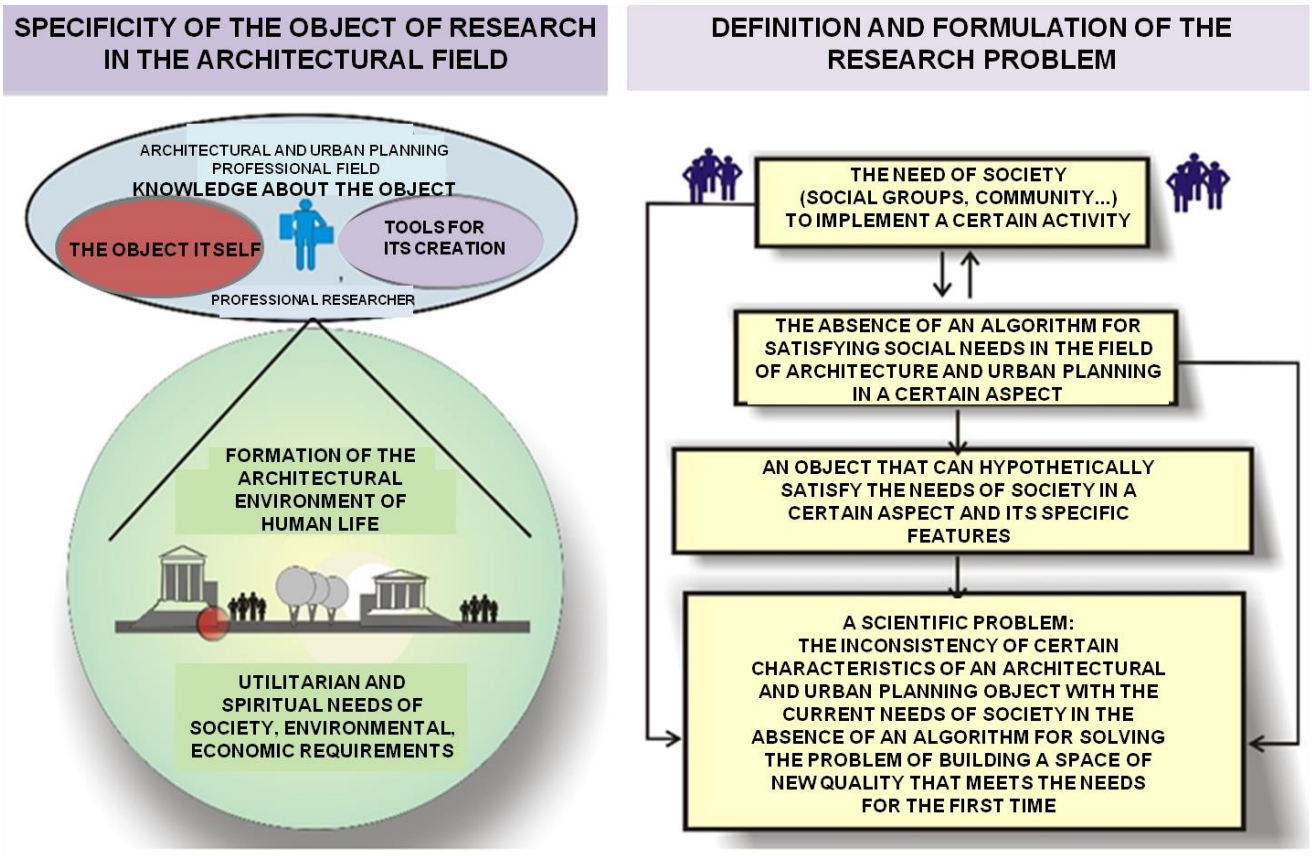


Figure 5 – Specifics of research objects in the field of architecture and urban planning and definition of the research problem

When determining *the subject of research* for a selected architectural, urban planning or design object, the purpose of the research should be clearly formulated. For example, we are researching the structural and functional organisation of modern residential buildings with the aim of improving its compliance with the current needs of various social groups of the population. In this case, *the object of the study* is residential buildings, and *the subject* is the features of their structural and functional organisation.

Thus, the specificity of architectural and urban planning research subjects is determined, on the one hand, by the specificity of the objects themselves and, on the other hand, by the specific aspect that is considered problematic in the work and subject to research. These aspects are related to the satisfaction of the utilitarian and spiritual needs of society, the satisfaction of ecological and economic requirements for the formation of the human environment. The correct selection of the object and subject of research is very important, as it is one of the indicators of student competence and the level of scientific work in general.

3 Content and structure of the master's work: justification of the relevance of the research problem in the field of architecture and urban planning and formulation of the research objective and theme

The relevance of the chosen research topic is determined by the importance and *significance* of the problem in this work. Problems in the field of architecture and urban planning arise from the mismatch between the functional and spatial organisation of the living *environment* and the *current needs* of society in the absence (or insufficiency) of scientific recommendations (algorithms) for positive changes in the situation.

To solve any problem, certain special measures are required, namely *scientific activity*. The complexity of the tasks solved by a master of architecture is determined by the inadequacy of standard, algorithmic methods for solving a particular design task and the need to use scientific research tools to solve the problem.

A *problem* is understood as a complex scientific task that covers a significant field of research and has promising significance. Solving the problem sets a general task – to make a discovery; to open up a new direction in research; to develop a new approach to solving the problem (fig. 6). For a master's thesis, it is sufficient to identify new principles, methods of forming or reconstructing a specific object of architectural and urban space, or to systematise and develop them. Setting (choosing) a topic is a complex and responsible task. The research *problem* is formulated based on an analysis of the contradictions in the direction of improvement (development) of the selected architectural and urban planning object.

The research problem *must be relevant*, i.e. important, requiring a solution at the present time. This requirement is one of the main criteria for determining the relevance of the entire master's thesis (fig. 7).

The research problem *must be significant*. For scientific research, this requirement is the element that determines the prestige of domestic science and forms the foundation for applied research (fig. 8).

The aim of the study is to solve the problem. It is reflected in the title of the work. For example: *the problem* is the mismatch between the characteristics of industrial areas

that have lost their original function and the needs of the urban community. *The goal* of the study will be to identify urban planning principles and methods for the reconstruction of industrial areas.

Title of work: 'Urban planning principles and methods for the reconstruction of industrial areas'.



Figure 6 – An example of the inconsistency of an urban development project with the current needs of the urban community.



Figure 7 – The relevance of the study is determined by the needs of the community in the architectural and urban transformation of the territory. Formulating the research problem and determining its relevance

The structure of justification of relevance in architectural and urban planning research consists of the following elements:

1. Identification of a specific problem that exists in the world, country, or region. For example, the problem of ensuring ecological balance, humanisation of urban space, preservation of the historical environment, reduction of energy costs, etc.

2. Indicate the needs of which groups of people are met by solving this problem. Emphasise that the current state of the selected object does not meet people's needs.

3. Emphasise that this problem is relevant to the field of architecture and urban planning (for example: this problem is given considerable attention at architectural forums; as evidenced by resolutions and laws relating to the architectural sphere); show that the industry is solving its share of a significant social problem (e.g., providing housing for young families).

4. Highlight the selected object as important for solving this problem and specify what and how this object exactly helps to solve it. Note that scientists have paid attention to this problem and object, but the problem has not yet been completely solved.

5. Conclude that solving this problem will have additional positive effects in various aspects: economic, environmental, and social.

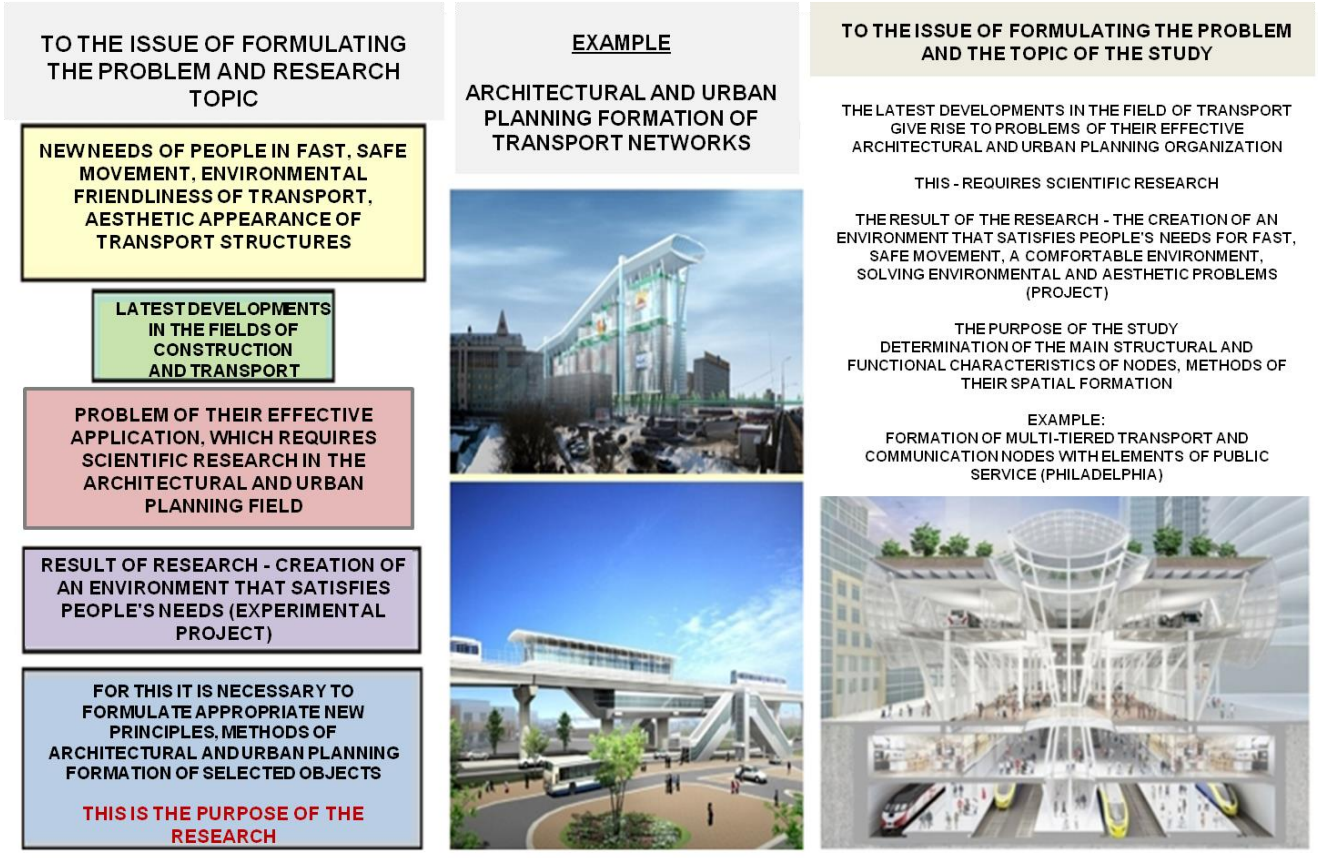


Figure 8 – Identification of the problem and research topic in the master's thesis

4 Content and structure of the master's work: tasks of a master's thesis and its structure

To achieve the goal of the study, which is aimed at solving a specific problem, it is necessary to formulate a series of tasks. The tasks of the study are a set of ways and means that must be implemented to obtain the planned result defined by the goal. It is important for every researcher to understand that each task has a special significance in the research process, but they are all interconnected and form a ‘logical chain’ that leads to the goal of the work. The following tasks are distinguished: identification of the most significant features of the research object; determination of the internal structure of the research object; justification of the system of means necessary to solve the scientific problem; comprehensively studying the practice of solving this problem, the causes, shortcomings and difficulties in solving it; experimentally testing the proposed system of means to solve the scientific problem; developing recommendations for the practical application of the research results. Thus, research tasks are an important component of scientific research (fig. 9). The tasks are solved in a logical sequence, the progress and results are presented in explanatory note and reflected in graphical part of the work.

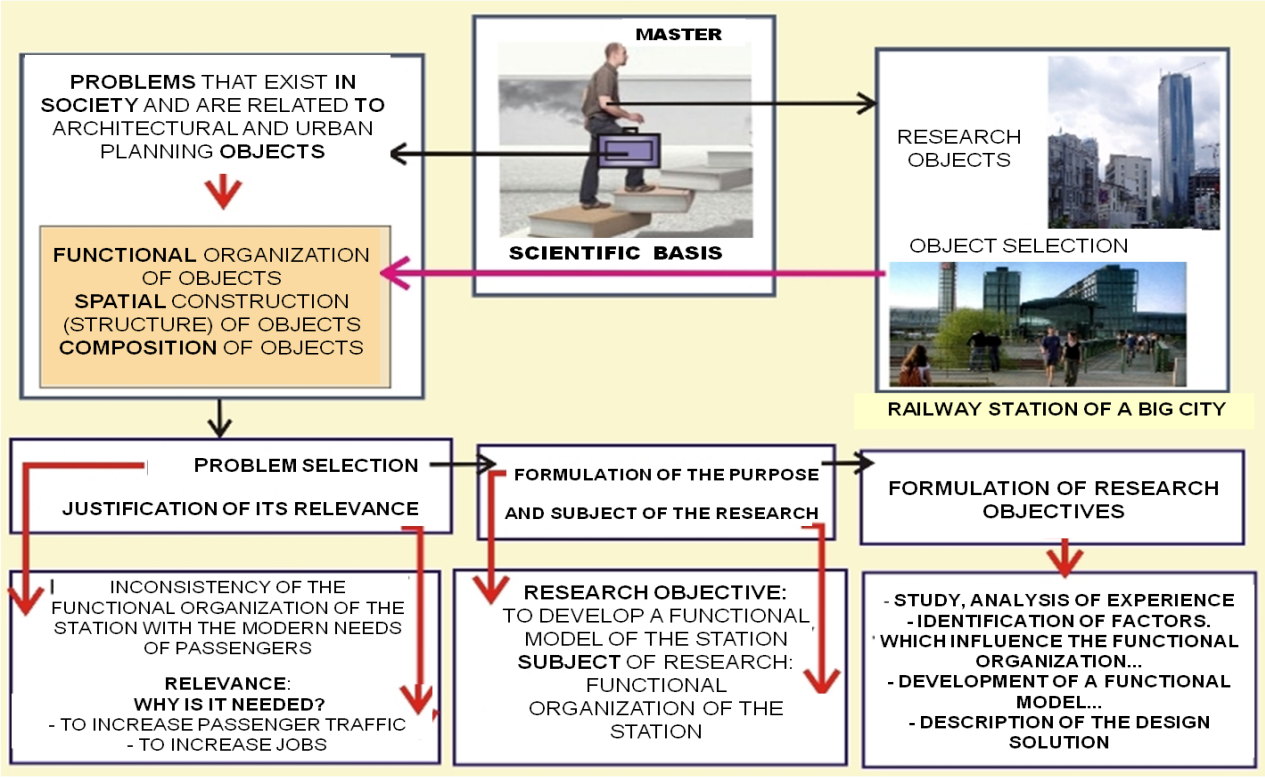


Figure 9 – Components of scientific research and their sequence

The structure of scientific research should be formed in such a way that the sections (or subsections) of the work correspond to the performance of a specific task, as a step towards achieving the goal (fig. 10). Thus, the first section of a study in the field of architecture and urban planning may be devoted to analysing the design, practical and scientific experience in forming analogues of the object of study. It is also possible to conduct a retrospective analysis of the development of the object of study within the structure of the city. In the second section, it is advisable to work on the task of identifying the factors (social, economic, natural and climatic, urban planning) that influence the formation of the object of research, as well as determining the principles and methods of forming the object under study.

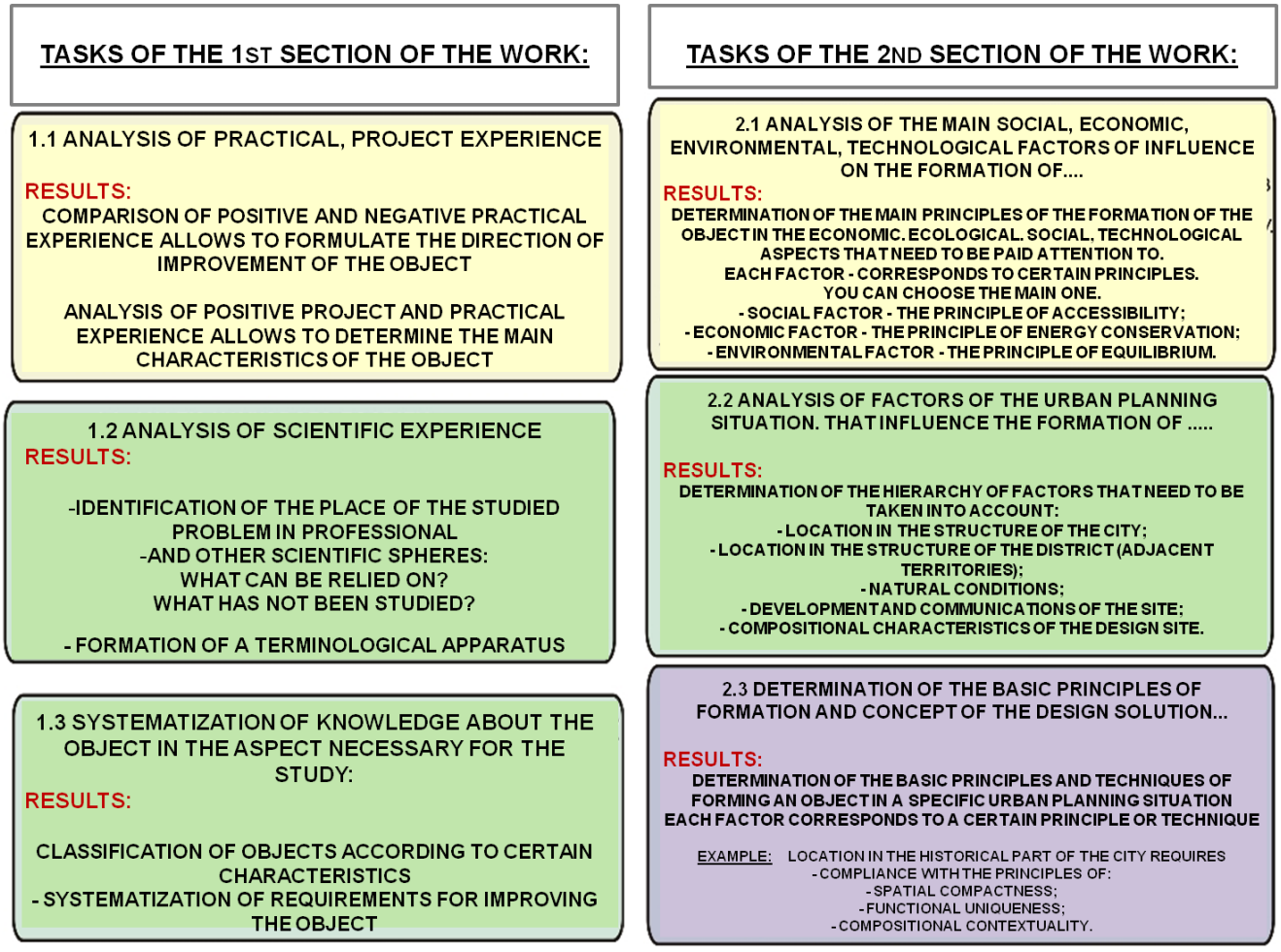


Figure 10 – Research objectives in a master's thesis

The task of the third section is usually to verify the results obtained during the experimental design. It is very important to define the results of each section and subsection of the work, which are usually included in the conclusions of the sections.

An important component of scientific research is the formulation of its hypothesis. By definition, *a research hypothesis* is a scientific assumption or predicted result of research that needs to be theoretically substantiated or experimentally verified in the process of writing a final qualification paper. It does not come out of nowhere. Its emergence is preceded by various assumptions that are not hypotheses as such. A hypothesis in a master's thesis is the most valuable methodological tool for the research being conducted. It is the hypothesis that sets the direction for the entire study and determines the scientific significance of the thesis. It must be stated in the introduction. The formulation of a scientific research hypothesis determines the way in which the problem will be solved, the methods, subject and object of the research depend on it, it determines the novelty and course of the thesis – if it is formulated incorrectly, the topic may lose its relevance. An example of the formulation of a research hypothesis for a scientific work is given in fig. 11.

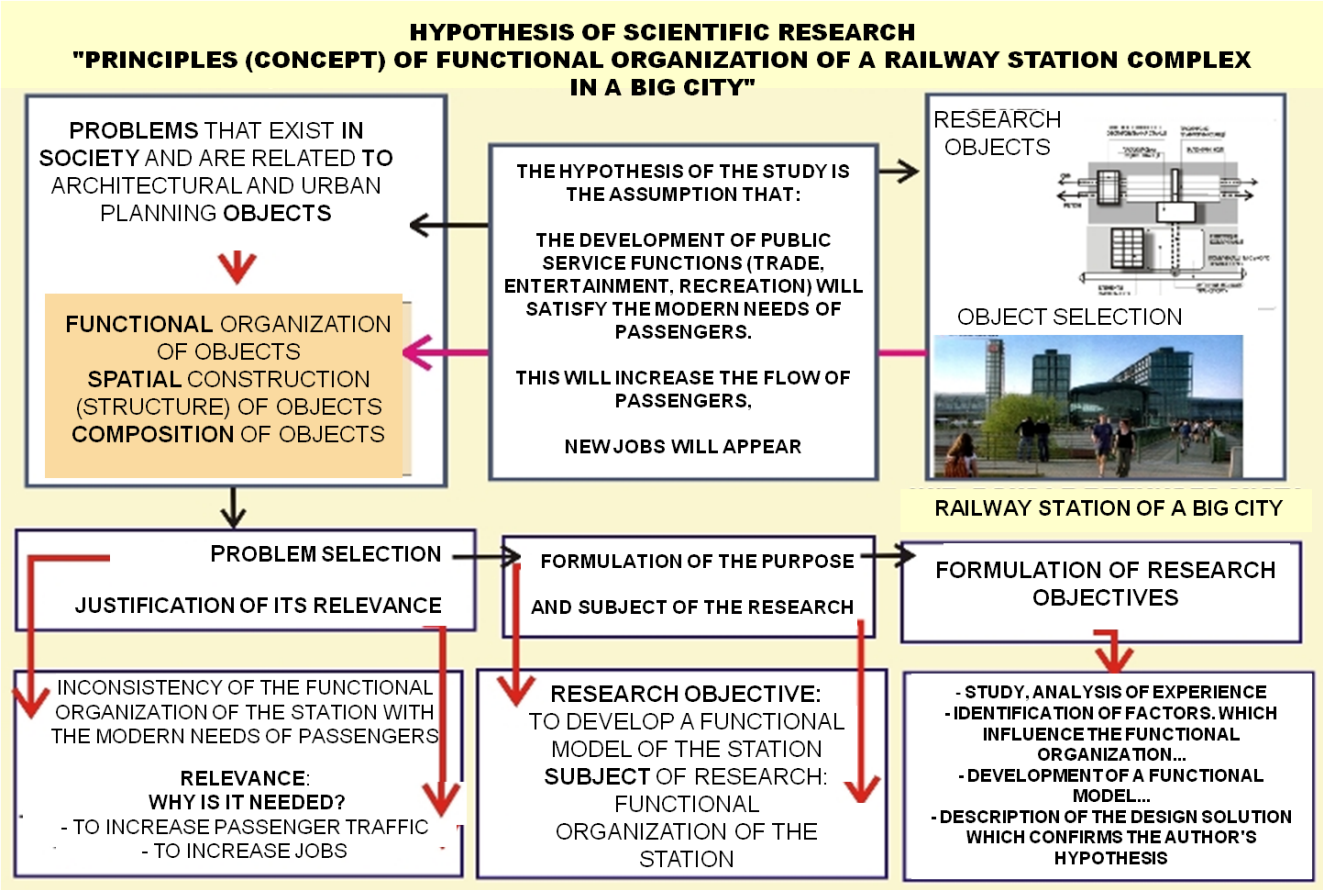


Figure 11 – Scientific research hypothesis

In summary, we can define *the general structure of a master's thesis*. Its main elements, which are developed sequentially, are as follows: introduction, research sections where its tasks are solved, general conclusions, list of sources used.

The *introduction* defines the research problem and the relevance of its solution, the object and subject of the research, its goal aimed at solving the stated problem, the research hypothesis, the research methodology, the scientific novelty and practical significance of the work. The *general conclusions* should contain brief information about the final results of research. Conclusions should correspond to the goals and objectives set.

The scientific research of a Master of Architecture include a *experimental design* section, which is presented in the graphic part of the work with all graphic materials,

5 Basic requirements for the results of applied research in the field of architecture and urban planning

The success of any scientific work is ultimately determined by the quality of the results obtained (fig. 12). Each work should be based on a specific scientific foundation, contain its own data from experiments, observations, and research; their processing, analysis, and generalisation; references to relevant scientific sources; and reflect the researcher's own position.

However, the question arises: how can we determine that the work we have done has produced high-quality results, i.e. results that can be safely put into practice and used? To do this, we need to determine in advance whether the results of this research will have such important characteristics as *reliability, usefulness and novelty*. These three properties are often referred to as the ‘three pillars’ on which the results of scientific work are based (fig. 13).

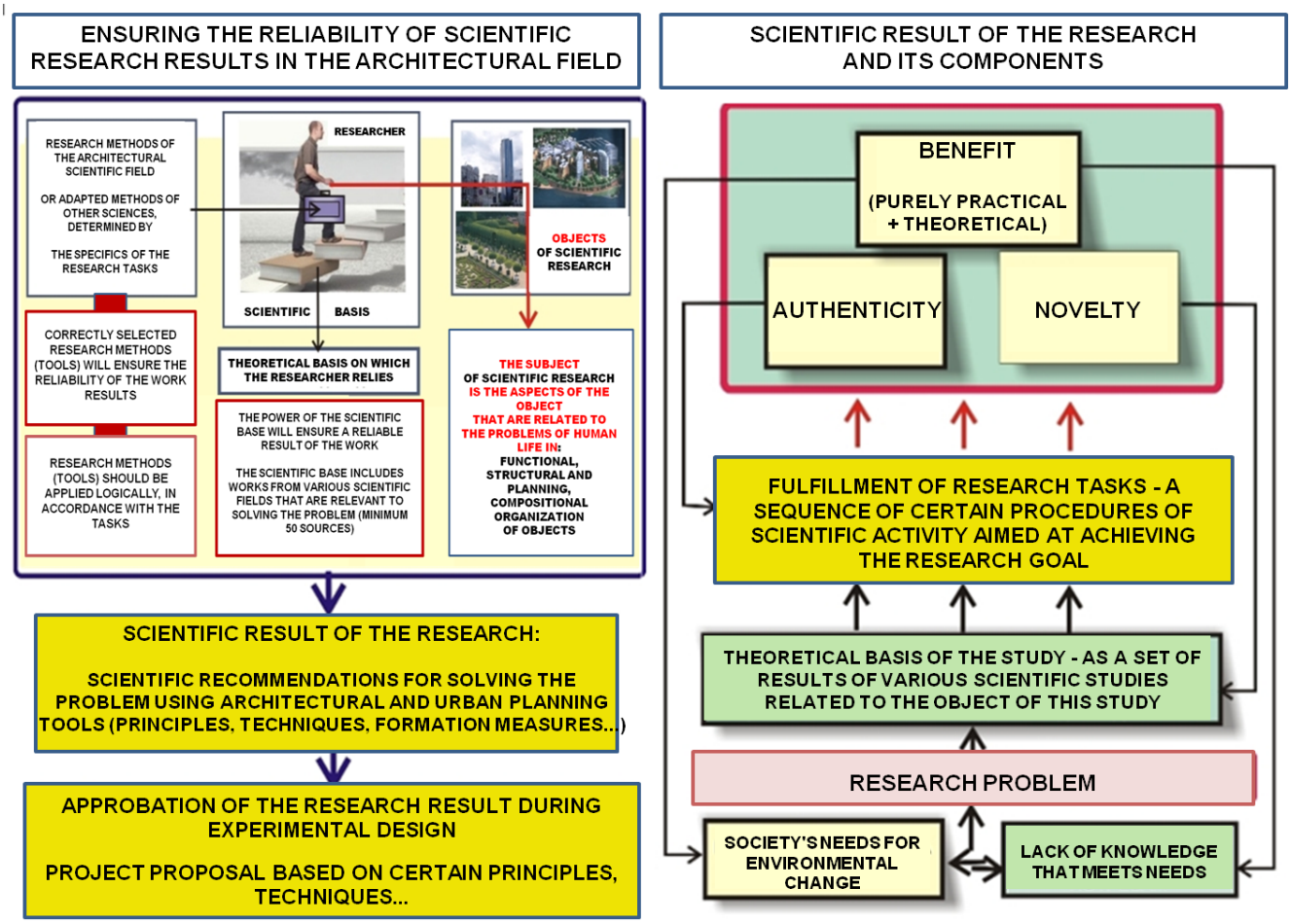


Figure 12 – Characteristic of the scientific research

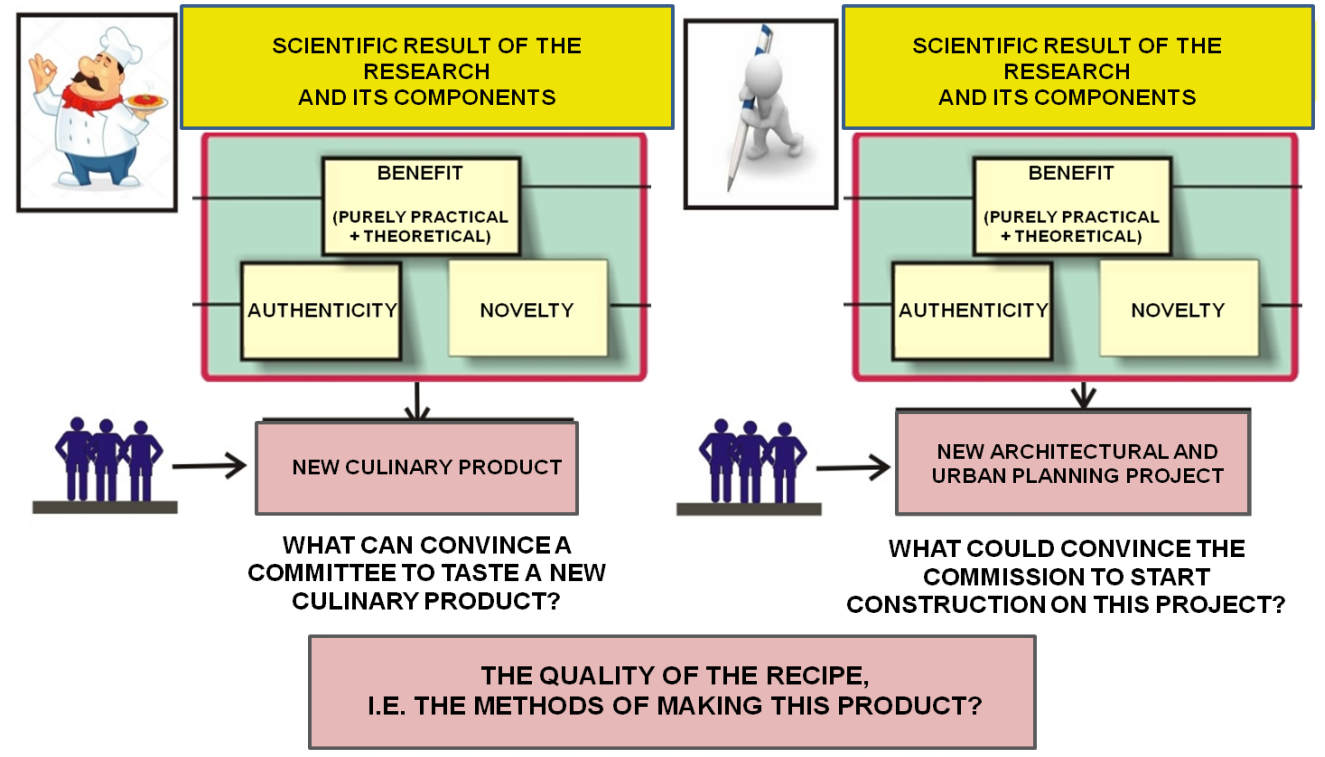


Figure 13 – The importance of research methods in ensuring the reliability of work results

The reliability of the results obtained in scientific research is determined by the correct procedures for obtaining the result. This means that the researcher has successfully selected the research tools (methods) for each step of the work and each research procedure, and has applied these tools in a specific order that corresponds to the logic of the organisation of scientific work. This can be compared to the process of preparing a delicious meal. If the recipe is good and everything is done according to the specified recipe in a certain order, we will get the expected wonderful result. The dish can be confidently offered to everyone, so the developed recipe can be used in practice.

For architects, such a ‘recipe’ is a research methodology consisting of well-known research procedures – both general scientific and specialised professional research methods. These will be discussed below. The following example illustrates how to achieve reliable scientific results:

– processing a sufficient array of empirical data on analogues of the research object (design and practical experience in forming the research object);

– analysis of a sufficient number of scientific sources on the selected topic;

– analysis of factors influencing the formation of the research object;

– modelling of the research object in the context of the projected situation;

– testing of the scientific provisions of the dissertation research by publishing the results of the work in professional publications in Ukraine and reports at international scientific and practical conferences.

Thus, the reliability of scientific results is ensured by the logical correspondence of research methods to the formulated goal and specific tasks in their consistent solution.

The results obtained by the researcher can be applied at a *practical or theoretical level*. From this, the theoretical and practical value of the work can be formulated. That which is used in further theoretical research is considered to be of theoretical value. For example, based on the analysis of the opinions of a number of authors, a classification of a specific architectural (urban planning) object is proposed. Or, the provisions of scientific concepts on the formation of the object under study are generalised.

The practical significance of scientific work results is the results that have already been implemented or can be used in practice (fig. 14). For the scientific work of an

architect, which is essentially applied, its practical significance is determined in the title of the study and revealed in the course of experimental design. The meaning of the study is based on the possibility of applying practical results. The following example illustrates the practical significance of the research results:

– using the research results to improve and obtain the architectural design process;

– using the research data to organise a significant amount of information on architectural objects of this type;

– improving the regulatory framework for the design of architectural objects type.

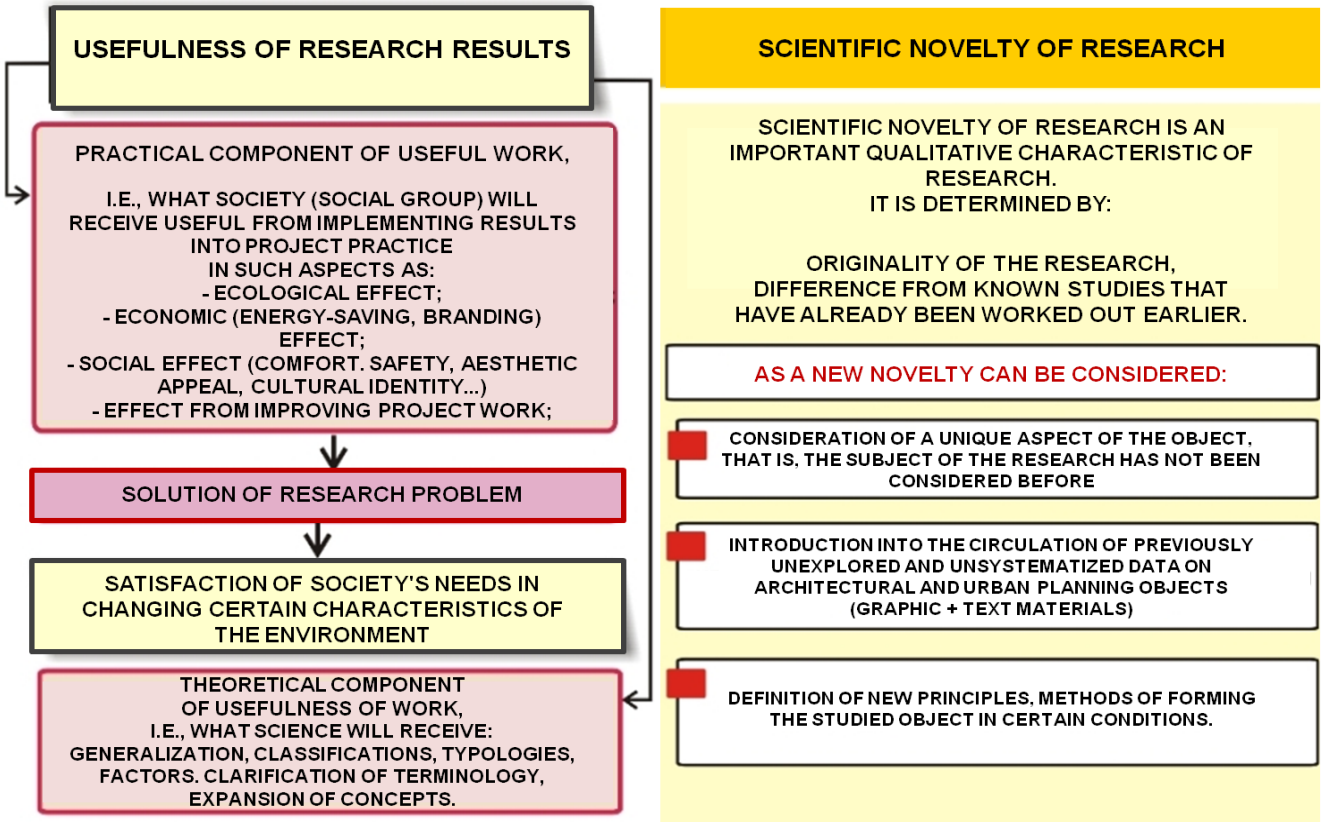


Figure 14 – Usefulness and scientific novelty of the research

The scientific novelty of the research is an important characteristic (fig. 14). The following example can be cited:

– For the first time, a hierarchical classification of public service facilities within the TPP has been developed based on a number of criteria.

– The group of factors determining the formation of public service facilities within the TPP and their functional structure has been clarified.

– Further development of the principles of architectural and planning organisation of facilities.

CONTENT MODULE 2
METHODS OF PRE-DESIGN ANALYSIS OF ARCHITECTURAL AND URBAN PLANNING OBJECTS

6 Empirical and general scientific research methods of scientific research in the field of architecture and urban planning

To achieve effective results in scientific research (characterised by novelty, usefulness and reliability), it is necessary to apply the necessary tools, i.e. to use appropriate research methods and techniques.

In the course of their master's thesis, architects use a variety of research methods, which can be divided into several groups.

Let us consider the features of general scientific research methods in the field of architecture and urban planning. Their structure can be divided into three levels:

1. Empirical research methods.
2. Theoretical knowledge methods.
3. General logical research methods and techniques.

Empirical research methods are among the most popular in the field of architecture and urban planning. They are usually applied at the initial stage of work. In the field of architecture and urban planning, these methods include observation, comparison, description, and measurement.

Observation is the purposeful study of objects, mainly based on sensory data (sensations, perceptions, representations). During observation, knowledge is gained not only about the external aspects of the object of cognition, but also about its essential properties. Observation can be direct or indirect. The latter is carried out with the help of various instruments and technical means, and with the development of science, it is becoming increasingly complex.

Description is a cognitive operation that consists of recording the results of observation using certain systems of notation that are accepted in practice. For example, architects often describe objects in the form of drawings that record their dimensions.

Measurement is a set of actions performed using measuring instruments to find the numerical value of a measured quantity in accepted units of measurement. Architects use this method to determine the physical characteristics of objects: height, width, length, distance between objects, etc.

Comparison is a method that allows two or more objects to be compared in order to learn something about one or all of the objects being compared. The comparison is based on certain characteristics. Thus, in the field of architecture and urban planning, objects are usually compared according to their functional composition, spatial planning organisation, and composition.

General scientific methods also include: analysis, synthesis, abstraction, idealisation, generalisation, induction, deduction, and a systematic approach.

Abstraction is the process of distracting from a number of properties and relationships of the phenomenon under study, while simultaneously highlighting the properties (primarily essential and general ones) that are of interest to the researcher (fig. 15). Abstractions from real objects are called first-order abstractions; abstractions from first-level abstractions are called second-order abstractions, and so on. For example, a model of a house can be called a first-order abstraction. A diagram of its functional organisation is a second-order abstraction.

Generalisation is the process of establishing the common properties and characteristics of objects. It is closely related to abstraction.

Idealisation is a procedure associated with the creation of abstract (idealised) objects that are fundamentally real. In the process of idealisation, there is a distraction from the real properties of an object with the simultaneous introduction of characteristics that are impossible in reality into the content of the concepts being formed. The result is a so-called ‘idealised object’ that can be used as a guide when depicting real objects. All drawings of real architectural and urban planning objects are good examples of their idealisation.

Analogy – establishing similarities in certain properties and relationships between non-identical objects. Based on the similarities identified, a corresponding conclusion is made – by analogy. Analogy provides probable rather than reliable knowledge. In a

conclusion by analogy, knowledge obtained from the consideration of a certain object (‘model’) is transferred to another object that is less studied and less accessible for study.

All of the above research methods are used at different stages of the research. Thus, the methods of observation, measurement, and description are used both at the first stage of work when analysing the design and practical experience of forming the objects under study, and at the stage of analysing urban planning factors influencing the design of the object under study during the analysis of the urban planning situation. Methods of abstraction and idealisation are used by architects on an ongoing basis during their work. The analogy method can be useful in the process of finding a solution to a research problem at the stage of experimental design.



Figure 15 – Examples of the application of abstraction methods in the field of architecture and urban planning.

7 Integration of knowledge from different scientific fields in pre-design analysis. Typology and classification as research methods in the field of architecture and urban planning

When completing the first section of a master's thesis, it is important to study existing practical experience and refer to scientific research that examines a specific type of architectural and urban planning objects.

In order to systematise practical experience and orientate oneself in scientific information, it is necessary to use such scientific research tools as classification and typology, with the help of which various characteristics of research objects are processed (fig. 16).

Features can be essential or non-essential. Essential features of an object are those without which its existence would be impossible; each of them is necessary, and all of them together are sufficient to distinguish one object from another. The set of essential features constitutes the content of the concept of a given object.

Researching objects in a master's thesis often allows you to expand (refine) *the content of the concept* of an object, which is an element of scientific novelty.

Classification is an important and proven scientific method for organising knowledge about the characteristics of an object.

It serves as a prerequisite for all types of theoretical constructs that involve a complex procedure for establishing causal relationships that unite classified objects. *Classification* describes the structural division of objects into groups. It carries information about the properties of these objects and *the grounds* on which these objects are distributed among classification groups. *The basis* on which objects are grouped is the most important element of classification. The informativeness of classifications is determined by their natural commonality, in accordance with the completeness of understanding their content.

Defining *a class of objects* means establishing *the essential* characteristics that are *common* to *all components* of that class of objects. The choice of classification basis is determined by the purpose of the study. For example, the purpose of the study ‘the

influence of window shape on the aesthetic characteristics of buildings' requires the classification of buildings by window shape. Characteristics such as roof shape, colour, and construction are not taken into account. If we are studying the influence of climatic conditions on the shape of a building's roof, then we need to develop a classification of buildings based on this criterion.

Typology is a classification based on the *defining characteristics* of objects. *The defining characteristics* of architectural objects such as buildings are their *functional usefulness (efficiency), durability (structural perfection) and aesthetic appeal.* Therefore, in the architecture of buildings, their types are distinguished according to their main function (residential, public, industrial, etc.); according to their 'durability' (durable or not, etc.); according to their aesthetic perfection (unique, valuable, background, etc.) (fig. 17).

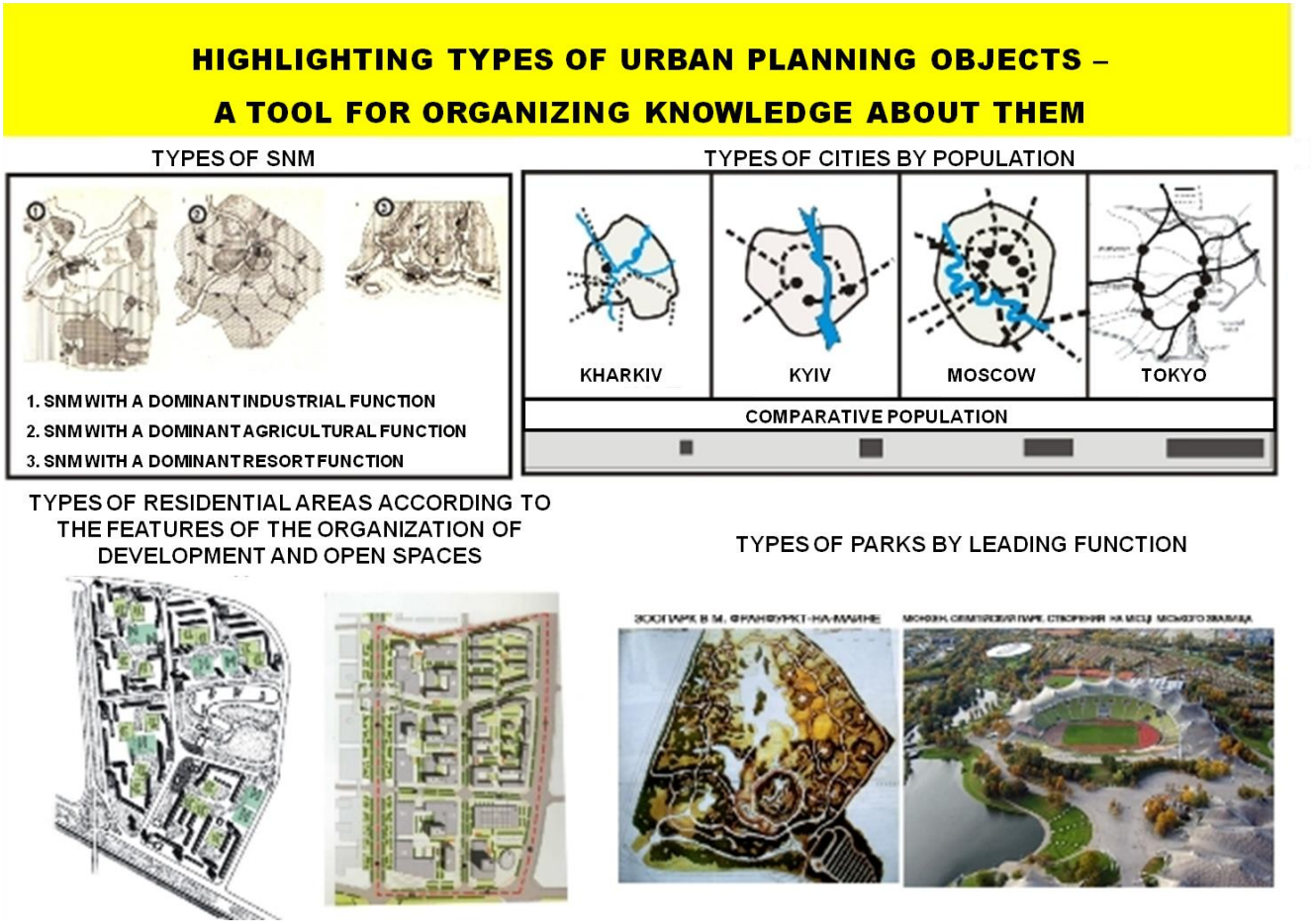


Figure 16 – Typological and classification characteristics of urban development objects

As an example, we can cite the classification of residential buildings according to a number of criteria selected by the researcher:

– in terms of the duration and nature of residence, residential buildings are divided into permanent (apartment-type residential buildings and buildings with public services) and temporary (dormitories);

– By number of floors, there are two groups of residential buildings: without lifts (low-rise: 1-3 floors and medium-rise: 4-5 floors) and with lifts (high-rise: 6-9 floors, high-rise: 10-16 floors and skyscrapers: above 16 floors);

–in terms of spatial planning structure, residential buildings can be: single-family (detached), block (two or more apartments), sectional, corridor, gallery, and mixed structure.

Typology and classification methods are usually used at the first stage of research when analysing project and practical experience in order to organise a large amount of information and identify the essential features of the object under study.



Figure 17 – Example of creating a classification of architectural objects

8 General scientific research methods of scientific research in the architectural and urban planning sphere

Research methods in science are classified by branches of science: mathematical, biological, medical, socio-economic, legal, etc. Content of the studied objects depends the type of methods: the methods of natural science or methods of social and humanitarian research. With all the difference and variety of methods, they can be divided into three main groups: general or philosophical methods, the scope of which is the widest and metaphysical methods; professional methods, a special group of methods is formed by methodic, which are methods for solving a special, particular problem. The choice of the correct methodic is an important condition for the success of the study.

The development of new knowledge is carried out through the widespread use of general scientific methods. General scientific concepts most often include such concepts as "information", "model", "structure", "function", "system", "element", "optimality", "probability", etc. Based on general scientific concepts and concepts appropriate methods and principles of cognition are formulated, which provide communication and optimal interaction of philosophy with special scientific knowledge and its methods. General scientific methods and approaches used in both theoretical and experimental research include: systemic and structural-functional, analysis and synthesis, induction and deduction, probabilistic, analogy and modeling, formalization, abstraction and concretization, and a number of others.

To complete a master's thesis in the specialty "Architecture and Urban Planning", it is necessary to perform a certain sequence of steps, where each of them uses appropriate scientific research methods.

Step 1. As already noted above, the work begins with the definition of *a socially significant* problem, the solution of which is facilitated by a certain organized architectural and urban environment. Having determined in this context the object and subject of the study, the author formulates the purpose of the study and directly the topic of the work and its tasks. Usually the research tasks are distributed between the sections of the work. Along with the relevance of the research topic, the object

and subject of the study, its purpose and tasks, the introduction of the work indicates the scientific novelty and practical usefulness of the research result, as well as its methods and hypothesis. *The first section of the work* is aimed at this by analyzing the design, practical and scientific experience related to the object and subject of the study. As a result, it is useful to obtain the main characteristics of the object under study, its typological features.

It is at this stage that the main array of the "list of used sources" is processed. Their number in the work should be more than 50 items. The main requirements for the list of used sources are as follows: the sources should not be too outdated (more than 20 years since publication), although some particularly valuable publications that reflect the history of the object of research or the nature of a certain historical era may be of considerable age; the authors of scientific sources should not be random individuals; the source base should include regulatory and legislative documents, monographs, scientific articles, abstracts of scientific conferences, important graphic and photographic materials. The source base can be formed using Internet resources (with appropriate links to them).

When processing the 1st section of the work, the following basic methods are used: observation, comparison, measurement, abstraction, terminological analysis, typology and classification, historical and genetic analysis, generalization of scientific research results.

Step 2 is devoted to the elaboration of *the second section of the work*, where the author identifies and investigates *the factors* under the influence of which the formation (and possible development) of the studied object occurs. For architects, the most important among these factors are the features of the urban planning situation - the location of the object of research and design. For example, it can be the central, middle, or peripheral zone of the city, its historical area, or the territory of modern development, etc., the features of natural conditions. Of course, among the influencing factors, economic, social, and environmental factors should be taken into account. The results of the study of influencing factors help to determine the

principles of its architectural (urban planning) formation, and the study of practical experience – to develop methods for forming the object.

Step 3 is devoted to building the foundation of the research work. “I have seen further, because I stood on the shoulders of titans,” - emphasized Isaac Newton.

Thus, the main result of the study of the second section of the work is the principles (and techniques) of the formation of the object under study in a certain urban planning situation, economic, social, and environmental conditions determined by the author. When working on the 2nd section of the work, the following basic methods are used: observation, functional, planning, compositional, complex analysis, logical and graphic modeling.

Step 4 is the implementation of an experimental project, that is, the development of a project proposal based on the principles (and techniques) determined as a result of the previous research work. This corresponds to the third section of the master's thesis, where the text part describes all the components of the experimental project. Immediately before this, the concept of the project proposal is formulated, which in a generalized form describes the structural-functional, spatial-planning, landscape-ecological and compositional aspects of the creative idea. When working on the 3rd section of the work, the following basic methods are used: logical and graphic modeling, conceptual design.

At the end of each section, conclusions are provided that briefly summarize its main achievements. General conclusions include the main achievements of scientific work, namely, principles, techniques, other provisions that are recommended to be based on when developing an experimental project.

The list of references is a necessary element of a master's thesis. Such a list is one of the essential parts of the work, reflecting the independent creative work of its author and demonstrating the degree of fundamentality of the research conducted.

The rules for compiling a bibliographic description are regulated by the state standard "DSTU GOST 7.1:2006 "System of standards for information, library and publishing. Bibliographic record. Bibliographic description. General requirements and rules for compilation (GOST 7.1-2003, IDT)".

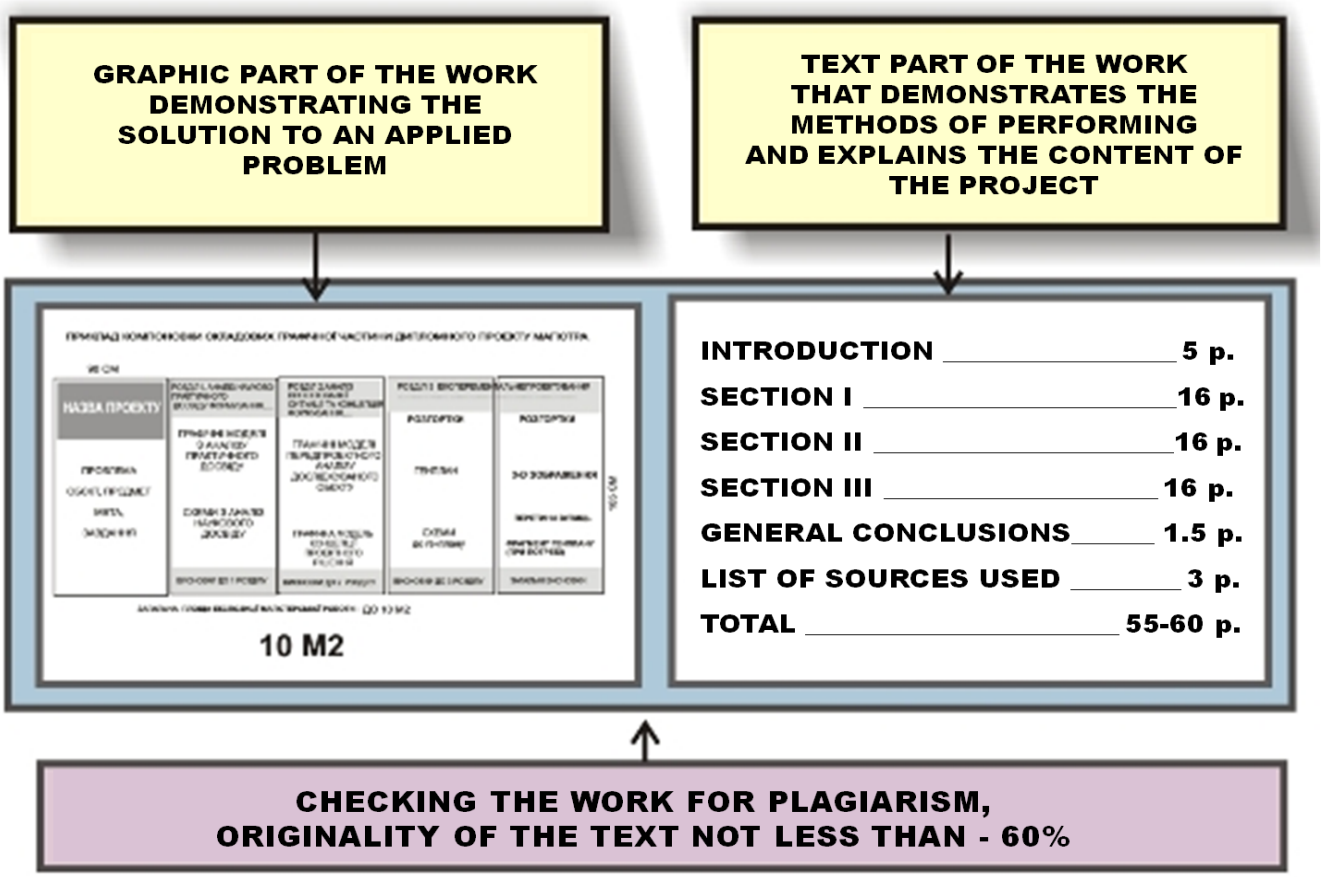


Figure 18 – Composition of the master's thesis

The master's thesis has two main components (fig. 18):

– an explanatory note, which includes an introduction, three sections with conclusions, general conclusions, a list of sources used"

– a graphic part - an exposition with a total area of project drawings and research schemes of 10 m2.

The graphic part consists of graphic blocks that correspond to the structural parts of the explanatory note (introduction and three sections). Examples of the exposition of the graphic part of the master's thesis are given in figure 36.

Recently, a presentation has been formed for the report during the defense of the thesis, which consists of a sequence of fragments of materials from the general exposition. Before the defense of the master's thesis, it must undergo a plagiarism check. A special program determines the degree of originality of the text in percentage. It must be at least 70%. Otherwise, the work will not be admitted to the defense.

9 General scientific research methods of scientific research in the architectural and urban planning sphere at the stage of pre-project analysis: terminological method, historical-genetic method

Terminological and historical-genetic analysis methods are important research tools in the field of architecture and urban planning. These methods are usually applied at the first stage of work (in the first chapter). The use of the *terminological method* ensures clarity, *comprehensibility and validity* in the use of terms and concepts that are essential to the work in question. This is particularly important in situations where terms and concepts are often borrowed from other scientific fields or foreign transcriptions are used. The scientific definition of the main concepts considered in the work ensures its success. If the defined concepts are not correct, there will be confusion in the terminology, and the research problem will not be solved in an understandable way (fig. 19).

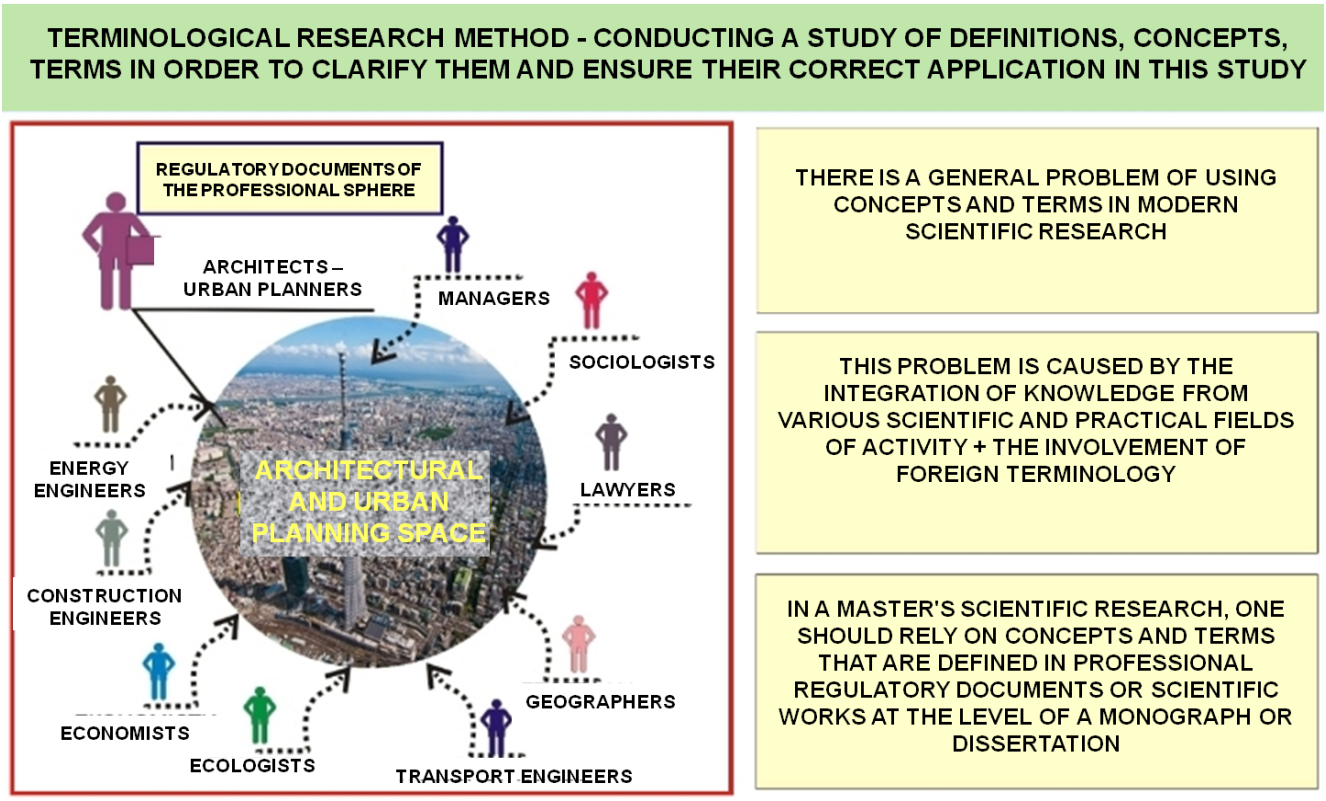


Figure 19 – The necessity of applying a terminological approach
in the study of architectural and urban planning objects

An example of the application of the terminological method is the analysis of the term ‘leisure’. Thus, in domestic and foreign encyclopaedias and reference books,

‘leisure’ is defined as: ‘Free, unoccupied time, a walk, freedom from business’, ‘Time free from work, at leisure – free from business’.

Foreign scholars believe that leisure as a scientific term derives from the Latin word *‘licere’*, which translates as ‘to be permitted’, the French word *‘loisir’* (‘free time’) and the English word *“leisure”* (‘freedom of choice of actions’).

According to the well-known French sociologist J. Dumazadie, *‘leisure’* is a set of activities that an individual engages in of their own free will for the purpose of rest, entertainment, and the development of their knowledge, and voluntarily participates in public life in their free time from professional, family, and social obligations. Figure 20 reveals the mechanisms behind the emergence of new terms that need to be understood and incorporated into scientific activity.

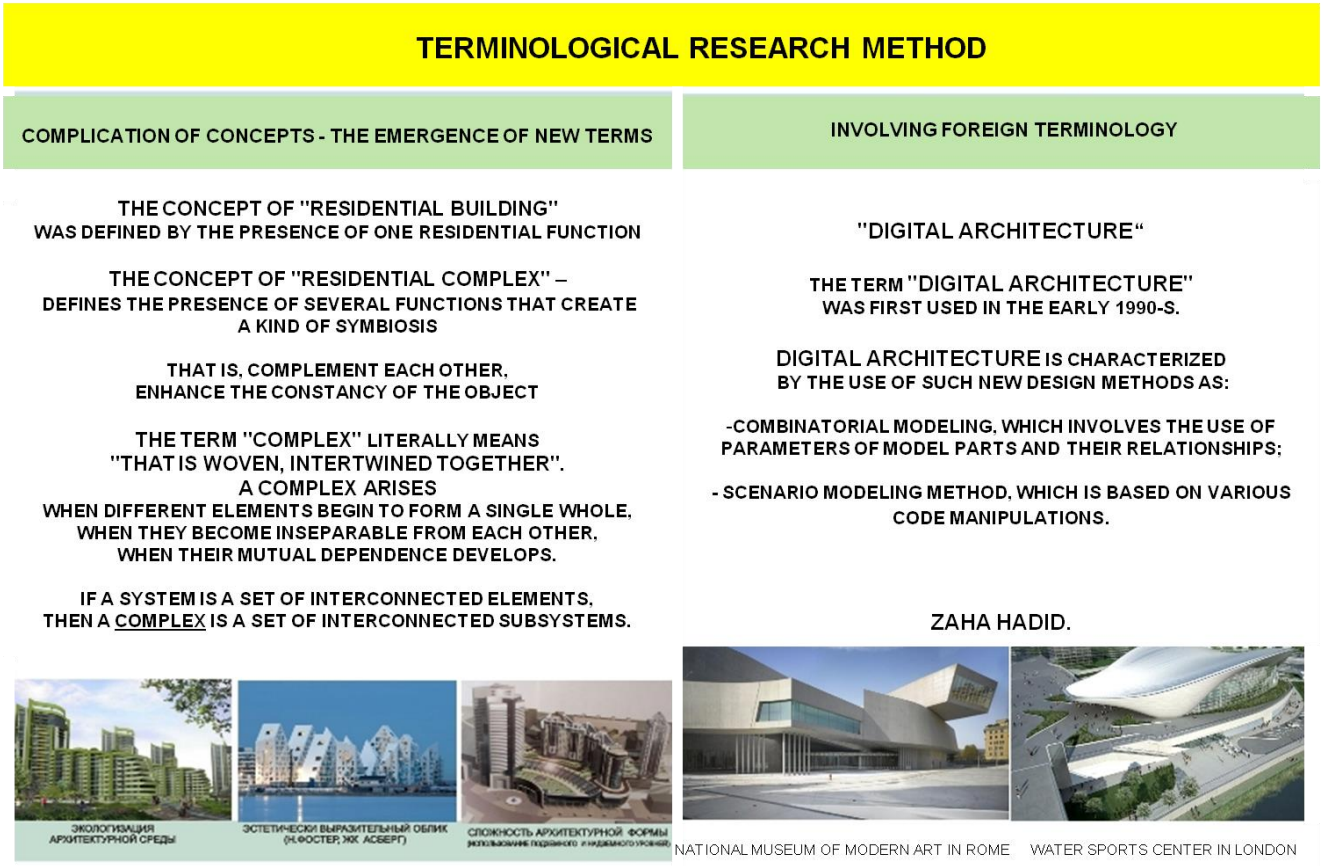


Figure 20 – Conditionality of using the terminological research method

An important aspect of scientific research in the field of architecture and urban planning is the application *of historical and historical-genetic methods* to the study of architectural and urban planning objects. The *historical-genetic method* is one of the

main methods of historical research, which aims to study the genesis (origin, stages of development) of specific historical phenomena and analyse the causes of these changes. The essence of the method lies in *the sequential* disclosure of changes in the studied architectural and urban planning objects in the process of their historical development. This method allows us to come as close as possible to recreating the real history of the object of study. At the same time, the historical phenomenon is reflected in the most concrete form, using archival photos, drawings, and descriptions.

The historical-genetic method of analysing architectural and urban planning objects allows us to trace how their main characteristics have changed over time. Such characteristics that change and are studied usually include functional composition, spatial and structural-planning organisation, connections with the surrounding environment, etc. This becomes the basis for answering the question: what factors influenced the development of the object under study, the patterns of this development, and predicting further trends in its formation (fig. 21). Terminological and historical-genetic analysis methods are usually applied at the first stage of research work.

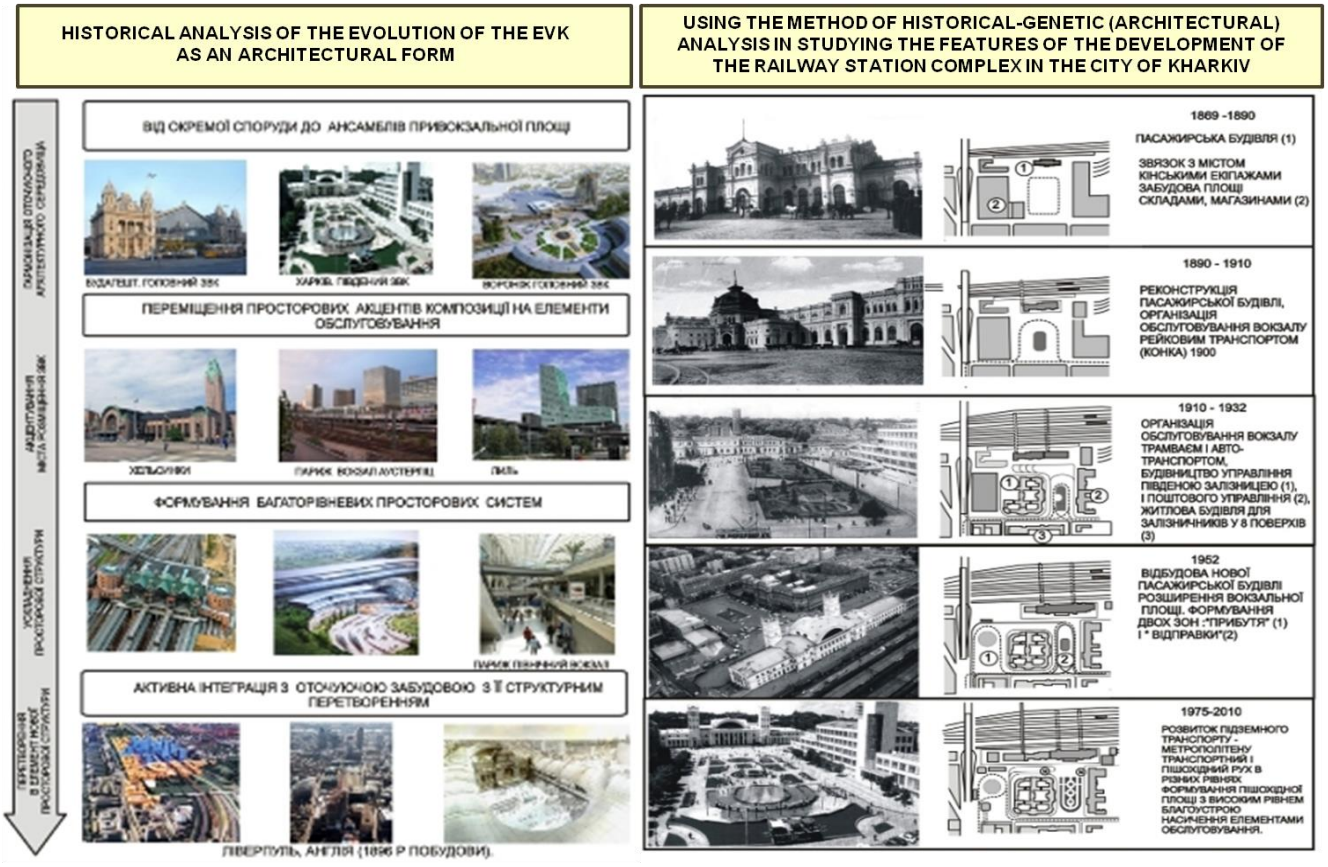


Figure 21 – Examples of the application of historical and historical-genetic methods of research on architectural and urban planning objects

10 Special methods of scientific research and evaluation of design solutions in the architectural and urban planning sphere

In addition to general scientific methods, special (professional) methods are also used in scientific research in the architectural and urban planning sphere. These research methods, first of all, include: the method of functional analysis of the object, the method of planning analysis of the object, the method of compositional analysis of the object. A characteristic feature of these methods is that they use the method of graphic modeling as an auxiliary tool.

The method of functional analysis can be used for: prototypes of the object under study, the designed situation, as well as the conceptual model of the proposed solution during experimental design. The method involves identifying and organizing existing functional elements; determining their interaction with each other and with the environment. So, first of all, a list of all functions is compiled. Further, their ranking is worked out: leading (system-forming functions), accompanying (those that complement the main) functions and service functions are determined. An example of the application of the functional analysis method is shown in figure 22. The diagrams clearly show which functions are leading and which are secondary.

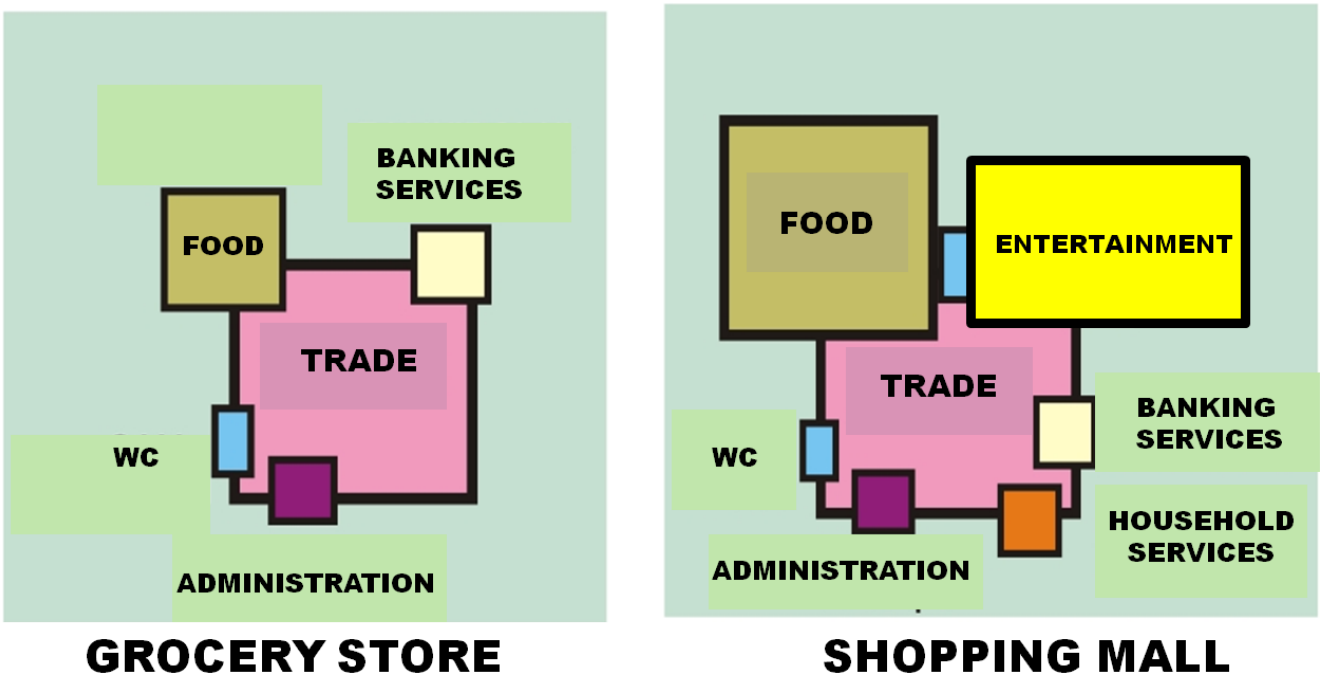


Figure 22 – Application of the functional analysis method

Comparison of two models of functional organization of 2 objects provides an opportunity to understand what their differences are and what they are similar to. Thus, the main features of effective functional organization of these objects include: compliance with the needs of the population (external connection), conflict-freeness, harmonization, mutual complementarity of functions (internal connections). The use of the functional analysis method with the involvement of the graphical modeling method creates an excellent analytical tool for scientific research in the architectural field.

The planning analysis method can be used for the same situations as the functional analysis method. Its main task is to determine the planning (structural-spatial) elements of objects and their physical characteristics. There are two groups of such elements: planning elements that "contain" localized functional processes (peculiar planning blocks) and planning elements that serve communication processes (horizontal and vertical communications of various functional purposes, main and secondary) (fig. 24).



Figure 23 – Example of application of functional, planning and compositional analysis methods. City of Wiesztok, Germany

As shown in figure 23, the use of the planning analysis method together with the graphical modeling method allows us to determine the main indicators of effective planning organization of the object. These are the compactness of the spatial organization of communications, the spatial flexibility of planning blocks.

The meaning of *the compositional analysis method* is to determine the characteristics of the physical form of the studied analogues of the object, or the conceptual proposal, as well as their artistic and figurative (semantic) characteristics.

The main physical characteristics perceived by a person are: scale and scale, complexity of the form (especially its silhouette), saturation with details, color, texture,

texture, etc. The characteristics of the physical form of an architectural object perceived by a person can be assessed through such an indicator as the level of information saturation (small, normal, too large) (fig. 25).

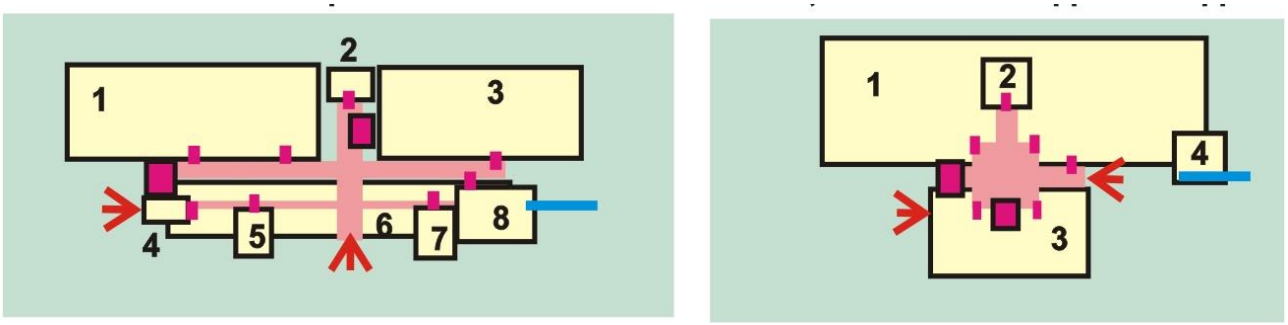


Figure 24 – Example of planning analysis of the studied objects

The semantic characteristics of the studied architectural object are assessed as the level of recognizability and uniqueness of the image. The main indicators of the effectiveness of the compositional organization of objects of the architectural and urban planning sphere are the positive aesthetic effect of their perception, including the harmony of the architectural form and image with the surrounding environment.



Figure 25 – An example of comparing two objects based on their compositional analysis in terms of the level of recognizability, uniqueness of the image, and information richness.

Such characteristics of architectural and urban planning objects as the uniqueness of the image, aesthetic effect, are usually determined by the method of expert assessment. The listed special research methods are used in the analysis of design and practical experience and the development of variants of the concept of a design solution.

11 Application of morphological and stylistic analysis methods in solving problems in the field of architecture and urban planning

The complexity of a Master scientific work is determined by the insufficiency of using standard, algorithmic methods to solve the given design task and the need to use the main tools of scientific research to solve the problem. For example, such as: systemic or complex approaches, methods of classification and typology, historical and genetic analysis, modeling and comparative analysis, etc.

The use of *the stylistic analysis method* could solve the stylistic issues in the conditions of new construction in the context of historical development. The bachelor's knowledge allows to work with proportions, tectonics, and the image of the building, based on the requirements of regulatory documents, to determine the height of the building, its location relative to the red lines and the building line. Functional content, as a rule, is presented in the design task. However, the bachelor's level does not allow you to convincingly justify which style is more appropriate: contextual or contrasting with the historical environment: both techniques can be used, but in current regulatory documents you will not find an answer to this problematic issue. The customer and his taste preferences will also not help solve the problem. What to do? Solving this problem (i.e., a task for which there is no ready-made solution algorithm) is within the power of a master of architecture, since he is trained to apply scientific tools (methods) to work on the problem.

Let's consider this situation with an example. First of all, the master will formulate the research problem: "Stylistical inconsistency of new building objects with the context of the historical environment". Based on the analysis of existing scientific and practical experience in the reconstruction of the existing historical environment, the master will find that two main principles are actively used - nuance and contrast. An analysis of positive practice will show that new building objects do not destroy the context of the historical environment if they are designed according to the principle of "nuance". "Contrasting" buildings often have a negative impact on the integrity of the historical environment. The question arises, how to determine the

degree of new, contrasting in the reconstruction of the existing historical environment? What is the assessment criterion, how is it determined? Analysis of scientific works and own observations will show that negative examples are associated with the destruction of the entire historical context, that is, there is too much "new", contrasting. On the contrary, if the new, contrasting is present in small splashes, then historical architecture only benefits next to the architecture of another style (for example, high-tech). If the new building is solved in a historical environment according to the principle of nuance, then the impression of its perception may tend to monotony. Thus, the question arises about the quantitative "measure", about the ratio of the new and the historical (traditional). This issue can be resolved by attracting both existing and new scientific tools. Such new tools (not prescribed in regulatory documents) can be the principles (requirements) of architectural formation of new buildings in a historical environment.

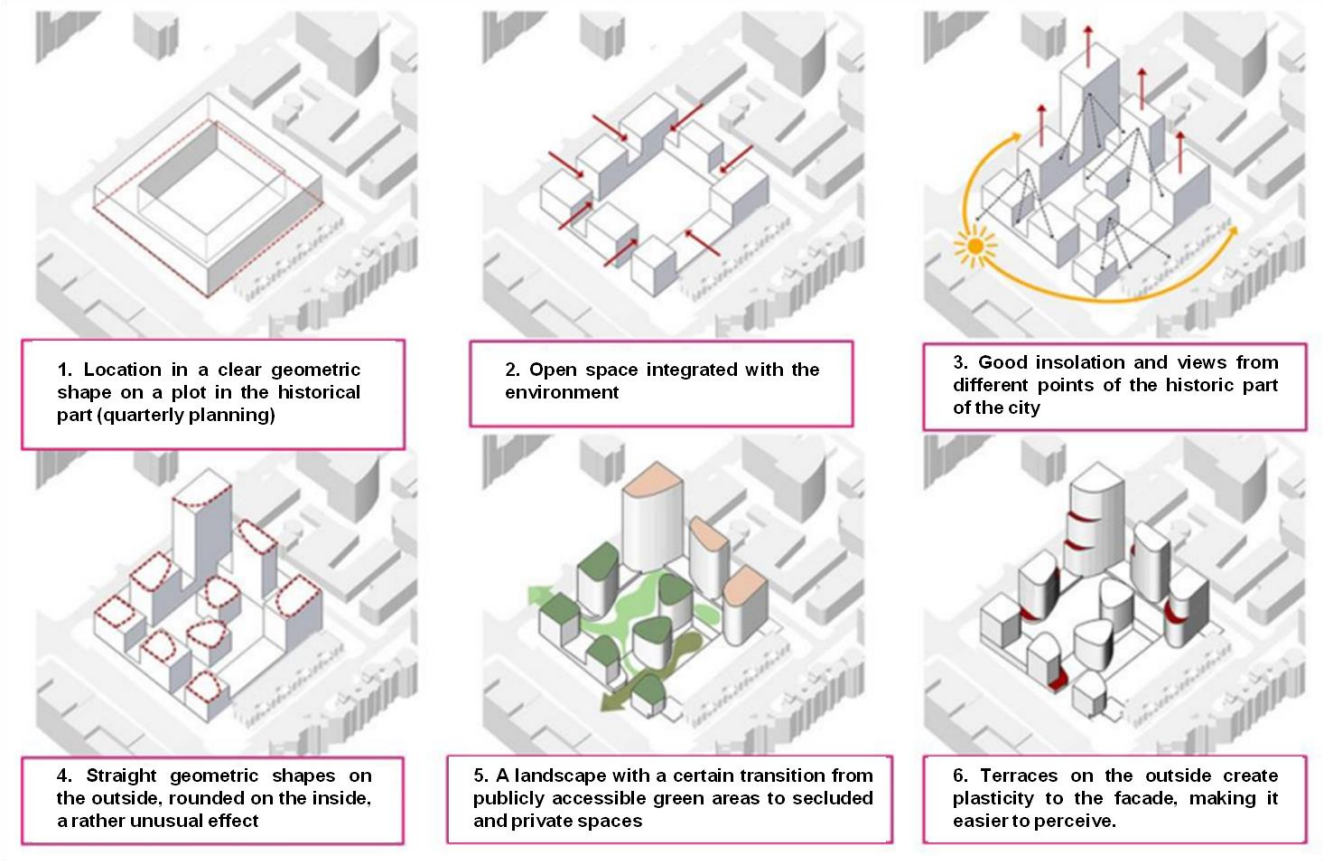


Figure 26 – Example of using the morphological analysis method of development

The method of morphological analysis occupies an important place in architectural and urban planning studies. Morphology is an “accounting of form”, a

description that allows us to rationally understand it, making internal and external connections understandable. Using of this method simplified the object *by graphic modeling*. This is done in order to reveal the main spatial structure of the building or urban space. This requires an analytical breakdown of the whole and, in order to reveal the architectural “mechanism”, a clear distinction between solid and void. Morphological drawings are therefore purely models that can be used to study spatial structure from a number of perspectives (fig. 26).

The morphology of a city or region can be illustrated by successive maps during a survey of the area, each of which should be worked out at the same scale and size in order to determine the characteristics of changes over time in the history of its development. This is more than just abstract knowledge. Understanding the physical complexity of different scales, starting with individual buildings, plots, street blocks and street patterns that make up the structure of cities, helps us to understand the ways in which cities have grown and developed. The qualities of a place are often largely attributed to physical characteristics such as the size, scale and relative proportions of the various elements (fig. 27).



Figure 27 – Example of using the morphological analysis method in urban planning

Methods of stylistic and morphological analysis are used both at the stage of analyzing the experience and urban planning situation of the formation of the studied object, and at the stage of developing the concept of its architectural organization during experimental design.

CONTENT MODULE 3
METHODS OF MODELING AND QUALITY EVALUATION OF DESIGN SOLUTIONS OF ARCHITECTURAL AND URBAN PLANNING OBJECTS

12 A method of systematic approach to scientific research of architectural and urban planning research at the stage of analysis and evaluation of the quality of design solutions of architectural and urban planning objects

An important place among the *tools* of scientific research of architectural and urban planning objects is occupied by a *systematic approach*, which is successfully used in many scientific fields and is therefore general scientific. By definition, an approach is a set of methods that are grouped around a main idea and create a specific algorithm of actions. The result of applying the approach is the determination of the parameters and characteristics of the object under study. A system approach are used, at the stage of pre-design analysis, including concept development during experimental design.

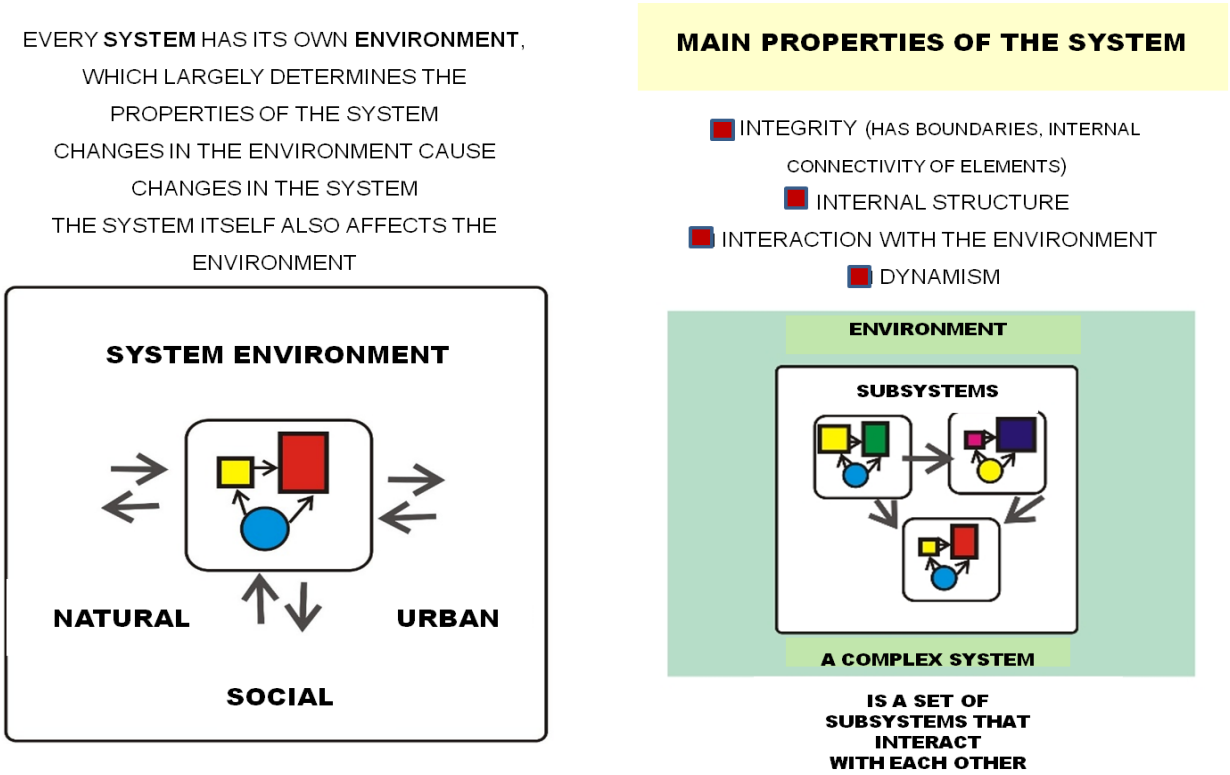


Figure 28 – The system, its environment, and the main properties of the system

Numerous of modern architectural scientific studies demonstrate a whole *range of models* for describing architectural systems, which differ significantly in their

interpretation of approaches to identifying system elements and their definitions (fig. 28). The main research method used in scientific works on architecture and urban planning is a *systematic approach based on* the ideas formulated in the works of L. von Bertalanffy, I.V. Blauberg, W. Ashby, G.I. Lavrik, V.N. Sadovsky, and others.

By definition, a system is a set of interconnected elements united into a single whole *to achieve a specific goal* determined by the purpose of the system. An element is the smallest indivisible object considered as a single whole. The essence of the idea of systematicity is that a set of closely interrelated objects has additional properties that are not observed in the same set of objects in cases of their purely mechanical connection. 'A system is not an object, but a list of variables' (W. Ashby).

Thus, defining *the object of study* as *a system* is based on the principle of integrity. The system is separated from the environment (the system's environment) and interacts with it as a whole, exhibiting basic systemic properties. Therefore, the systemic approach is based on the desire to construct a holistic picture of the object under study, taking into account the elements of the object that are important for solving a specific problem, the connections between them, as well as external connections with other objects in the environment (external environment). Architectural and urban planning objects can be effectively viewed as *systems*, which allows them to be isolated from their surrounding reality as a whole, relatively autonomous and stable, characterised by functional and territorial connectivity and the orderliness of its elements.

Urban planning systems are complex and often have a hierarchical structure. The model replaces a complex object and facilitates its effective understanding. Systems of architectural and design objects have a more simplified structure. The use of a *systems approach* opens up opportunities not only to study the properties of the object under study, but also to improve the process of managing the development of these objects. The *systems approach* involves building models of the objects of architecture, urban planning and design under study. These *models* include the system itself, as well as its external environment. The external environment is a *source of factors influencing* the formation of each object of architectural and urban space. These factors are divided into groups: economic and natural-climatic, urban planning conditions, social requirements.

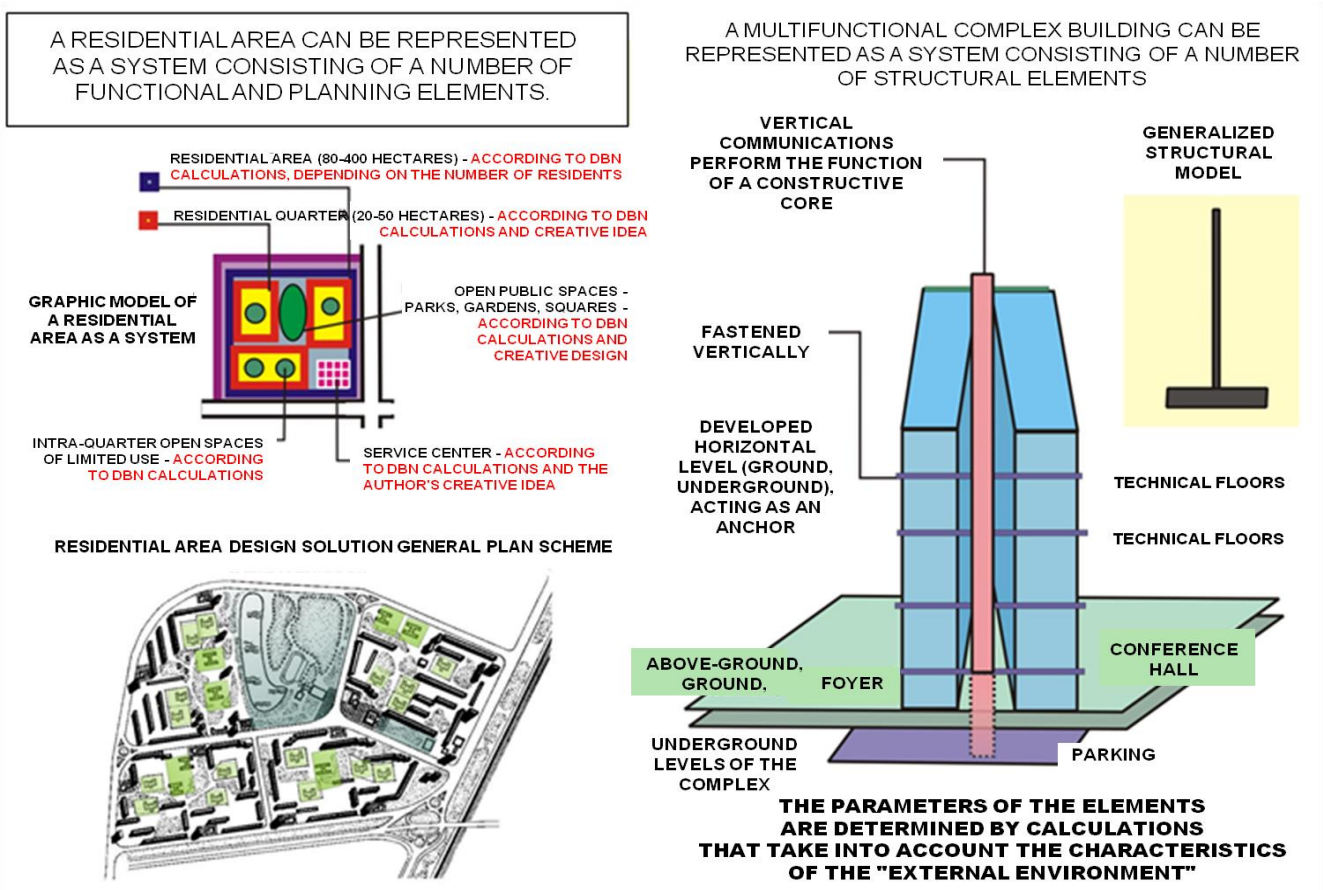


Figure 29 – Results of using a systems approach in the architectural and urban planning sphere

To describe an architectural and urban planning system, it is important to determine the structural organization. *The structure of the system* is given by the list of elements that make up the system and the configuration of the connections between them. The concept of structure implies the ability of an object to maintain its identity to itself under conditions of various external and internal changes. Analyzing numerous definitions of structure, V.V. Agudov concluded that *structure is primarily the connections between parts of a whole*, regardless of whether we abstract from the parts themselves or take them in conjunction with them. This definition of the system structure is "convenient" for the study of architectural and urban planning objects. The latter have their own *structure*, characterized by *spatial parameters*, that is, individual elements of the studied object are interconnected *in space in a certain way*. This connection ensures the functioning of the complex: its fulfillment of the target tasks of its existence. The effectiveness of the system approach can be observed on various examples of architectural and urban planning objects (fig. 29).

13 Modeling of architectural and urban planning systems. Analysis of examples of master's thesis in the field of architecture and urban planning

One of the most important in research in the architectural and urban planning field is the modeling method. *This method* is the main one in research in most fields of knowledge. The modeling method is used to assess the characteristics of complex systems and make scientifically sound decisions in various areas of human activity.

Modeling, by definition, is a research method based *on replacing the original object under study with its model* and working with it (instead of the object). This greatly simplifies research work.

Model (from Latin modus – "measure", "volume", "image") - an auxiliary object that reflects *the most significant* for *this study* patterns, essence, properties, features of the structure and functioning of the original object. *When talking about modeling, usually they mean modeling of some system.*

The model is *a scientific information formation*, a kind of "*undressing*" of a real object from everything that is *not essential* for *this study*, and a "manifestor" of the most essential – elements and connections between them and the surrounding environment. This makes it possible to study the object from a certain perspective, in a certain subject plane. *Modeling* is the process of adequately reflecting the most essential aspects of the studied object with the accuracy necessary to solve the formulated task. Architectural and urban planning modeling is a means of substantiating decisions on the formation of urban structures adequate to real economic and social processes and natural conditions.

Modeling of complex dynamic objects as a method of their research is gaining increasing importance in modern architectural and urban planning science because it is an effective tool for decision-making in the context of analyzing a large number of socio-technical processes, a variety of structures, the relationships between their constituent elements and the environment.

For architects, it is advisable to use both logical and graphic modeling during research work. The tools of graphic modeling are very wide. It is usually used during

research at its various stages. The involvement of modern IT technologies allows developing graphic *3D models of the designed object*, both close to reality and conceptual, very abstract. Traditional graphic models are 2D models of the objects under study. These are building plans, master plans and their schemes, which reveal the essence of various aspects of the organization of objects: functional, structural-spatial, compositional.

Based on the abstraction method based on *2D models of the studied objects*, it is useful to develop generalized *graphic mode*ls of the functional structural-spatial, landscape, and compositional organization of a certain type *of object* (fig. 30). Such models allow us to abstract from the characteristics of a certain type that are not essential for the model and to focus on the studied qualities of the object. Thus, in Figure 26, the main attention is paid to the structural-functional organization of the residential area. Therefore, the generalized functional model abstracts from the planning and compositional features of the object. The functional elements of the residential area are represented in it in the form of rectangles of different colors.

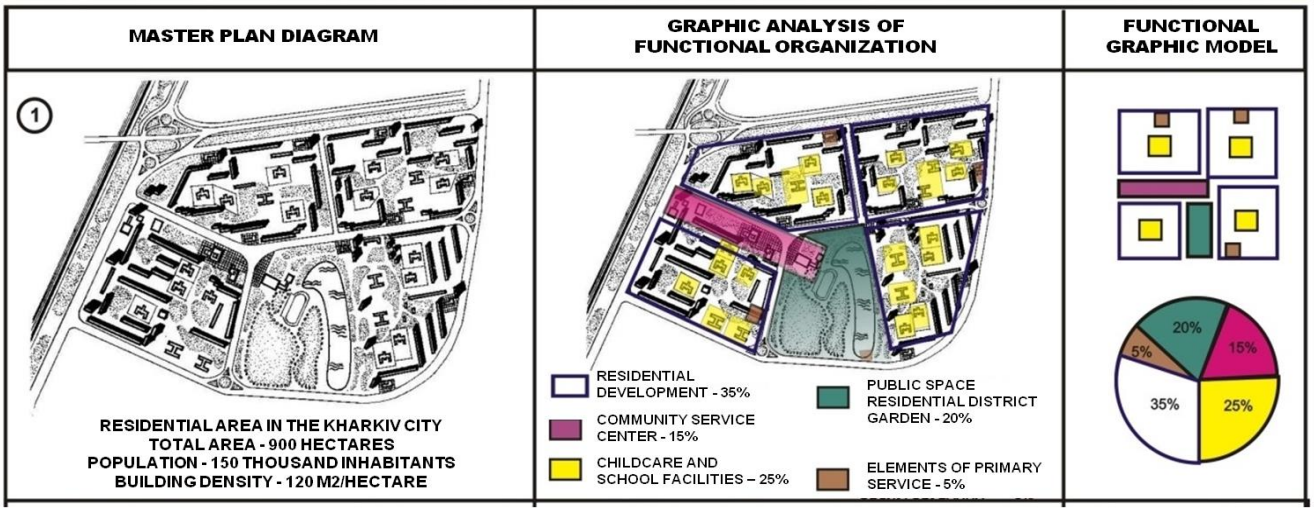


Figure 30 – Examples of the application of the graphical modeling method at the stages of analysis of analogues of the object under study

The use of such a graphic model is the basis for determining the general principles of the structural and functional organization of residential areas and developing options for the spatial placement of functions in various urban planning conditions.

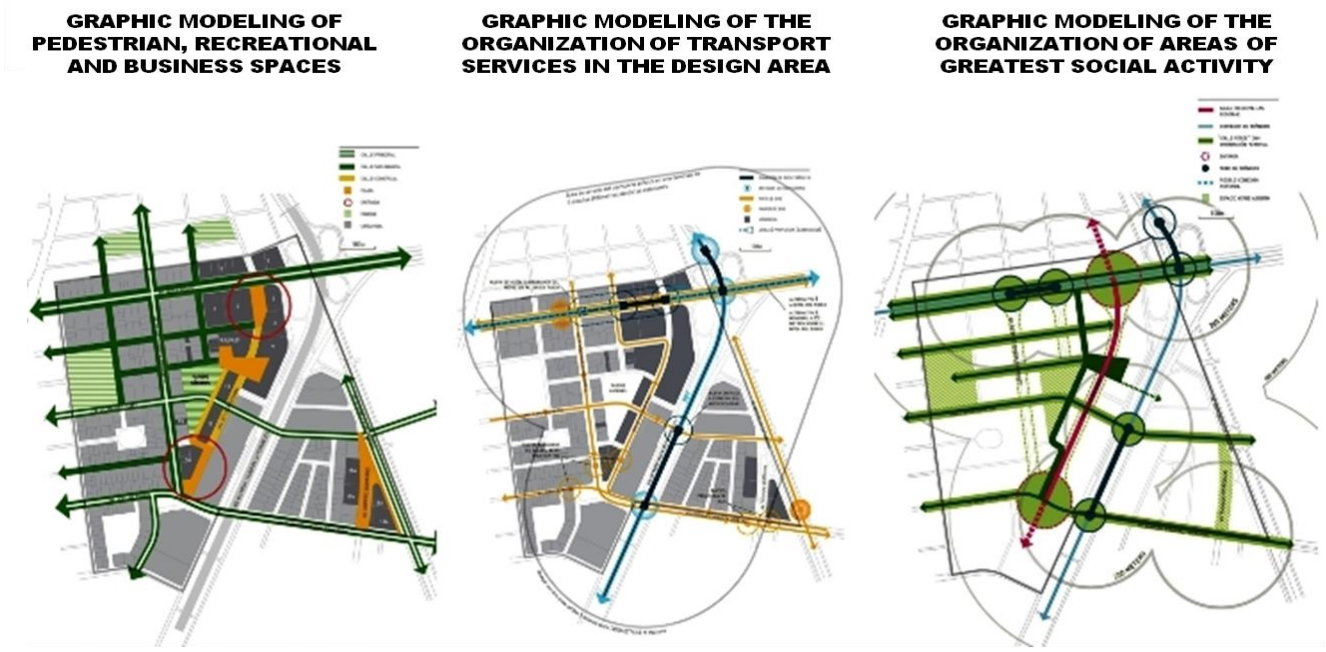


Figure 31 – Examples of the application of the graphical modeling method at the experimental design stage

Using graphic models, it is possible to investigate and "visualize" such features of the urban planning organization of the studied objects as pedestrian connections and transport service of the territory, the placement of locations of various types of social activity in space and propose their improvement. (fig. 31).

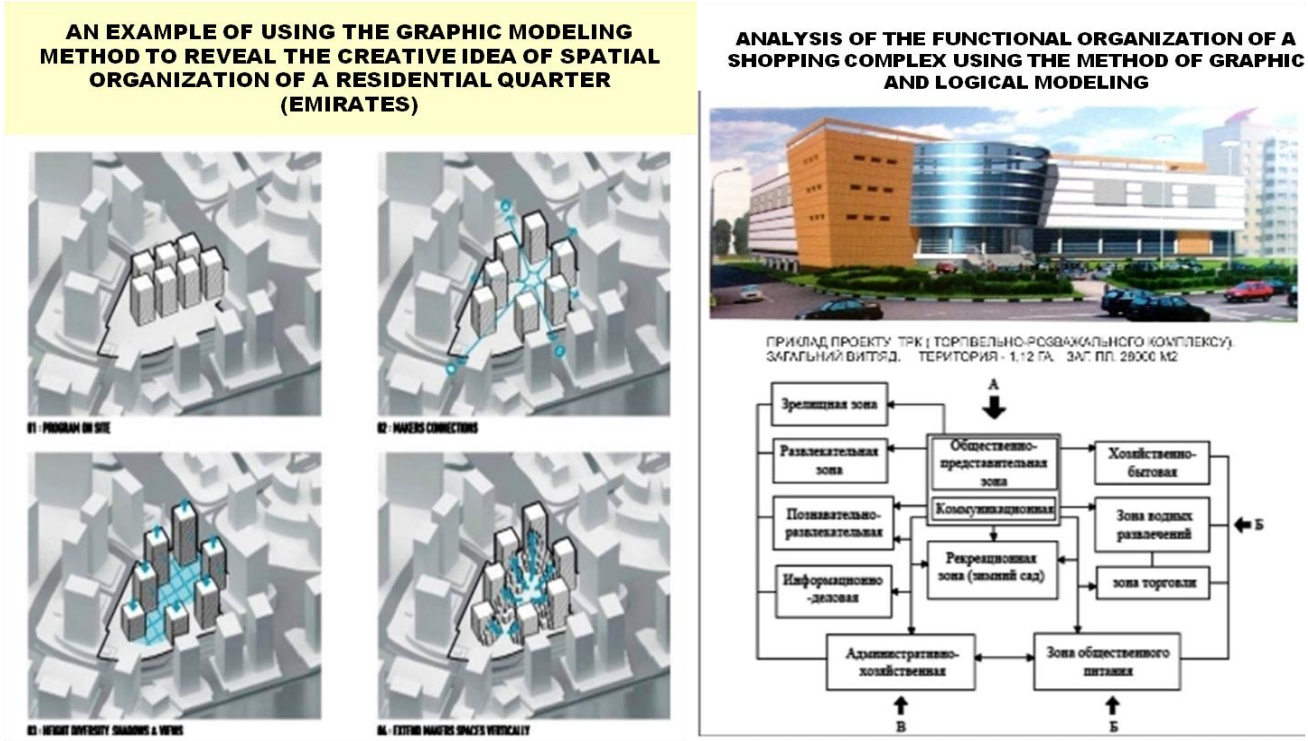


Figure 32 – Examples of the application of the graphical modeling method at the experimental design stage

Graphic modeling is also an effective method of demonstrating the formation of a creative idea of its main idea (fig. 32). So, in this example, using a 3D model of the object under study, it is shown what important tasks were gradually solved and how they were achieved. Another figure shows a model of the functional organization of the object under study. The language of graphic modeling is very expressive and almost does not require explanations.

Thus, the modeling method (logical and graphic) is used at the stage of analysis and generalization of experience in the architectural and urban planning formation of the objects under study to develop their ideal models. At the stage of experimental design, an appropriate method of conducting a search for an effective solution is the development of conceptual models of the architectural organization of the object under study and their comparison.

As an example of the implementation of the master's thesis, we will consider the research on the topic "Concept of renovation of the Ivanovo industrial district of Kharkiv" by student Shpakovich V (fig. 33).

Introduction. The relevance of the research is due to the fact that in the development of the city in the post-industrial period, the renovation of industrial areas is becoming increasingly important. This is largely due to the decline of industrial enterprises in new socio-economic conditions. The feasibility of renovation, the introduction of alternative functions in the territories being vacated, is determined by social, economic, psychological, historical and aesthetic factors.

The problem of the research is that today the architectural-spatial and functional organization of the territories of industrial districts of Ukrainian cities, which occurs spontaneously, does not correspond to their urban planning significance and potential. Therefore, the development of a concept for the renovation of these territories is very relevant. The problem of renovation of territories and entire zones of "dying" industrial enterprises is particularly acute for the central part of the city.

Purpose of the study: to develop a concept for the renovation of the Ivanovo industrial district of Kharkiv.

Subject of the study: renovation of the Ivanovo industrial district of Kharkiv.

Object of the study: the territory of the Ivanovo industrial district in the structure of the Kharkiv city.

Research objectives:

– analysis of scientific and practical experience in the renovation of industrial districts of large and largest cities;

– analysis of factors that influence the renovation of industrial territories in the structure of central districts of modern cities;

– development of a concept for the renovation of an industrial district in the structure of the central hub district of the city;

– verification of the research results during the experimental design of the renovation of the Ivanovo industrial district of Kharkiv.

The research methodology is based on the main provisions of the system approach. The work used such methods as: observation, measurement, comparison, typology and classification, terminological analysis, graphic modeling and conceptual design. The research methodology also includes: research of the designed situation at the "city" level in functional, structural-planning, compositional, landscape-ecological aspects in order to assess the urban development potential of the territory.

The scientific novelty of the results obtained lies in the formulation of the principles of renovation of the industrial district in the central planning district of the largest city, which became the basis of the concept of its renewal in the context of sustainable development.

The practical significance of the work lies in the use of the research results in adjusting the zoning of the city and in design practice at the stage of pre-project analysis and variant design, which will allow to increase the validity of urban planning decisions.

The introduction reveals the relevance of the topic of the master's thesis, formulates the goal, subject and objectives of the research, formulates the novelty of the scientific research, substantiates the practical significance of the work, and reveals its structure.

In section I. "Analysis of practical and scientific experience in the reconstruction of industrial districts of large and largest cities" it was shown that numerous industrial enterprises and entire zones that have lost their significance under the influence of scientific and technological progress, changes in the economic situation, and increased environmental requirements have become an important reserve for the renewal of significant territorial fragments of the planning structures of large and largest cities.

In section II. "Analysis of factors and development of the concept of reconstruction of industrial areas in the structure of central districts of cities" several groups of factors influencing the content of reconstruction of territories of industrial districts in the structure of the largest city are identified and analyzed. External factors are urban planning, natural and climatic, socio-economic, technological conditions and factors. An important factor influencing the renewal of industrial areas is the need to ensure sustainable development of the city.

In Section III "Experimental Design of Renovation of the Ivanovo Industrial District of Kharkiv" it was proposed:

– in the functional aspect: development of elements of the city-forming base, namely a technopark, an industrial enterprise with innovative technology, public service complexes of the city rank, development of external transport nodes; development of the residential function;

– in the structural and planning aspect: development of the district within its planning boundaries, taking into account historical planning, improvement of the subsystems (transport interchanges, parking lots, elevated pedestrian crossings);

– in the landscape and ecological aspect: strengthening and development of the landscape and ecological framework by forming a developed embankment, a system of internal boulevards and a district park.

Based on the generalization of the results of the research and experimental design, the following general conclusions were formulated:

1. Socio-economic changes and the needs of the city's development require scientifically based approaches to the renovation of industrial districts, which are significant resources for the sustainable development of urbanized areas.

2. An analysis of scientific and practical experience has proven the effectiveness of the formation of new urban planning formations of various functional purposes in territories that have lost the functions of industrial production: residential, public service, recreational, scientific and industrial.

3. The features of the industrial districts renovation determine such urban planning factors as: the location of the industrial district in the zonal structure of the city; the level of harmfulness of industrial enterprises subject to removal and reconstruction; functional and planning features of the district's territory and its natural conditions.

4. The urban planning principles of the renovation of industrial districts, which formed the basis of the concept of the design solution, are based on the replacement of the city-forming functions of part of industrial production with others, which ensures the growth of the urban planning potential of the territory.

5. The implementation of the research results in the experimental project – the concept of renovation of the Ivanovo Industrial District of Kharkiv proved the effectiveness of the systemic approach to functional renewal, development of communication infrastructure, compositional harmonization, landscape and ecological balance of the territory, as an integral structural and functional element of the urban system.

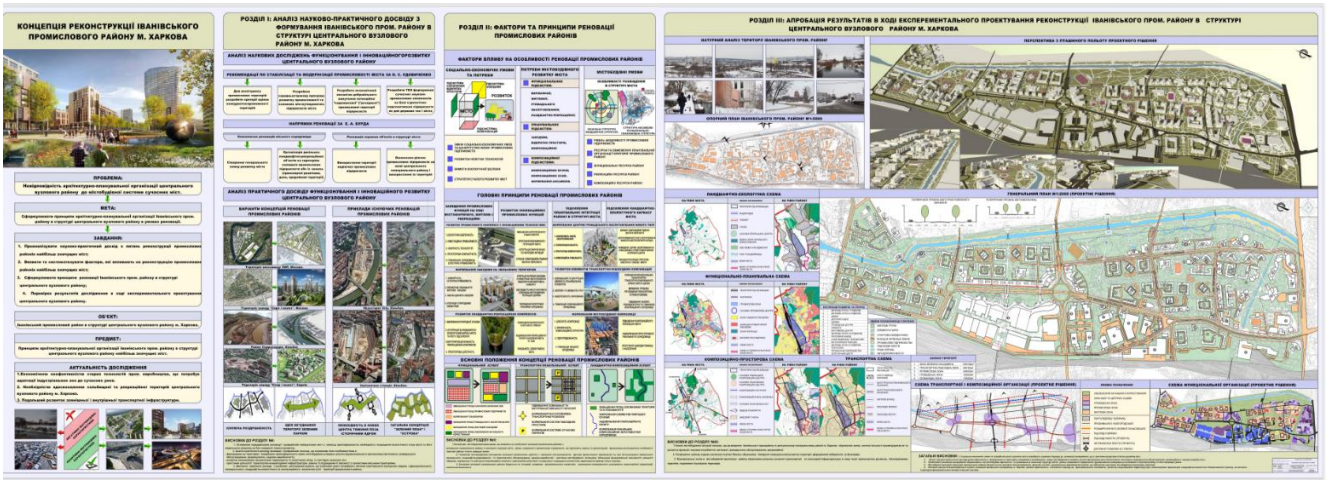


Figure 33 – Example of the design of the graphic part of the master's thesis

14 A method of conceptual modeling as a component of research activities in the field of architecture and urban planning

Development of concepts of a design solution precedes the development of an architectural and urban planning project. Today, as a rule, at least two alternative concepts are developed for their comparison and selection of the correct direction of further movement in the design. This allows to avoid mistakes and obtain a more effective solution. In addition, conceptual design solutions are more understandable for customers, for the procedure of "public discussion", as well as for "adjacent parties". Only after choosing a certain concept does the development of a draft design begin, and then - working drawings.

Therefore, the *conceptual design method* is a very important tool for pre-project research. The concept is built on three main databases:

– data on the analysis of current design and practical experience;

– data from scientific research (from the architectural sphere and "related");

– data from the pre-project analysis of the designed situation (urban planning, socio-economic, environmental).

The conceptual design method consists of a sequence of research steps, which include:

– analysis of the designed situation;

– logical and graphic modeling of the main idea of the project;

– graphic modeling of design solution options at different levels of detail and in different aspects (functional, planning, compositional);

– comparison of graphic conceptual models of the designed object and selection of the best one according to certain criteria;

– comparison of graphic conceptual models according to the "was"-"became" scheme.

Conceptual graphic modeling in architecture is the process of creating abstract, general representations of architectural ideas and concepts without the details of specific

solutions. The main goal of conceptual modeling is to develop the basic framework of an architectural project, defining its key principles and ideas.

The following characteristics can be used as criteria for evaluating conceptual solution options: the number of elements of the functional organization of the object and their qualitative composition; structural and spatial organization of functions; planning continuity of green spaces and their share in the designed territory; diversity of landscape arrangement, internal and external planning connectivity. Compositional comparison of solution options usually occurs using the method of expert assessment of the aesthetic qualities of objects.

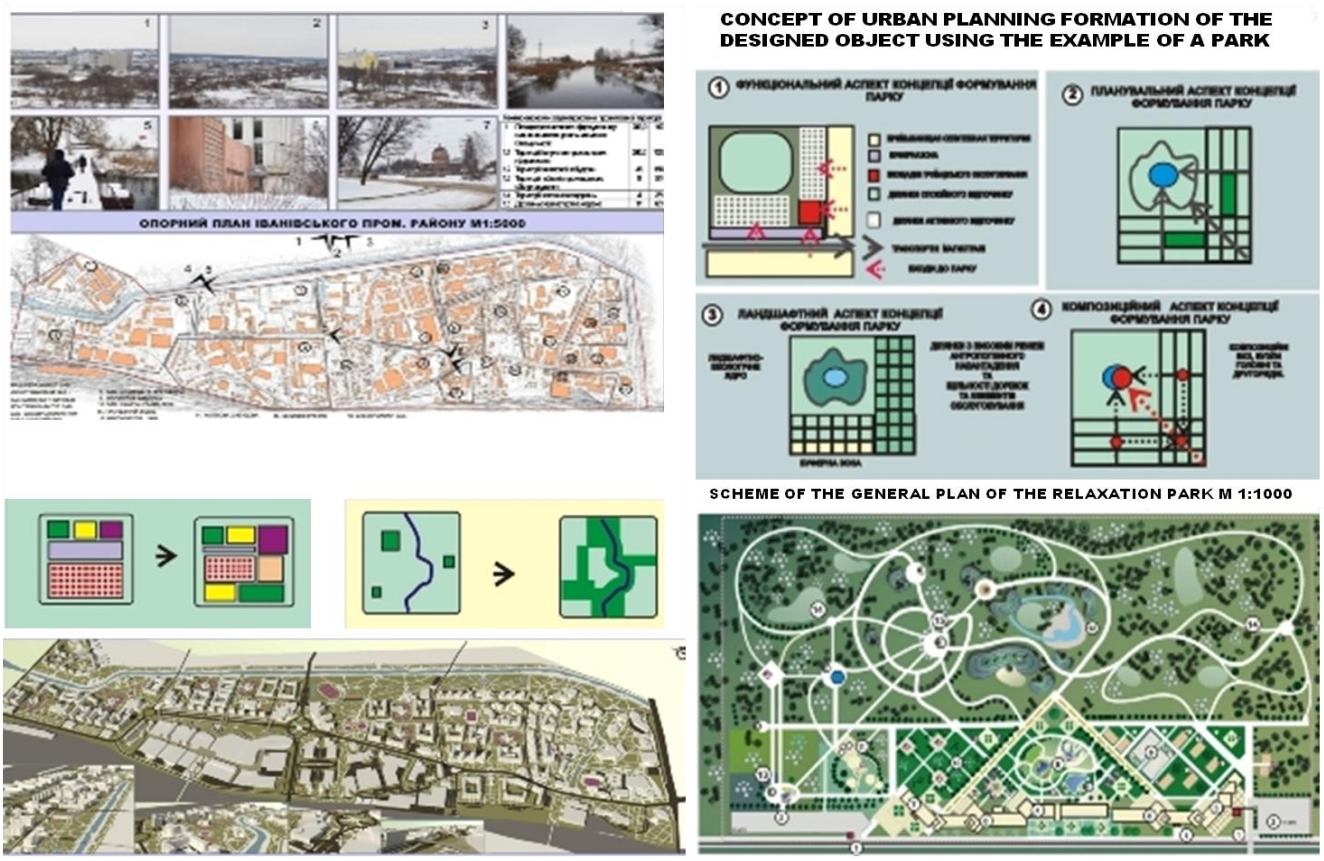


Figure 34 – Examples of using the conceptual design method at the final stage of research work

It is determined in advance that each of the assessment criteria has a certain, acceptable scale of points. For example, from "0" to "10" points. Summing up the points obtained for different solution options, you can choose the best one (fig. 34).

The use of this method has become especially useful in the context of introducing the provisions of the concept of integrated development of cities and communities into

the design process. The latter involves discussing the main idea of the future project with representatives of the community in whose territory construction is planned.

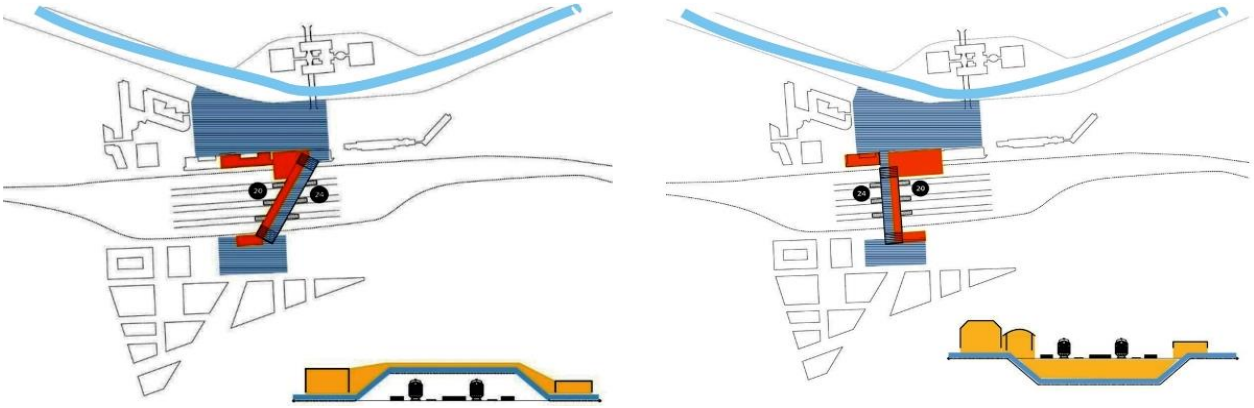


Figure 35 – An example of comparing two conceptual models of planning and spatial organization of a railway station connecting two parts of the city

The use of conceptual modeling allows you to:

• *Focus on ideas*: the method helps to separate concepts from details, so that the architect can concentrate on key aspects of the project without paying excessive attention to technical details.

• *Reach mutual understanding with the customer* as soon as possible: this method helps to create a common language between the architect and the customer, which facilitates the understanding of concepts and requirements.

• *Determine the architectural direction and functional content of the building*: conceptual modeling helps to establish the basic principles and ideas that will determine the design of an architectural object and its functional and planning content.

• *Helps in faster modification of the object*: provides flexibility to make changes to the concept without significantly affecting the details of the project.

In general, conceptual design is an important stage in the development process of any architectural project, helping to determine the main ideas and principles that will form the basis of further details and structures, functional, planning and compositional organization of space (fig. 35). Mastering the conceptual design method is becoming an important requirement for modern professionals in the architectural and urban planning field.

15 Integrated approach to the study of architectural and urban planning objects as elements of social, economic, environmental subsystems of society.

The complexity and multifaceted nature of architectural and urban planning projects requires not only the involvement of a large amount of knowledge from related scientific and practical fields, but also the use of various research methods from these fields at different stages of work. Therefore, the problems that an architect solves are often called interdisciplinary, and the scientific approach to their solution is complex (sometimes combined).

Thus, to create a modern architectural and urban environment, it is necessary to comprehensively solve the tasks not only of effective functional, planning, compositional organization of its elements, but also of environmental safety, economic feasibility, and social justice.

An integrated approach involves the use of terminology from those areas of knowledge that are involved in the study. The results of research in sociology, ecology, economics, and other scientific and practical areas are often considered as factors of influence on the formation of architectural and urban objects. Conversely, an architect must understand, determine, and take into account how the parameters of the architectural and urban environment he has designed will affect its sociological, ecological, and economic characteristics.

As an example of the application of an integrated approach to solving the tasks of further effective development of architectural and urban space, we can cite the well-known concept of “sustainable development.”It involves a comprehensive solution to sociological, ecological, and economic issues in the formation of architectural and urban objects. The concept of sustainable development of architecture and urban planning involves the creation of buildings and cities that meet the needs of the present without compromising the opportunities of future generations. This is achieved through a balance between environmental sustainability, social justice and economic growth. Architecture and urban planning implement this through ecological design, the use of renewable resources, energy efficiency, the creation of comfortable communities for life and the reduction of negative environmental impact.

The key principles of the sustainability in architecture and urban planning are:

Environmental sustainability: Reducing energy and water consumption, using environmentally friendly, renewable materials, recycling waste, creating green areas and integrating the building into the surrounding environment.

Social justice: Ensuring access to quality housing, a safe urban environment, convenient transport infrastructure and public spaces for all segments of the population.

Economic feasibility: Ensuring the long-term economic viability of projects, which includes efficient use of resources and reduced operating costs in the long term.

An integrated approach is used both at the stage of pre-project research of the designed situation (collection of information on various aspects and their comprehensive consideration), and at the stage of making a project decision. In order to "combine" several goals in a single solution of the architectural and urban planning organization of the designed object, it is necessary to develop and compare several options. Thus, often a successful solution in one aspect (for example, economic) has significant flaws on another aspect (for example, sociological or environmental). Therefore, it is necessary to seek compromises in each specific situation by comparing different options for conceptual solutions because the development of the concept is part of the research (fig. 36). This is also a feature of the integrated approach.



Figure 36 – The example of formulating the research problem and determining its relevance that creates the concept and gives idea of solution

16 A comprehensive approach to researching architectural and urban planning objects. The concept of SWOT analysis

A comprehensive approach of researching architectural and urban planning objects could be provided at the stages of pre-project analysis and development of the concept of a project solution involves a systematic, multi-faceted study of the future project, taking into account all interrelated factors – technical, economic, market, legal, social and environmental. Development and evaluation of alternative concepts gives possibility to generation of several project solution options, systematic comparison of these options according to all analyzed criteria (economic, technical, market, etc.) and selection of the most optimal concept that best meets the project objectives and minimizes risks.

The key components of a comprehensive approach are the set of analysis:

– multi-factor – analysis of needs and requirements: provided the detailed study of the needs of the customer and users, clear formulation of project objectives;

– market – analysis of demand assessment, competitive environment, potential risks and opportunities in the market;

– technical and technological – analysis of existing infrastructure, necessary technologies, technical feasibility of the project and potential innovations;

– economic and financial – forecasting costs, assessment of financing sources, calculation of return on investment, payback period and sensitivity of the project to changes;

– legal and regulatory – verification of compliance with legislation, building codes, licensing requirements and permit documentation;

– social and environmental – analysis of the project impact on the environment, local community, taking into account social responsibility and sustainable development.

As an example of a comprehensive approach at the stage of pre-project analysis and development of the project solution concept, SWOT analysis can be cited (fig. 37).

SWOT analysis is a special method that consists in identifying factors of the internal and external environment of the organization of the studied object and dividing

them into four categories: strengths, weaknesses, opportunities and threats. Strengths and weaknesses are factors of the internal structure of the object of analysis, opportunities and threats are factors of the external environment.

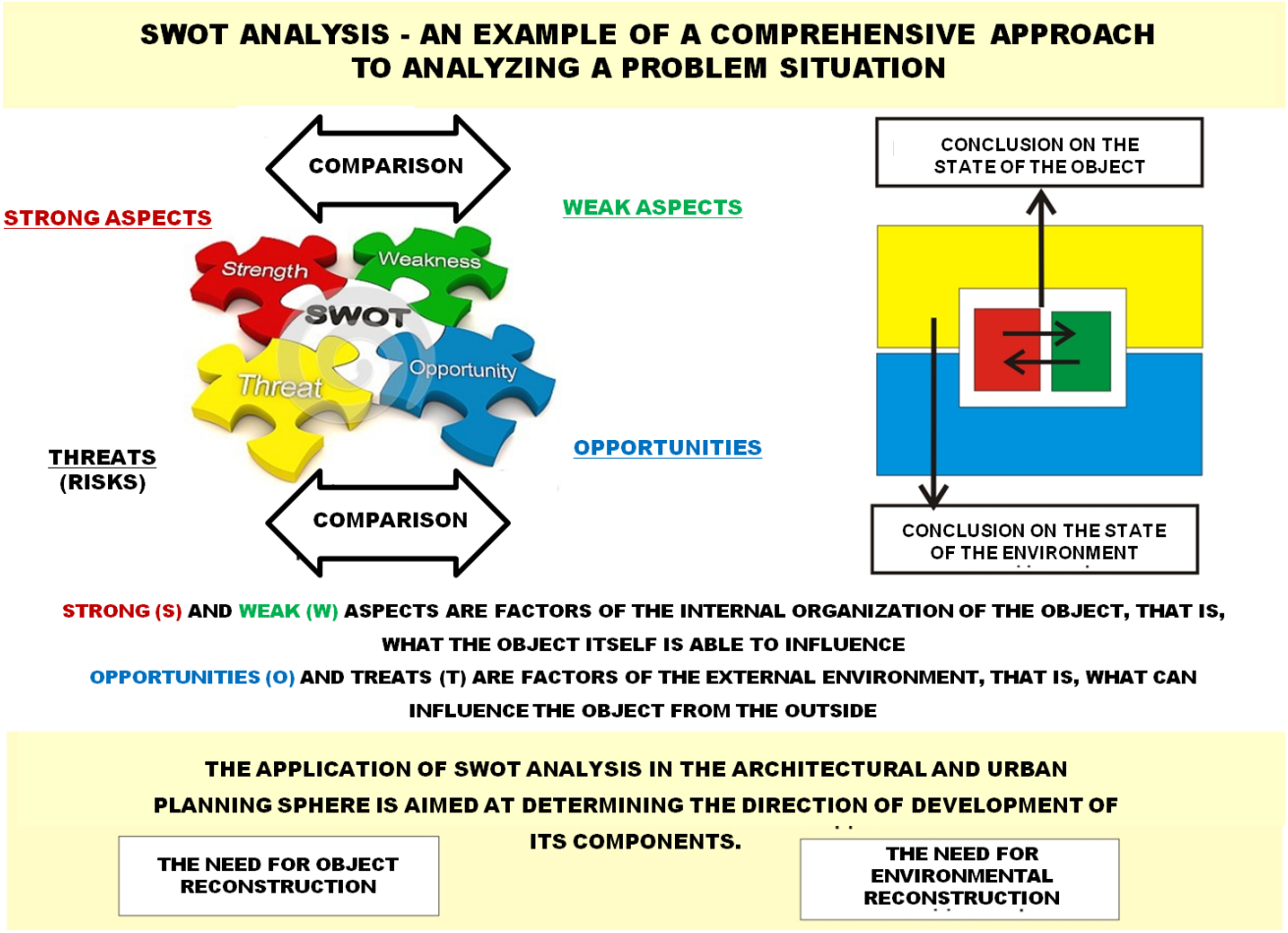


Figure 37 – The essence of SWOT analysis

The basic approach to research in urban planning is a comprehensive assessment of the territory from the point of view of natural, urban planning and landscape characteristics. This approach involves: analysis of the functional and transport structure of the territory; assessment of the compositional and planning scheme, and zones of visual perception; determination of capacity and passability. Thus, a comprehensive architectural and urban planning approach to the study of urban recreation involves the study of issues of the functional purpose of the territory, morphology and composition of architectural space. They are united by 14 interdisciplinary connections with social and psychological approaches (study of society, perception of the comfort of a recreational environment, etc.).

TERMINOLOGICAL DICTIONARY

Abstraction is a mental distraction from insignificant properties, connections, relationships of objects and the selection of several sides that interest the researcher.

Analogy is a method by which knowledge about objects and phenomena is achieved on the basis of their similarity to others.

Analysis is a method of cognition by dismembering or decomposing objects of study into their component parts.

Measurement is the physical process of determining the numerical value of a certain quantity by comparing it with a standard.

Measurement is finding a number that determines the quantitative ratio of objects of the same type or their parameters that characterize certain properties.

Hypothesis is a scientific assumption put forward to explain any processes (phenomena) or causes that cause a given consequence.

Deduction is a conclusion in which a conclusion about a certain element of a large quantity is made on the basis of knowledge of the general properties of the entire large quantity.

Dialectical method – a general scientific method of research for revealing the laws of development and change of things in their interconnection, internal contradiction and unity.

Eclecticism (in scientific research) – an uncritical accumulation of various unrelated methods.

Empirical level of research – one at which the process of accumulating facts is carried out

Induction – a conclusion from facts to some hypothesis (general statement).

The historical method of cognition involves the study of the emergence, formation and development of objects in chronological sequence.

Idealization – the creation of concepts for objects that do not exist in reality, but have a prototype in it (a geometric point, a sphere, an ideal gas).

Categories – the most general concepts.

Method – a way of research, a way of achieving a goal, solving specific problems. This is a set of approaches, techniques, operations for the practical or theoretical development of reality. From the definition of a method it follows that there are two large groups of methods: cognition (research) and practical action (methods of transformation).

Research methods – techniques, procedures and operations of empirical and theoretical knowledge and study of phenomena of reality. With the help of this group of methods, reliable information is obtained, which is used to build scientific theories and develop practical recommendations.

Modeling is the process of adequately reflecting the most essential aspects of the object under study with the accuracy necessary to solve the formulated task.

Scientific activity is intellectual creative activity aimed at obtaining and using new knowledge.

Concept – a set of essential features of the object.

Problem – a set of contradictions, violations of the functioning of the object of study, inconsistency with its parameters of existence, quality of the environment, etc., identification of tasks, the conditions of which are determined when identifying the problem. The carrier of the problem is the object of research, design.

Comparison is the establishment of differences between objects of the material world or finding common ground in them; carried out both with the help of the senses and with the help of special devices.

Observation is a way of knowing the objective world, based on the direct perception of objects and phenomena using the senses without intervention in the process by the researcher.

Synthesis – the union of individual aspects of an object into a single whole.

Generalization – the definition of a general concept, in which the main, basic, essential characteristics of objects of this class are reflected.

RECOMMENDED SOURCES

Methodical support

1. Distance course «Methodology of scientific research in architectural and urban planning objects» at Moodle. Access mode [Electronic resource]. – Electronic text data. – Regime of access: https://dl.kname.edu.ua/course/view.php?id=4562 (date of the application: 20.03.2025). – Header from the screen.

2. Methodological recommendations for practical work on the discipline «Methodology of scientific research in architectural and urban planning objects » (for 1–nd year foreign students of full-time education, educational level «master» specialty 191 – Architecture and urban planning) / O. M. Beketov National University of Urban Economy in Kharkiv ; comp. L. Martyshova. – Kharkiv : O. M. Beketov NUUE, 2025. – 21 p. Regime of access: http://eprints.kname.edu.ua/68010/1/2024%20166%D0%9C%20%D0%A0%D0%B5%D0%BF%D0%BE%D0%B7.%20%D0%9C%D0%B0%D1%80%D1%82%D0%B8%D1%88%D0%BE%D0%B2%D0%B0%20%D0%9B.%20%D0%A1..pdf (date of the application: 11.10.2025). – Header from the screen.

Recommended literature and information resources

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КОНСПЕКТ ЛЕКЦІЙ

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