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# PRINCIPLES OF RECONSTRUCTION THE URBAN TERRITORY IN DENSE BUILDING AND COMPLEX GEOLOGY CONDITIONS

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**ABSTRACT**

The principles of transformation urban territory in dense building and complex geology conditions have been developed for planning and safe performing conversion and consequences prediction depending on geotechnical properties, characteristics of existing buildings and new construction options. In process of urban engineering and territory planning it allows to plan spatial development of residential areas, density of housing and population by carrying out a new construction and use of potential territorial resources while preserving historical infrastructure of city.

Key words: urban territory transformation, dense building, complex geology, engineering preparation, consequences prediction.

## 1. INTRODUCTION

The continuous process of preserving, updating and adapting buildings to changing requirements is an integral part of a modern city development. Reconstruction of cities, and especially city centers, is one of the most difficult problems of modern urban planning. This is due to permanent dynamic process of the center development, and the reenactment and renewal the formed city central part for the radical improvement of population life. In recent years, the town-planning state policy is aimed at addressing the issues of increasing the efficiency of the city's territories use, and especially the historical cities centers as the most attractive for investment processes. In this regard, the price of land in the cities central areas constantly increased, and, accordingly, at a dynamic pace, the building density of central neighborhoods increases.

During designing measures for reconstruction in a dense urban building, all modern city-planning, architectural, sanitary and fire safety requirements and, most importantly, constructive requirements for the preservation of existing buildings and ensuring their normal and safe exploitation should be taken into account. The most difficult task of transforming the planning structure is solved in the case of new construction within the existing buildings, especially in historical regions of the old cities and areas that are directly adjacent. In these conditions, the reconstruction of the roads network is also difficult due to the fact that the transport arteries are a very stable structure of the general plan that forms the city framework.

Methods of reconstruction largely depend on specific factors of the urban environment, namely, architectural and compositional and historical-cultural, sanitary-hygienic, land site features, and functional factors. And one of the main – structural deformation of old historical buildings, which causes its acceleration of degradation due to the negative impact of new construction near, which is particularly acute in the centers of historic cities, that had evolved under other conditions.

## 2. STATEMENT OF THE PROBLEM

During the reconstruction by increasing the average building density in any of the marked groups of territories, it is necessary to take into account the impact of new construction on the surrounding buildings, conduct special research and develop appropriate measures to reduce the impact and safe realization of the reconstruction (Fig. 1).

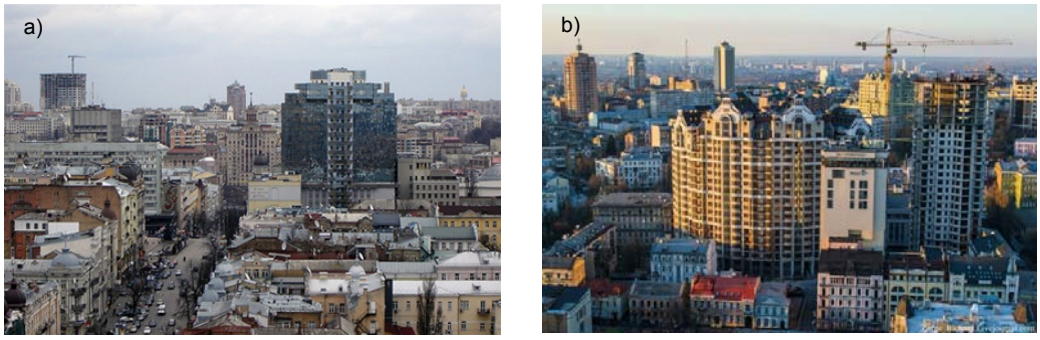


Fig.1. The examples of modern complex reconstruction of residential districts of the Kyiv city with historically formed dense buildings by the implementation of new high construction. Source: a) http://kiev.vgorode.ua, b) www.zorge-richard.livejournal.com

In addition to the formation of a long-term urban and socio-economic strategy for the urban areas reconstruction, its scale and nature inevitably require the development of a methodology for assessing the impact on the construction of buildings and structures, and surrounding infrastructure in general. Appropriate research works is a systemic task with the maximum full account of all factors and all criteria for impact assessment [1].

With the development of cities, the buildings adapts to new conditions, and the process of urban reconstruction at the present stage, as a rule, is to consolidate the building by constructing on the inner-quarter areas of a large-storey buildings. And the main problem has become the impact assessment of new high-rise buildings on the dense surrounding building construction, especially in complex engineering and geological conditions (Fig. 2).

However, the intensification of the urban transformation of the central areas of cities in recent decades has led to the emergence of new problems in planning and improvement of residential areas that require fundamental theoretical approaches and practical methods, that aimed at preserving historical development during reconstruction. The problem of improving the historical centers of cities is so multifaceted that it requires constant scientific research aimed at revealing the general laws of this process and the justification of specific comprehensive methods and techniques of reconstruction.

Along with the identification, generalization and formulation of the general principles and methods of urban development of the large city historic center, it is necessary to develop a system of methods aimed at scientific and technical support the entire complex of measures for planning, designing and safe realization of reconstruction processes. Depending on the results of such complex studies, it has been chosen the appropriate direction of the center planning structure development and the approach to its reconstruction, which is carried out by means of new construction on free areas within the formed city center with the adaptation its structure to the modern requirements [5].

The process of reconstruction of centers of historic cities is called to solve the most acute problems that arose due to a number of reasons caused by rapid changes at the socio-economic level. Existing theoretical studies are devoted mainly to the problems incorporating new buildings into the existing structure of the formed historic center, namely in the process of free territories reconstruction. During the reconstruction planning of urban areas with dense buildings, it is also necessary to evaluate the efficiency of urban development of neighborhoods in the centers of historic cities (Fig. 3).

The urgent task regarding the territories of historic citiy centers, where is the densest concentration of urban culture layers, the environment acquires specific properties inherent in a particular city, which in turn requires a balanced attitude in the planning and use of the territories. The environment of the centers of historical cities is not only a set of functional, space-planning and other components, but a complex system of organically interconnected elements, that change the one of parameter necessarily leads to a change other. Economically, these are the most valuable urban land, due to the specific conditions for the formation of differential and monopoly rent, so the main task of urban development – conservation and renewal of the environment, rational and efficient use of territories [10, 12].

The balanced development of urban development systems is associated with a permanent position in the urban environment. According to the State conception of sustainable development of cities, the main goals of the development of settlements and territories are the rational use of resources, preservation and revival of historical and cultural potential. An integral part of the problems solution for settlements sustainable development is the achievement of efficiency in various spheres of city-planning activity: identification of modern trends in the development of cities and separate territories, formation of the environment, justification of rational use and reconstruction of territories, etc.

The considered directions are aimed at improving the cities development and relate to the

theoretical provision of pre-project studies, methods for the formation, development and reconstruction of urban areas, focused on ensuring the continuity of the inherited urban environment. At the same time, issues of expanding research to increase the validity of design decisions remain relevant, considering the effective use of territories on the basis of systemic and techno-economic approaches.

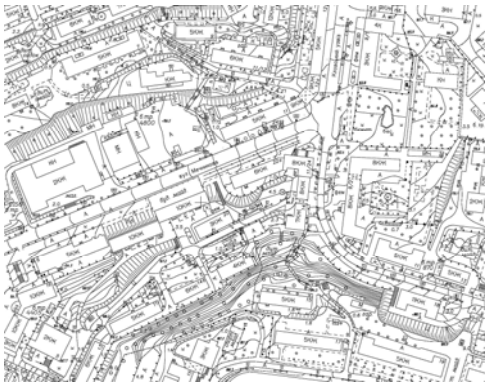

Fig. 2. An example of urban territory with dense buildings and complex geological conditions in the Pechersk district of the Kyiv city (M 1: 2000). Source: Kyiv topographic plan

Fig.3. An example of a new construction in the conditions of dense buildings and complex geological conditions in the Pechersk district of the Kyiv city (Project layout). Source: Kramall-Studio, http://kramall.com.ua

Thus, in the context of growing volumes of urban construction with a shortage of free territories, the definition of the effectiveness of city-planning solutions in pre-design studies and in variant design becomes of great importance [2].

Due to these diverse problems and the complication of factors affecting the effectiveness of the planning and spatial solution of such a city-planning object as the city center and the dynamism of its transformations, which has intensified over the past decades, it is necessary to involve many sciences in predicting these complex processes. Scientific researches, which are based on the principle of the problem aspect, become interdisciplinary. Such an approach corresponds to a fundamental shift in science, because in place of monodisciplinary knowledge (the essence is hidden in the subject) came a problem-interdisciplinary approach (the essence is in ties and relations). The questions of ties and relations formulate strategic questions of forecasting of city planning both horizontally - planning-composite, spatial, infrastructure and network, and on a vertical - legislative, planning-regulating, cadastral, etc. Hence is deduced one of the main task of urban engineering – the formation of high-quality environment for the vital activity of the population in conditions of sustainable cities development.

## 3. RESEARCH METHODOLOGY

The modern city usually develops on the basis of the old, historically formed city, and city planners face complex tasks combining old and new, and significant difficulties arise in a historically developed city when it becomes a major industrial, administrative and cultural center.

Reconstruction design in the formed architectural-historical environment conditions has its own features. Usually, in addition to the stratification of society, in the last decade the pace of stratification of urban areas has become more evident - so-called "prestigious" and "non-prestigious" urban districts have emerged. This process depends on certain

conditions due to the unique historical events and conditions of country developing, and has a heterogeneous cyclical character, which is connected with the political, ideological and socio-economic changes that have taken place in recent years.

Significant population growth in cities and expanding the range of needs makes construct new buildings, mainly in the city center, and carry out the reconstruction of urban areas with dense buildings as entire architectural and historical formations.

Reconstruction of urban areas is based on the analysis of different planning regions formation in the large cities structure in accordance with territorial-planning development, changes in the territories functional saturation, the socio-spatial city structure. Under changing the socio-economic conditions during the entire city development history, based on a detailed analysis of the urban development situation it is necessary to consider numerous tasks of planning areas development, taking into account historical trends at different stages of the city evolution [8].

The rapid growth of the population of large cities raises the problem of the territories choice for new housing construction, as a rule, by planning and carrying out new construction in the central areas with dense buildings and difficult geological conditions. It is largely due to the use of restricted sites, the violation of sustainable balance of the system of "basis – constructions", and, therefore, greatly affects the surrounding building.

In this situation, the scientific and technical substantiation of urban redevelopment as the main stage of the process of modern city territorial development. Also, the efficiency and degree of implementation of city-building decisions is substantially increased on the basis of creation and development of effective methods for calculation and analysis of urban construction objects. In addition, the importance of a scientific research complex as the basis of designing and planning works to improve the decisions quality and validity, the use effectiveness of limited resources in urban development. [9].

Proposed principles should be reflected in schemes and projects of regional planning, master plans, detailed planning projects as the main documents defining and solving complex territorial planning problems, with mandatory requirements for scientific and technical analysis of the possibilities of urban areas reconstruction on the basis of creation and development of effective calculation and research methods. Consequently, the formation of principles for sustainable city development should take into account all aspects of the balanced development of large metropolises and all the main components of its elements. Afterwards, it has been reflected in the state urban planning doctrine on the basis of objective materials, scientific and technical substantiation and engineering support. Then it should become the basis for development of effective city-planning policy, perspective programs and master plans.

Thus, a balanced approach to the solution of city-planning problems with an appropriate urban development policy for the free inland areas building should be developed, which is one of the most important and promising tasks that will not only improve the structure of urban land use, but also functionally and town-planning the existing construction [11]. The principles of reconstruction is to take into account the full range of related and interconnected factors, while simultaneously solving architectural urban-building problems and scientific technical problems. Prioritization of one of the sectors will inevitably lead to a disturbance of sustainable balance within the other, which in turn will negatively affect the state and development prospects of the city.

At the present time, the sequence of urban regulation procedures, which are necessary for the construction of the concept and the reconstruction process of the open spaces of the residential area, is as follows. According to the findings of the data, on the basis of the collection of initial information and pre-design analysis, a technical task is performed. Further, the concept of development of open spaces of a particular region is developed, with maximum consideration of interests and requirements of different parties in the development of the formed territories due to the open spaces reconstruction. As

a result of a comprehensive analysis, the choice of the final solution to the architectural and planning transformations of the residential area open spaces. Further, the city or district administration forms the task of designing, taking into account the limited funds of the municipal budget and the need to attract investors' funds.

Thus, in this article, the following methodology for developing the principles of reconstruction planning of urban areas with dense building and complex geological conditions has been proposed on the basis of scientific and technical substantiation.

The strategic goal of large city development in the long-term perspective, defined by the General Plan of City Development for the long period, is the creation of a high-quality environment for the population on the basis of the city's sustainable development in the new socio-economic conditions and ensuring the city's functions fulfillment. Accordingly, within the framework of the urban environment reconstruction regulation, a balanced approach to the urban problems solution with an appropriate development policy for the free intra-quarter territories is being developed, which is one of the most important and perspective tasks that will not only improve the structure of urban land use, but also functionally organize the existing building. This entails the development of new and improved existing regulatory and methodical documents of the construction industry in general, and architectural and urban development activities in particular, which regulate the issues of standardization and regulation in civil and urban engineering.

The analysis of historical, social and economical preconditions for the urban areas transformation provides grounds for the conclusion that the reconstruction of the quarter should be aimed at solving the most important social urban planning tasks – increasing the housing stock, improving sanitary and hygienic living conditions, creating a complete system of rest, modernization of the preserved residential fund, construction or placement of new service facilities, etc. It ensures the most effective use of valuable urban areas.

The results of architectural planning, engineering geodetic and engineering geological surveys are a number of possible places for planning, designing and conducting reconstruction of urban areas. Within this framework, the architectural and planning composition of the city, reflected in the master plan, is the basis for the volume-spatial solutions for the city as a whole and for its individual parts. Improving the aesthetic qualities of urban development, the creation of new architecturally distinct ensembles, the achievement of the architectural unity of the city – the most important creative tasks that arise during the city reconstruction.

An indispensable condition for the city reconstruction is measures for the protection of the surrounding urban landscape, features of which should be taken into account in the reconstruction of the city districts, so the organization of architectural ensembles of the urban territory should be based on the characteristics of the area. For example, in cities with cross-country terrain, elevation points are used, from which beautiful landscapes are opened and where the most significant and interesting in the architectural sense of societies, buildings, visible from everywhere are located. The difficult relief features should be taken into account when building existing areas with complex relief conditions to achieve architectural expressiveness, which allows uniting the diversity of existing and new developments into a single whole.

According to modern approaches, the study of the urban development situation is carried out in the following directions: the current state of the urban environment and the urban engineering of the central territories use. It defines the territory value, and includes: historical and urban analysis; analysis of functional zoning; characteristic of the state of the building fund; analysis of the territories using intensity. Economic characteristic determines the territory rental value: the differentiation of the value based on the monetary valuation of settlements; relative cost of the territory, differentiation of territory by market indicators of the land cost; territorial analysis of investing in housing and public construction in cities. As a result of the analysis, the features and problems of territories, the de-

pendence of the territory rental value on the characteristics of the urban environment are revealed.

To determine the possible scale of reconstruction, it is necessary to conduct a comprehensive study of the new construction impact on the bases state of adjacent existing buildings, which requires the solution of complex scientific problems related to the methods of continuous mechanics in the general approach on the basis of the proposed scientific-technical justification methodology for the urban areas reconstruction. The solution of this complex problem with reliable analysis is related to studies of the combined space, namely, the interaction of solid deformed bodies with soil masses, on the basis of the nonlinear theory of elasticity and plasticity laws, nonlinear soil mechanics, with the effective variational numerical methods.

The processes of urban areas reconstruction in conditions of dense building are related to the installation of deep foundation pits and the in-depth structures, one of the main issues of impact on existing adjacent construction is to ensure its conservation and normal exploitation.

Design and construction of buildings and structures in areas with dense urban construction and complex engineering and geological conditions is associated with the need to solve complex geotechnical problems, in order to ensure normal operation conditions of newly erected and existing buildings and structures, and to prevent emergency situations. In the case of a complex engineering-geological situation, the development of appropriate measures to strengthen soil bases and protect the territories is necessary. It is also necessary to further develop normative documentation that regulates the implementation of the main technological processes of construction and installation work and takes into account the current situation of construction in a dense urban building, its impact on existing building nearby, which would include a special section on scientific substantiation and scientific and technical support for carrying out reconstruction.

The whole complex of these measures during the performance of work in the reconstruction process of territories with dense urban buildings and complex engineering geological conditions should be included in the development of projects and schemes of district planning with the justification of the appropriate reconstruction scale [6, 7].

## 4. THE COURSE OF THE RESEARCH PROCESS

Studies on the working out the principles of urban areas reconstruction have been held considering the comprehensive analysis of the factors of influence on the surrounding building. Engineering preparation is associated with a significant violation of the soil bases of the territory with dense building, as a rule, by the arrangement of deep excavations. It requires both the solution of complex engineering problems and the conduct of appropriate scientific research, the results of which are the values of strains and deformations of soil bases, structures for deepening pits, and, as a consequence, deformations of surrounding buildings and structures [3].

The various engineering and geological conditions of the territories have been analyzed and their influence on the reconstruction design decisions of the areas with dense urban construction leads to conclusions about the need to apply various special measures to strengthen and protect the territories. The methodological prerequisites for the development of theories and methods for risks assessing of urban areas transformation have been analyzed, in particular the impact of engineering preparation on buildings and structures nearby. The consideration of groundwater filtration were investigated, geotechnical measures of soil bases strengthening were considered, engineering methods for assessing the soil bases stability and structures bearing capacity during soil masses consolidation. Also methods of research and application of geotechnical measures for strengthening soil bases during engineering preparation of territories have been considered, that

made it possible to identify factors of influence on the stressed-deformed state of the fence of pits and bases and foundations of adjacent building.

Along with this, it is necessary to take into account the processes of filtration and changes in ground water levels in the built-up areas, and studies of the corresponding changes in soil properties due to man-caused impacts introduced in the developed methodology and allows more accurately determine the stress-strain state of the soil bases of the territory and the need for appropriate anti-filtering measures.

The volume of necessary research and methods for optimal strengthening of soil masses in the limited construction conditions depends on the scale of geotechnical measures to strengthen soil bases during the territories engineering preparation, considering the complex engineering-geological conditions and features. Thereby, the scientific substantiation and scientific-technical support for the reconstruction has been proposed, followed by the implementation of a special measures complex to strengthen the soil masses, that allows to preserve the historical development of cities, and it is profitable to use intra-quarter space (Fig. 4).

Fig.4. An example of the deep excavation for the new construction in the conditions of dense buildings and complex geological conditions in the Pechersk district of the Kyiv city. Source: the author's photo

An analysis of the modern experience in the urban areas reconstruction leads to the need to build a integral system of interactions between scientific (research) and engineering (project) approaches, which is based on integrated approaches and require its integral scientific justification. Hence formulation the task of scientific directions integration follows for solving modern problems of the urban environment reconstruction. On such integration basis the methodology has been created for study the situation parameters for scientific substantiation of planning, design, technical implementation of all reconstruction stages.

This methodology differs significantly from the existing approaches to the integration of sciences, from the deformed solids mechanics, soil mechanics, structural mechanics, with

the involvement of bases and foundations designing, building structures, buildings and structures, ending with the theory of urban planning; using the means of solving the multidisciplinary problem of different approaches to research and project activity as an object, and means for managing the development of the urban environment as an object.

Thus it is established that the analysis of these systems can be carried out only by means of numerical modelling, which require the creation of a special mathematical apparatus, considering the complexity of the corresponding problems solution, and first of all in the adoption of a substantiated physical and mathematical model. Such approach describes most accurately the nonlinear processes of environment material deformation, including the soil material, as well as in the choice of calculation schemes and the implementation of special calculation algorithms that ensure the calculation results reliability.

In the course of the urban reconstruction due to the new construction impact, the existing buildings foundations are unevenly settled, in the bearing structures there is damage, and the house in general comes to an emergency state (Fig. 5). In order to ensure the integrity of the territory and the surrounding building on it, a full range of relevant studies and calculations should be performed, with a comprehensive analysis of the stress-deformed state of soil bases, fencing reinforcement structures, and elements of buildings located in the zone of the deep foundation influence. Henceforth, it is necessary to develop appropriate recommendations for preventing or rectifying emergencies, carrying out new construction, and ensuring the further safe operation of the new facility and surrounding buildings.

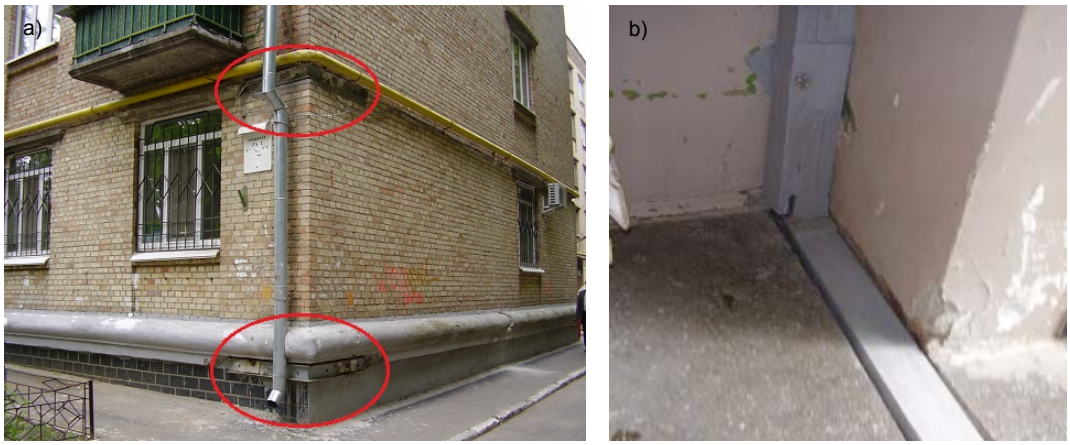


Fig.5. An example of emergency state of the existing building due to the nearby new construcSion influence, and external (a) and internal (b) measures to strengthen it. Source: the author's photo

The study of the bearing capacity assessment of the system "fencing structures – soil bases – surrounding construction" to ensure the strength and stability of this combined environment can be carried out only on the basis of an improved mathematical model of soil behavior, taking into account its heterogeneous structure, cavities and rigid inclusions, and using nonlinear theories and methods for calculating the bases when determining stresses and deformations. Such researches are carried out on the basis of engineering geological surveys data, which consists soils physical-mechanical characteristics, as well as the characteristics of buildings or structures located in zone of the new construction influence, and the results of calculations are conclusions about the stability of the soil massif, artificial structures of consolidation and the total stress-deformed state of all combined half-space.

The reliability of the methodology is proved by the results of numerical solutions by conducting experimental research of the nature interaction of the system "new construction – protective structures – existing construction", during the reconstruction of urban areas with dense constructions and complex geology on examples of real objects of the Kyiv city. The results of the conducted researches allow to assert that despite the stiffness and durability of buildings structures located in the zone of deep pits influence, uneven deformations of the foundation and enclosure constructions of the pit significantly affect the unevenness of deformations of buildings and violate the normal and safe nature of its operation. It was also found that instead of the strained-deformed state of the soil basis of existing construction, not only the construction of a deep foundation in the process of construction affects, but also affects the full weight of the new building upon completion of construction. Thus, a certain change in the stress-strain state of the bases is a criterion for the impact of adjacent construction in the urban zone on the state of basis and foundations of adjacent buildings, its preservation and ensuring safe operation.

For the research of real objects for reconstruction engineering preparation the urban areas with dense constructions and complex geological conditions, the most typical examples of the territory transformation by means of new construction in the Kyiv city have been selected (Fig. 6).

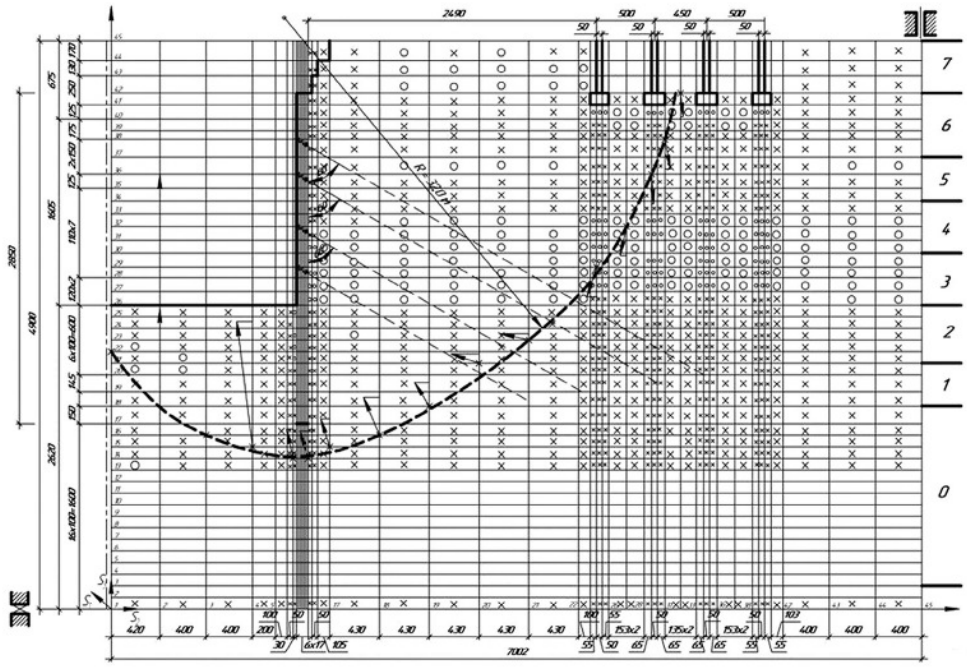


Fig.6. A design scheme for investigating the interaction of new construction and existing buildings in dense housing and complex geology conditions. Source: the author's scheme

In these examples on the basis of the developed theory and methodology, the impact processes modeling has been performed associated with new construction during the reconstruction of the existing infrastructure, namely:

– A comprehensive analysis of the reconstructed urban district characteristics, the territory and the construction site;
– An analysis of the initial data, justification the choice of research and calculation option

and methods, as well as the arrangement of reinforcement structures;
– An analysis of all possible consequences of the new construction impact on surrounding existing buildings, which, for old buildings and architectural monuments with low-strength walls, can lead to destruction;
– Forecasting of filtration processes in the influence zones of deep foundation pits, which leads to increase of filtration gradients values to critical ones and causes the phenomena of suffusion or soil erosion in the foundation basis;
– An analysis of the strained-deformed state of protective fencing structures for a deep excavation strengthening, in order to protect from the destruction of nearby buildings;
– Specification the calculations of soil massifs strengthening structures as bases of adjacent building;
– Study of the stress-deformed state (SDS) of the combined half-space;
– Comparison of the research results of the combined half-space state with the results of a full-scale experiment on the displacement of engineering preparation constructions;
– An analysis of obtained results of the combined half-space SDS research;
– Prediction of the engineering preparation consequences and the reconstruction of urban areas with dense building and complex geology;
– Elaboration of conclusions and recommendations for the reconstruction of the city territory to prevent the impact on dense surrounding building.

The conducted researches allow to assert that despite the stiffness and durability of buildings structures located in the of deep pits influence zone, uneven deformations of the foundation and enclosure structures of the pit significantly affect the unevenness of deformations of buildings and violate the normal and safe nature of their exploitation.

The results of research on the engineering preparation impact on the urban territory indicate that prediction of the new construction impact on existing buildings and structures can not be standardized and depends on many factors:
– Qualitative and comprehensive physical and mechanical characteristics of the soil half-space of a concrete construction site;
– Geometry of the placement of new buildings and existing structures, and also loads from them;
– The size and depth of the excavation pits and the volume of excavation work.

On the basis of the obtained results of numerical investigations, it has been established following:
– Numerical realization of correlations and algorithms of nonlinear deformation allows to solve the design problems of enclosing structures for soil massifs strengthening that protect territories and existing buildings from the new (especially high-rise) buildings and structures influence;
– Solving the problem of in-depth reinforcement structures stability on the proposed methodology basis provides the problem solution of the new construction impact on existing buildings and structures, that allows to formulate recommendations for the design of protective structures with a limited number of optimal design parameters;
– The developed methodology and its numerical implementation provides a more precise calculation of the strength and stability of the enclosing structures elements of deep foundation pits, retaining pits, screens and their combinations in conditions of change of active and passive soils pressure, and other structures used in urban engineering, in determining the elements stability in conditions of boundary deformations development;
– As a result of the developed methodology application during the research of real objects, measures and parameters of optimal design have been proposed that correspond the regulatory requirements for strength, stability and deformability of the enclosing strengthening structures, in order to ensure the urban territory stability and the

normal exploitation of the surrounding existing buildings;
– The application of the developed methodology allows to make decisions about optimal scales of new construction in densely built areas during its reconstruction, and to develop recommendations for the long-term planning of the urban areas transformation with dense building and complex geological conditions.

There is no definite solution for the considered problems of the influence of territories engineering preparation, especially by planning reconstruction in dense building and complex geology conditions, therefore, it is necessary to carry out scientific and technical support of each specific case of design and construction in the specified conditions. The methodology for bases stability modeling and complex conditions impact assessing on the existing buildings stress-strain state during the urban facilities reconstruction provides a precise calculation of the fencing strengthening structures elements by evolution technologies implementation of external influence on the soil space, and also in the development of boundary deformations conditions.

The reconstruction process of territories with dense buildings is associated with preservation the unchanging existing strained-deformed state of the bases under them. In these conditions, engineering protective structures and constructing technologies has a great importance, that would ensure the minimum changes in the bases stability. Calculations of the strengthening structures, namely protective screens, diaphragms, retaining walls of different configurations, walls in the ground, solid and combined with drilling piles with a depth of 40 m or more, should be conducted considering the nonlinear behavior of soils, especially on the stage of deep pit arrangements. Taking into account heterogeneous inclusions with different physical and mechanical characteristics in soil bases, and establishing dependencies on the deformed state definition of existing construction and other objects of the municipal property on these data basis, and obtain the dependence of the inhomogeneous ground base influence on the stressed-deformed state of the municipal objects during quarterly territories reconstruction.

## 5. RESULTS AND CONCLUSIONS

The results of the performed researches suggest that despite the stiffness and durability of the buildings structures located in the deep pits influence zone, uneven deformations of the foundation and strengthening structures significantly affect the unevenness of buildings deformations, and violate the normal and safe nature of their exploitation. Ensuring a reliable and economical solution to the territories engineering preparation problems is possible only on the basis of the interaction analysis of the systems "existing construction – protective structures – deep foundation pits", and different combinations of interaction between existing and newly designed buildings.

In the process of urban areas reconstruction through new constructioning in a dense building, in particular, the extensive use of underground space in complex engineering and geological conditions, there is an intensification the additional processes in the soil bases and existing buildings foundations. The need to predict the effects of this activation has become a topical issue not only in the design and construction, as well as in the perspective planning of urban development. Such problems are simultaneously related to such scientific areas as nonlinear mechanics, structural mechanics of combined structures, engineering geology, deep foundations analysis, calculation of soil strengthening structures. Especially important is studying the behavior of existing buildings constructions and structures in changed conditions.

In order to solve such problems of scientific and technical substantiation of the urban areas reconstruction decisions in the above-mentioned conditions, it is necessary to combine these sciences in the construction industry within the framework of the new principles formulation. It should be considered the boundary condition of the various stages of inhomogeneous materials and continuous environment.

Optimization of city-planning decisions on urban areas engineering preparation is carried out on the basis of multi-factor estimation of decisions considering the principles of construction production technology and organization, and also technical-economic and socio-economic substantiation. Within the framework of technology and organization of reconstruction realization, decisions on design, construction, reconstruction, considering the exploitation conditions of buildings, structures and complexes, shall be taken into account, and appropriate technologies and assembly processes related to the construction, reconstruction, restoration, repair of buildings, structures and complexes, in particular in special conditions. The socio-economic efficiency of the integrated solution the implementation issues of project proposals for the open spaces reconstruction can be justified by the multifunctional system of investment and construction real estate projects management.

The next step is to formulate and approve the recommendations for planning, designing and providing urban reconstruction, taking into account multivariate assessment of city-planning decisions at different phases and stages of concrete objects reconstruction, the general concept of planning and designing of urban areas with dense buildings and complex geological conditions.

Thus, in the reconstruction of urban areas with dense buildings and complex geological conditions, final decision-making should be based on the results of the necessary implementation stages, taking into account all the above-mentioned factors. Further it is necessary to develop appropriate design and technological documentation for the execution of construction and installation works and monitoring of the object, adjacent building and territory. Herewith, it is required the carriyng scientific and technical support for the solution of city-planning, architectural, constructional, technical and technological problems. It has allowed to conduct safely all reconstruction processes of the city territory with a view to its preservation and protection.

Subsequently, on the basis of developed reconstruction principles of the urban territory in dense building and complex geology conditions can be solved the problem of urban areas zoning. It has allowed to plan and conduct the transformation and prediction of consequences depending on the geotechnical properties of the site, the characteristics of existing buildings and new construction options. It is also necessary to consider the degree of risk-based criteria for assessing the possible effects of the reconstruction and the extent of the required engineering preparation. This principles of urban territory reconstruction has become the basis of strategic planning transformations of urban areas in order to ensure sustainability of their operations and the use of rational, given the conservation and development of the building.

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