

## AIRPORTS AND THEIR INFRASTRUCTURE

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### THE METHODOLOGY FOR THE CONSEQUENCES PREDICTION OF ENGINEERING PREPARATION FOR TRANSFORMATION THE URBAN TERRITORY IN DENSE BUILDING AND COMPLEX GEOLOGY CONDITIONS

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**Abstract.** *The methodology for scientific substantiation of engineering preparation measures for urban areas transformation and predict their possible effects has been developed on the basis of the analysis of stressed state numerous studies and estimation of the foundations stability on the generalized parameters for the design, that allowed to build the urban areas reconstruction principles in dense building and complex geology conditions, and make appropriate recommendations to determine the impact and extent of rehabilitation engineering preparation necessary for protection areas and preservation of existing buildings.*

**Keywords:** urban territory transformation, engineering preparation, consequences prediction.

#### 1. Introduction

The current territorial planning development of major cities is impossible without reconstruction and transformation of urban areas, especially with the existing dense historic building and complex engineering geological conditions. This exceptional value gains the theory and methodology development for scientific and technical substantiation, based on certain research methods and calculations integration, and generalized methods and general principles creation for engineering preparation of urban areas transformation, the extent of the necessary excavation and bases reinforcement, forecasting the effects of new construction on existing buildings; creation a system of risk assessment criteria and principles of zoning of urban areas as the basis for decision-making on urban design and planning stage works, and the formation of sustainable urban development for the efficient use of limited resources, efficient development of urban areas while preserving existing infrastructure.

Reconstruction of urban areas, especially in the dense building, which also has great historical and cultural value requires the scientific substantiations at the stage of the adoption of fundamental decisions on the character and feasibility of reconstructive measures, as well as improved methods of predicting the effects of certain buildings and construction technologies [1].

#### 2. Statement of the problem

For each such case, it is necessary to research and to forecast the effects of the urban area transformation on the stability of the system "new construction – basis of territory – surrounding buildings". Thereby, the relevant concept is to develop risk assessment of urban areas transformation, taking into account the urban territory characteristics, existing buildings structure and condition, new construction options and the introduction of risk factors of transformation and predict the consequences of the mutual influence of engineering-geological situation, surrounding buildings and planned construction, which has become the basis for reconstruction strategic planning in order to ensure the stability its efficient operation and use due to conservation and development area.

During the urban areas reconstruction with dense areas and difficult geological conditions there are certain difficulties maintaining constancy of the urban area existing state, which is associated with the problems of engineering preparation for new construction by deep excavation arrangement, the soil mass strengthening structures, on the stress-strain state of basements, foundations and structures adjacent area, that requires a comprehensive and thorough researches of the combined half-space considering its engineering and geological structures, cavities and rigid inclusions.

In Ukraine over the last decade have been established new terms of land use and development

of the urban area, there is reforming regions in planning the structure of large cities going with the transformation of further territorial and development planning, and foremost the modernization of housing stock in the current building.

It is connected with the problem of selecting sites for new housing, usually in the central areas with the dense buildings and complex engineering-geological conditions, which to a large extent dependent on the use of limited areas, the equilibrium constant violation of the "territory – building" .

In this situation the exceptional importance gets creating a new concept of urban areas zoning for transformation planning and execution and forecast based on geotechnical properties of territory characteristics, existing buildings parameters, and new construction options, considering the degree of risk-based criteria for assessing the possible effects reconstruction and extent of the required engineering preparation.

This concept of zoning has become the basis of strategic planning transformations of urban areas in order to ensure their sustainable and efficient operation, for its preserving and developing.

The principles of zoning must consider the impacts within the "territory – buildings – construction" to predict its effects on pre-design stages to produce approaches to strategic planning and reconstruction of residential groups and evaluation of territorial-building resources in order to increase the housing stock.

Formation of sustainable urban development should consider all aspects of sustainable development big cities and all major constituent elements and displays in the state urban doctrine, based on objective materials and scientific and technical substantiation and engineering support, which should be the basis for the development of effective urban policy, promising programs and general plans.

Thus, to be developed balanced approach to solving urban problems with the urban policy relevant area of free intradistrict territory, which is one of the most important and perspective challenges that will improve the structure of urban land use, and organize functionally the existing building.

### **3. Analysis of the latest research**

Despite the large number of works in many areas, using of any single theory or methodology does not allow to explore all aspects of engineering preparation,

the full range of factors influence the reconstruction of existing urban areas typically associated with the construction of new facilities, the processes of soil deformation in the adjacent foundations in dense buildings and difficult geological conditions have been insufficiently studied.

It requires the development and improvement of special theoretical, design and planning decisions due to the scientific substantiation the reconstruction, development the effective methods of mathematical modeling and research of engineering preparation, that most closely allowing for the specificity interactions with the soil half-space structures, scientific and technical analysis of the possible the amount of reconstruction, and the creation of relevant concepts considering the impact of urban transformation, predict its consequences, and the principles of zoning the urban area, which generally determine the priorities in the current issue of urban engineering and territory planning [2].

*The purpose of the work* is to develop a methodology for predicting the consequences of the urban areas transformation with dense buildings and complex geology for the urban territory zoning depending on the risk exposure and further substantiation of decision-making on the reconstruction of urban facilities, urban planning and design principles for preserving of historic buildings, engineering protection of urban areas, safe and efficient development of built-up areas and their rational planning in modern social and economic conditions.

### **4. The concept methodology for the consequences prediction of engineering preparation for the urban areas transformation**

It is associated with prerequisites of transformation and reconstruction of districts, which should be directed at solving critical challenges of modern urban planning – the housing stock increasing, while ensuring the most efficient use of urban areas. Solving these problems is possible by increasing housing districts territory in the old buildings demolition, and additional new construction.

Historical, social, economic and environmental prerequisites, architectural and urban planning aspects of transformation and reconstruction districts have led to draw conclusions on the need for an integrated approach to the reconstructive measures to improve the functional and architectural planning of residential development at the level of districts, ensuring the most efficient use of urban areas by

increasing residential districts territory by additional new construction, as well as methods and assess the impact of new construction in the territory for intra existing building [3].

The development of large cities in modern conditions involves the rational use of local resources through new construction on intra-quarter free areas with dense housing, which is one of the most important and perspective challenges of forming the concept of development. A balanced approach to solving the urban planning transformation problems of central urban areas with the historical buildings entails the use of problem-based interdisciplinary approach to the analysis of various factors (historical and urban planning, functional zoning, building fund performance, usage areas etc.), involving many sciences to prediction of complex processes that accompany reconstruction engineering training areas in the face of rising volumes of urban development with a deficit-free areas will increase the efficiency of urban planning decisions with predesign researches and in variant design.

Within the concept of urban reconstruction counted full set of interrelated and interdependent factors and simultaneously solve territorial and technical problems. Giving priority to one of the areas will inevitably lead to a breach of a sustainable balance within another, and it affects on the state and perspectives of the urban development.

The current normative regulation of the urban environment reconstruction in a dense housing problems associated with creating the legal framework for regulating the ratio between and new construction, and rationing in the existing historic environment as fixing issues remain unresolved need for a comprehensive analysis of the possibility of new construction in the territories with the existing building, its effects on surrounding buildings and structures, in order to prevent accidents and the necessary scientific and technical support to the whole process of research, design, construction and subsequent operation of new and existing facilities in the urban environment reconstruction.

At present, the sequence of procedures urban regulations that are needed to build the concept and realization of the process of reconstruction of open space residential district is the following. As a result of the data identified based on the initial information gathering and analysis is carried out the preproject requirements specification. Then it is developed the concept of open space specific area, with the maximum regard the interests and requirements of

different sides in the development of existing formed areas due to its reconstruction. As a result of a comprehensive analysis it is performed the final decision selection on the architectural–planning transformation of the open space residential district. Further the city or county administration forms design task, considering the limited funds of the municipal budget and the need to raise investors funds.

Overall, the reconstruction of the urban area is related to the solution of a number of separate narrow specialization of researches on engineering problems forming area, which currently have significant branching theoretical developments, and the proposed methodology are interrelated and comprehensively to determine the state of a complex combined environment consisting of ground bases and foundations of buildings and structures, and the problem of stability analysis sections of the urban area during its engineering preparation, risk assessment and forecast of reconstruction areas.

The methodology for the consequences prediction of engineering preparation for transformation the urban areas in dense building and complex geology conditions is based on a comprehensive analysis of the factors influencing engineering preparation to the surrounding building. The engineering preparation carrying associated with a significant breach of the ground base area, usually by deep excavation arrangement that in dense housing conditions necessitates a solution of complex engineering problems and conduct relevant research, that resulted stresses and strains values of soil foundations, strengthening of structures deep pits, and consequently deformation of surrounding buildings and structures.

During engineering preparation is necessary to consider the filtration processes and changes of groundwater levels in built up areas, and research relevant changes in the properties of soils due to anthropogenic influence, is implemented in methodology and can more accurately determine the stress-strain state of soil base area and the need for appropriate measures antifiltration .

The amount of the assessment and consolidation methods for optimal soil areas in limited construction conditions depends on the scale geotechnical measures to strengthen the foundations of ground during areas engineering preparation, considering complex geological conditions and characteristics, and therefore proposed the scientific basis and scientific technical support the

reconstruction, with further implementation of a special measures complex to strengthen the ground masses, thus preserving the historic building cities, and advantageous to use internal quarterly space.

The proposed methodology reconstruction of urban areas is based a complete system of interactions between scientific (research) and engineering (design) approaches, integrating research directions to address contemporary issues of the urban environment reconstruction; and research opportunities initial situation and its main parameters, the scientific basis of planning, design, technical implementation all phases of reconstruction, scientific and technical support urgent the reconstruction processes and the impacts on the building assessment.

This methodology is significantly different from existing approaches by sciences integration, including mechanics of deformable solids, soil mechanics, structural mechanics, design tools, involving bases and foundations, building structures, buildings and structures, and urban planning theory; with the use of interdisciplinary problem solving various approaches to research and development activity as the subject, and controls the development of the urban environment as an object.

During the reconstruction of urban territories through new construction in a dense housing, including large-scale use of underground space in complex geological conditions, there is additional activation processes in soil base areas and foundations of existing buildings. The need to predict the consequences of this activation has become an urgent problem, not only in design and construction, as well as long-term planning of development of urban areas. This kind of problem while connected with such scientific fields as nonlinear theory of elasticity and plasticity, nonlinear soil mechanics, structural mechanics of combined structures, engineering geology, the deep foundations analysis and design, the soil mass strengthening structures calculation, and the study of the existing structures buildings behavior in the changed conditions. To solve such problems of the scientific and technical substantiation of the urban territories reconstruction making in the above circumstances, it is necessary these sciences association of civil engineering industry within the general setting, i.e. taking into account geometrical and physical nonlinearities, subject to the boundary condition at different stages of heterogeneous materials deformation, interaction different module materials, solids of the a continuous elastic-plastic medium, etc. [4, 5].

This scientific and methodological concept of urban engineering aims to support and ensure the system of urban design and planning, providing active balance of all components of the urban environment in the local level, by setting specific targets, followed by the introduction of scientific practice planning, design, management development urban infrastructure, and the development of new relevant regulations.

The methodology for urban areas transformation scientific support is based on the stability investigations of the system "new construction – territory foundations – surround buildings", the definition of the reconstruction possibility on the urban areas characteristics, structure and condition of existing buildings, new construction parameters, and the introduction of risk factors for urban territory transformation and predict the consequences of the mutual influence of engineering-geological situation, surrounding buildings, and the planned construction.

For a comprehensive analysis of the urban setting parameters is developed the system of risk assessment and forecast of the transformation of the urban area, which is associated with scientific and technical support for the new building, the surrounding area monitoring, to provide a solution in urban engineering, architectural, structural, construction and technological problems with minimal risk of errors that are not regulated by applicable norms and standards, and without sufficient experience or direct analogues in native and international practice.

The investigation of the bearing capacity evaluation of the "building envelope – soil foundation – surrounding buildings" to ensure the strength and stability of the combined environment can be made only on the basis of improved mathematical model of soil behavior considering its heterogeneous structure, cavities and rigid inclusions, and using nonlinear theories foundations and methods of calculation to determine stresses and strains. These studies are conducted on the basis of geological surveys, which are taken from the physical and mechanical properties of soils and characteristics of buildings or structures located in the zone of new construction influence and calculation results are conclusions about the stability of the soil mass, strengthening engineering structures (fencing of pits) and total stress-strain state of the combined space.

Thus, the renovation of urban areas in dense buildings and complex engineering-geological

conditions necessary stages of its implementation is the engineering survey and inspection of the surrounding area (possibly with the use of unmanned aircraft systems fitted with remote sensing), designing objects with all the above factors relevant to the development of engineering documentation with the construction and installation works and monitoring facility adjacent buildings and areas, and required scientific and technical support for safe execution of all processes of reconstruction of the urban area with dense housing for its preservation and protection areas.

## 5. Conclusions

Based on the risk assessment researches and forecast of the urban areas transformation for a substantiation an integrated approach to urban planning reconstruction of residential development, the need for scientific and technical support to its implementation in order to preserve the surrounding buildings and structures and protection areas; design principles and implementation of these approaches in the practice of urban development. It will enable to develop urban development, and the transition from considering the construction of certain facilities to integrated planning reconstruction of microdistricts, and to the districts and areas reconstruction planning while ensuring preserving of existing buildings and its safe operation.

The recommendations can detect correlation characteristics urban engineering residential development that has arisen, and her account of spatial development in stability and bearing capacity of foundations and territorial-building resource. The concept of risk assessment and forecast of the urban areas transformation by analyzing the urban areas characteristics, existing buildings structure and condition, new construction parameters and introduction the risk factors of urban territory transformation and predict the consequences of the mutual influence of engineering-geological situation surrounding buildings and the planned construction, should be the basis for strategic planning transformations of urban areas in order to ensure the stability of their functioning and rational use due to conservation and development area.

Subsequently, on the basis of the methodology for assessment and forecast of the urban territory transformation can be solved the problem of urban areas zoning for planning and safe execution their conversion based on geotechnical properties area, characteristics of existing buildings, and new construction parameters, considering degree of risk-based criteria for assessing the possible effects of reconstruction and the extent of the required engineering preparation. This concept of zoning has become the basis of strategic planning transformations of urban territories to ensure the stability of their efficient operation and use for preserving and developing area.

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**Д. Е. Прусов. Методологія прогнозування наслідків інженерної підготовки перетворення міських територій зі щільною забудовою та складними геологічними умовами**

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Запропонована методологія наукового обґрунтування заходів з інженерної підготовки перетворення міських територій та прогнозування їх можливих наслідків, на підставі проведеного аналізу чисельних досліджень напруженого стану та оцінки стійкості основ реальних об'єктів за узагальненими параметрами проектування, що дозволило побудувати принципи проведення реконструкції міських територій зі щільною забудовою та складними геологічними умовами та надати відповідні рекомендації з визначення впливу реконструкції та масштабів необхідної інженерної підготовки з метою захисту територій та збереження існуючої забудови.

**Ключові слова:** інженерна підготовка; прогнозування наслідків; реконструкція міських районів

**Д. Э. Прусов. Методология прогнозирования последствий инженерной подготовки преобразования городских территорий с плотной застройкой и сложными геологическими условиями**

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Предложена методология научного обоснования мероприятий по инженерной подготовке преобразования городских территорий и прогнозирования их возможных последствий, на основании проведенного анализа многочисленных исследований напряженного состояния и оценки устойчивости оснований реальных объектов по обобщенным параметрам проектирования, что позволило построить принципы проведения реконструкции городских территорий с плотной застройкой и сложными геологическими условиями и предоставить соответствующие рекомендации по определению влияния реконструкции и масштабам необходимой инженерной подготовки с целью защиты территорий и сохранения существующей застройки.

**Ключевые слова:** инженерная подготовка; прогнозирование последствий; реконструкция городских районов

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