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ЭКОНОМИКА / УПРАВЛЕНИЕ

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Международный научно-технический журнал включен в Перечень рецензируемых научных изданий, в которых должны быть опубликованы основные научные результаты диссертаций на соискание ученой степени кандидата наук, на соискание ученой степени доктора наук.
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На обложке печатаются работы фотохудожника Валентина Герцмана (Нью-Йорк).

Уважаемые читатели!

Повышение социально-экономической эффективности расширенного воспроизводства исторически сложившихся городов в условиях бурного развития городских пространств — важнейший источник удовлетворения растущих материальных и духовных потребностей населения.

В этом контексте задача устойчивого городского развития заключается в синтезе ресурсных потоков и создании адекватных антропологических условий реализации национальной программы «Стратегия пространственного развития РФ» (2019 г.) на длительный период. Все звенья городского хозяйства связаны в единую сложную систему пространственно-территориального девелопмента.

Процесс пространственно-территориального девелопмента является результатом сложнейших взаимоотношений в системе «Природа–Общество–Человек», а управление реструктуризацией городской недвижимости, как совокупности материальных и нематериальных ресурсов развития, локализованных в городском пространстве и времени, обеспечивает их капитализацию.

Поиски и выбор наиболее эффективных решений — неотъемлемая и важнейшая составная часть общего процесса управления устойчивым развитием городских территорий. Такие поиски должны осуществляться в каждом звене городского обновления сложившейся застройки, и особенно на стыках звеньев, где и возникают наибольшие риски и потери от несогласованности принимаемых решений.

Они взаимодействуют как по управленческой вертикали, так и на территориальном уровне за счет реализации контрактов жизненного цикла различными организационными формами расширенного воспроизводства объектов городской недвижимости. Все связи имеют многоаспектный, многокритериальный характер: процессы реструктуризации взаимосвязаны технологически, ресурсными потребностями, экономическими, социальными и экологическими последствиями. Наконец, тесно взаимосвязаны в этой системе решения текущего, досрочного и стратегического характера. Этим и другим проблемам девелопмента городской недвижимости и путям их решения посвящен настоящий номер журнала.

Главный редактор, **Пётр Грабовый**

СОДЕРЖАНИЕ

АКЦЕНТЫ НОМЕРА

Манухина Л.А., Якубов Х.Г.
Российская Федерация только начинает выстраивать собственную систему «зеленой» сертификации с комплексным подходом к взаимосвязи ресурсосбережения, энергоэффективности, экологической безопасности и комфортных условий проживания. Внедрение стандартов «зеленого» строительства в нашей стране все еще довольно сложно. Это вызвано, прежде всего, устаревшим нормативно-техническим регулированием строительного комплекса.

Грабовый П.Г., Волков Р.В., Волгин В.В.
Умный город использует различные наборы электронных данных, а также технологически продвинутые датчики для эффективного управления своими активами и ресурсами. Хотя технологии со временем меняются, становясь все более сложными, именно возможность внедрения и их открытый, инновационный характер делают город или недвижимость «умными».

Суворова М.О., Наумов А.Е.
Мировыми трендами в строительстве являются такие направления, как декарбонизация не только существующих, но и вновь возводимых зданий, создание условий для реализации инвестиционно-строительных проектов с позиции низкоуглеродного развития, а также оценка углеродного воздействия реализуемых проектов, в том числе уже на ранних стадиях архитектурно-строительного и организационно-технологического проектирования.

5 РАЗДЕЛ — ТЕХНОЛОГИЯ И ОРГАНИЗАЦИЯ СТРОИТЕЛЬСТВА

6 РАЗДЕЛ — ОТЕЧЕСТВЕННЫЙ И ЗАРУБЕЖНЫЙ ОПЫТ

7 РАЗДЕЛ — ПРАВОВЫЕ И СОЦИАЛЬНЫЕ АСПЕКТЫ

АКЦЕНТЫ НОМЕРА

Овсянникова Т.Ю.
Существующие организационно-финансовые механизмы, основанные на региональных программах капитального ремонта общего имущества многоквартирных домов и федеральном проекте ликвидации непригодного для проживания жилья, не обеспечивают комплексной реновации жилищного фонда и развития застроенных территорий. Основными ограничениями являются неразработанность региональной нормативно-правовой базы, отсутствие региональных институтов и низкая маржинальность проектов реновации существующей жилой застройки, что делает такие проекты инвестиционно-непривлекательными для потенциальных инвесторов.

Звонов И.А., Каширина Н.В.
Методологическая основа применения данных из информационных моделей на различных этапах жизненного цикла объекта реализована в рамках комплекса стандартов Единой системы информационного моделирования, где складывается терминологическая основа для нормативно-правовой системы РФ в области информационного моделирования.

Эль-Хашем А., Федулова Н.С., Беляков С.И.
В современных условиях городской жизни, в особенности в крупных городах и мегаполисах, все большее значение приобретает принцип обеспечения экономии времени для жителей. В актуальной российской практике данный принцип получает наиболее широкое применение в обновленной концепции развития городского пространства, реализуемой ГК «Самолет», — «таймбэк».

CONTENTS

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2.1.7 Technology and organization of construction (technical sciences);
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2.1.14 Life cycle management of construction objects (technical sciences).

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SECTION 1: OFFICIAL SECTION

SECTION 2: COVER STORY

SECTION 3: PROPERTY ECONOMICS AND MANAGEMENT

SECTION 4: URBAN REGULATION AND MANAGEMENT OF HOUSING AND PUBLIC UTILITIES

SECTION 5: TECHNOLOGIES AND ORGANIZATION OF CONSTRUCTION

SECTION 6: DOMESTIC AND OVERSEAS EXPERIENCE

SECTION 7: LEGAL AND SOCIAL ASPECTS

ACCENTS

Manukhina L.A., Yakubov H.G.

The Russian Federation is just beginning to build its own system of “green” certification with an integrated approach to the relationship of resource saving, energy efficiency, environmental safety and comfortable living conditions. The introduction of green building standards in our country is still quite difficult. This is caused, first of all, by the outdated normative and technical regulation of the construction complex.

Grabovyy P.G., Volkov R.V., Volgin V.V.

A smart city uses various sets of electronic data, as well as technologically advanced sensors to effectively manage its assets and resources. Although technologies change over time, becoming more and more complex, it is the implementation option and their open, innovative nature that make a city or real estate “smart”.

Suvorova M.O., Naumov A.E.

Global trends in construction are such areas as decarbonization of not only existing, but also newly erected buildings, creation of conditions for the implementation of investment and construction projects from the perspective of low-carbon development, as well as assessment of the carbon impact of ongoing projects, including at the early stages of architectural, construction and organizational and technological design.

Ovsiannikova T.Yu.

The existing organizational and financial mechanisms based on regional capital repair programs for the common property of apartment buildings and the federal project for the elimination of uninhabitable housing do not provide comprehensive renovation of the housing stock and the development of built-up areas. The main limitations are the lack of development of the regional regulatory framework, the absence of regional institutions and the low marginality of renovation projects of existing residential buildings, which makes such projects investment-unattractive for potential investors.

Zvonov I.A., Kashirina N.V.

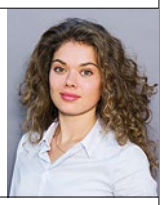
The methodological basis for the application of data from information models at various stages of the object's life cycle is implemented within the framework of a set of standards of the Unified Information Modeling System, which forms the terminological basis for the regulatory legal system of the Russian Federation in the field of information modeling.

UDC 721:502.1

Suvorova M.O.
Naumov A.E.

Scientific and theoretical approaches to complex assessment of building life cycle from a low–carbon development perspective

Construction activity is carried out in close interaction with the environment, which has always focused the attention of researchers on ecological safety of construction objects, including low-carbon development and reducing resource intensity and energy consumption at all stages of the building life cycle. The global trends in construction are such areas as decarburization of not only existing but also newly constructed buildings, creating conditions for the implementation of investment and construction projects from a low-carbon development perspective, as well as assessing the carbon impact of implemented projects, including at the early stages of architectural and technological design. The World Green Building Council identifies the carbon impact at early stages as "upfront carbon", which is becoming increasingly important in a complex life cycle assessment in buildings by low-carbon criterion. The article presents scientific and theoretical approaches to a comprehensive life cycle assessment in buildings from a low-carbon development perspective. The authors have identified the factors allowing to estimate the future building project from the position of low-carbon applied design solutions, suggested a multilayer factor space of the considered indicators (building resources) of carbon impact, proposed a minimization indicator of the building carbon impact, which enables to estimate comprehensively the influence of all factors and indirectly characterize the degree of carbon impact at the life cycle stages, preceding the building operation.
Keywords: *building life cycle, low-carbon construction, carbon footprint of buildings, whole building life cycle assessment from a low-carbon development perspective*



Suvorova Maria Olegovna,
Senior Lecturer of the Department of Expertise and Property Management; Belgorod State Technological University named after V.G. Shukhov (BSTU named after V.G. Shukhov); 46 Kostyukova St., Belgorod, 308012, Russian Federation; ID RSCI: 811292, Scopus: 57196246833, ResearcherID: AAC-4403-2019, ORCID: 0000-0001-7423-6866; marykrutilova@gmail.com

Naumov Andrey Evgenyevich,
Candidate of Technical Sciences, Assistant Professor, Head of the Department of the Department of Expertise and Property Management; Belgorod State Technological University named after V.G. Shukhov (BSTU named after V.G. Shukhov); 46 Kostyukova St., Belgorod, 308012, Russian Federation; ID RSCI: 683551, Scopus: 56448117200, ResearcherID: K-1704-2018, ORCID: 0000-0002-8162-1946; andrena@mail.ru

INTRODUCTION

Adaptation to the effects of climate change and air pollution control is a priority for the Russian economy as a whole, including the construction industry. Intensive construction growth and increased attention to the global climate change makes the reduction of greenhouse gas emissions (GHG) from mass construction an urgent and promising area of research. GHG emissions occur at all stages of a building's life cycle [1]. Currently, according to the researches, about 70–80 % of the building carbon impact is associated with the operational phase, the rest, the so-called "embodied" indirect impact is associated primarily with the construction materials production, transportation to the construction site and construction operations [2]. The World Green Building Council identifies the carbon impact, reduced to GHG emissions, in the pre-operational stages as "upfront carbon" (preliminary GHG emissions), which is becoming increasingly important in a complex life cycle assessment of buildings by low-carbon development perspective.

The issue of the need in regulating GHG emissions against the background of climate change is considered at the state level in the Russian Federation in the framework of the "Environmental Safety Strategy of the Russian Federation until 2025", approved by Presidential Decree No. 176 of April 19, 2017. Since December 30, 2021, the Federal Law of July 2, 2021 No. 296-FZ "On limiting greenhouse gas emissions" came into force, forming a system for managing greenhouse gas emissions. The law introduces the required conceptual framework (greenhouse gases, carbon footprint, climate projects, carbon units, regulated organizations, etc.) and forms the legal basis for the implementation of climate projects, including the construction industry, and the circulation of carbon units. The Russian Government Decree No. 3052-r of October 29, 2021 approved the Russian strategy of socio-economic development with low GHG emissions until 2050. The strategy aims to ensure Russia's transition to the trajectory of diversified economic development characterized by low greenhouse gas emissions and strengthening the national goal of reducing emissions, the launch of economic incentives for companies. In addition, the Government of the Russian Federation by its Order No. 3268-r dated October 31, 2022 approved the Development Strategy of the construction industry and housing services for the period up to 2030 and the forecast until 2035, where the climate agenda has a special place.

The analysis of the regulatory framework in order to improve the environmental safety of construction projects from the position of low-carbon development has shown that despite the global trend to reduce GHG emissions, the Russian regulatory framework and green building standards in the current edition do not sufficiently regulate the environmental condition of human habitat to reduce the carbon impact of buildings and the fight against global warming [3, 4]. The key practical drawback of the current situation is the underdevelopment of state policy at the federal and regional levels and used in practice science-based methods and algorithms for complex decarburization of construction and market incentives for low-carbon construction[1].

1 Prognosis of long-term socio-economic development until 2030. URL: http://www.consultant.ru/document/cons_doc_LAW_144190/

The MAIN PART

Based on a critical review of Russian and international theoretical and experimental researches and in order to minimize the indirect carbon impact of buildings, factors for assessing the future building design by low-carbon criterion are identified. To quantify the indirect carbon footprint of the building, analyze and systematize the various carbon footprint factors, a multi-layered factor space of considered indicators (building resources such as building materials, construction machinery, including vehicles) of indirect carbon footprint has been proposed.

The multi-layered factor space is shown in Fig. 1. On the top layer of the factor space is combined into clouds, grouping indicators of carbon impact by their purpose and the origin of indirect GHG emissions [5, 6]. The authors proposed to identify the *l*-th number of *i*-factors, among which production F_{1jk}, organizational F_{2jk}, logistical F_{3jk} have the most value.

The production factor includes energy consumption and, as a consequence, GHG emissions arising during the life cycle of construction materials (as a result of extraction and processing of raw materials, production of materials, etc.) [7]. The organizational factor includes energy inputs and, as a consequence, GHG emissions arising in the process of construction production from the operation of construction machinery and equipment [8]. The logistic factor includes energy inputs and, as a result, GHG emissions in the process of transportation of construction resources and their delivery to the on-site warehouse of the construction facility [9]. Factors F_{ijk}, formed on the central base layer from the groups of sources of indirect carbon impact of the building, consist of *j*-factor vectors that determine the list of building resources to assess their indirect carbon impact. Consequently, for the production factor F_{1jk} the number of analyzed construction resources depends on the building design solutions and may include the *m*-th number of *j*-factor vectors (F_{11k}...F_{1mk}). For the organizational factor F_{2jk} the number of analyzed vectors depends on the need for construction machinery and mechanisms, which are analyzed by type of fuel and their energy consumption. For the logistics factor F_{3jk} the number of analyzed indicators depends on the range of transportation of construction cargoes determined by cost-effective routes using information on the preferred modes of transport.

A subset of *k*-factor nodes by *j*-vectors determines the specific technological characteristics of the production of building materials, transportation, obtained from manufacturers or suppliers. The identified multi-layered factor space formed the basis of multi-criteria analysis of the indirect carbon impact of buildings [10].

The requirement for the building environmental safety on its carbon footprint is reduced to solve the optimization problem:

$$CI = \gamma_i \sum_{i=1}^{l} \gamma_j \sum_{j=1}^{m} \gamma_k \sum_{k=1}^{n} F_{ijk} \rightarrow \min, \quad (1)$$

where CI — a comprehensive indicator of reducing the carbon footprint of construction projects;

γ_i — specific weight of the *i*-th factor;

γ_j — specific weight of the *j*-th vector;

γ_k — specific weight of the *k*-th node;

F_{ijk} — *k*-factor node *j*-vector *i*-cloud.

The specific weights of the factor space γ_i, γ_j, γ_k are the tools for focusing the low-carbon assessment of building on certain fragments of the created factor space.

$$\sum_{i=1}^{l} \gamma_i = 1, \sum_{j=1}^{m} \gamma_j = 1, \sum_{k=1}^{n} \gamma_k = 1. \quad (2)$$

The presented complex assessment tool allows managing the scope and list of construction resources in accordance with the specifics of the region and stimulating local low-carbon industrial production [11]. Quantization (qualimetric ranking) of construction resources for complex life cycle assessment of buildings by

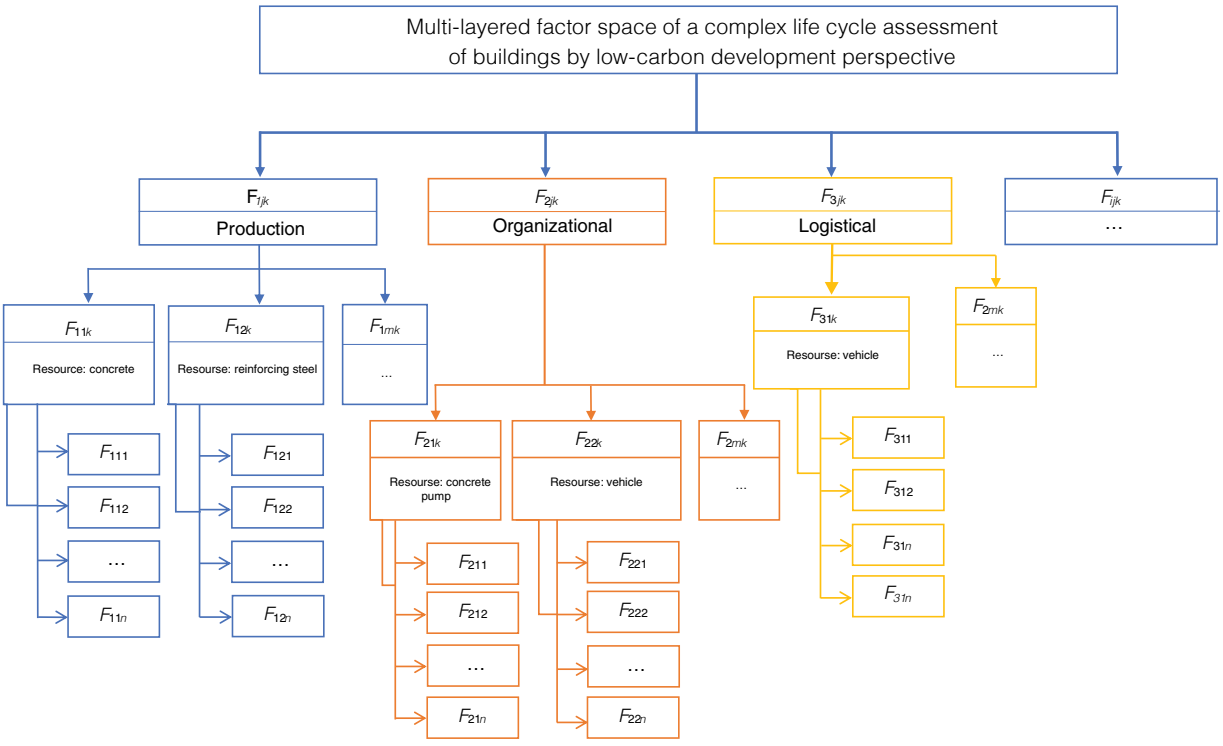


Fig. 1. System of factors to assess the building carbon footprint at the stage of design decisions

Quantization (qualimetric ranking) of construction materials for complex life cycle assessment of buildings by low-carbon development perspective

List of resources	Parameters of the carbon impact scale
Resources: materials (per 1 unit of material consumed)	Concrete, m^3
	Reinforcing steel, tons
	Steel frame structures, tons
	…
Transportation	up to 20 km
	21–49 km
	More than 50 km
Construction operations	up 20 mash-hours
	21–49 mash-hours
	more than 50 mash-hours
Additional operations: organization of the construction site, provision of temporary construction infrastructure: power supply, roads, utility buildings	up 50 workers/20 machinery
	51–199 workers/21–49 machinery
	More than 200 workers/ 50 machinery

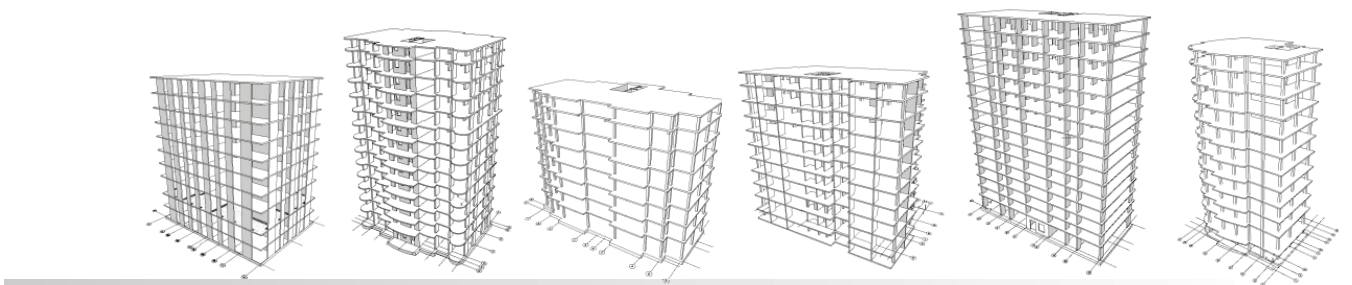
low-carbon development is presented in Table. In the first approximation, these values are equal for all construction resources and are determined by the method of expert evaluations [12]. An alternative option for assigning specific weights is the Fishburn weighting coefficient system.

All the features presented ought to be put in base of proposed Structural Carbon Analysis (SCAn) toolkit dealt with the quantitative carbon assessment embedded with the building, computated wholly and per building unit, as a monetized unit carbon footprint (UCF) in percent of construction's cost. Some buildings' UFC increasing cost of the construction resulted by authors are shown in Fig. 2. Building's UCF assessed by SCAn toolkit for comparative analyses of building carbon footprints seems to be practical criterion to pick the mostly carbon efficient building design within several possible ones at the stage of investments feasibility studies making building life cycle more efficient and carbon-friendly [13].

CONCLUSIONS

The proposed complex indicator of reducing the carbon footprint of construction projects (CI) allows comprehensively assessing the impact of all factors and indirectly characterizing the degree of carbon impact of the building at the early project stages, thereby creating an organizational and economic sustainable system of the regional construction cluster. The condition of improving the environmental safety of the building from the perspective of assessing its carbon footprint is reduced to the optimization problem solution [14].

Based on the created factor space of the carbon impact of the building created by the authors, it is possible to propose Structural Carbon Analysis toolkit, which evaluates the GHG emissions from the resource information presented in the design solutions. This tool unites carbon analysis and construction cost computation-providing assistance in the selection of environmentally friendly design and low-carbon technical solutions of buildings, taking into account the type and technological characteristics of construction resources and technologies of construction projects within monetized criteria on complex life cycle assessment.



Area, m^2	8,500	12,800	5,850	9,400	17,200	7,700
Volume, m^3	27,200	39,850	22,840	28,800	54,200	24,020
UFC, %	10.2 %	16.5 %	19.2 %	24.3 %	18.4 %	12.0 %

SCAn, 2023

Fig. 2. Building carbon footprints assessment in SCAn toolkit

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Научно-теоретические подходы к комплексной оценке жизненного цикла здания с позиции низкоуглеродного развития

Строительная деятельность осуществляется в тесном взаимодействии с окружающей средой, что заостряет внимание исследователей на вопросах повышения экологической безопасности объектов строительства с позиции низкоуглеродного развития и снижения ресурсоемкости и энергопотребления на всех стадиях жизненного цикла здания. Мировыми трендами в строительстве являются такие направления, как декарбонизация не только существующих, но и вновь возводимых зданий, создание условий для реализации инвестиционно-строительных проектов с позиции низкоуглеродного развития, а также оценка углеродного воздействия реализуемых проектов, в том числе уже на ранних стадиях архитектурно-строительного и организационно-технологического проектирования. В соответствии со Стратегией долгосрочного развития России с низким уровнем выбросов парниковых газов до 2050 года, нормирование и снижение уровня углеродного воздействия и, как следствие, переход к низкоуглеродному развитию, в том числе и отрасли строительства, зависит, прежде всего, от научной проработки вопроса. Представлены научно-теоретические подходы к комплексной оценке жизненного цикла здания с позиции низкоуглеродного развития. Выявлены факторы, позволяющие оценить проект будущего здания с позиции низкоуглеродности применяемых проектных решений, предложено многослойное факторное пространство учитываемых показателей (строительных ресурсов) углеродного воздействия, предложен показатель минимизации углеродного воздействия здания, позволяющий комплексно оценить влияние всех факторов и опосредованно охарактеризовать степень углеродного воздействия на стадиях жизненного цикла, предшествующих эксплуатации здания.

Ключевые слова: *жизненный цикл здания, низкоуглеродное строительство, углеродное воздействие зданий, оценка жизненного здания с позиции низкоуглеродного развития*

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Об авторах: **Суворова Мария Олеговна** — старший преподаватель кафедры экспертизы и управления недвижимостью; **Белгородский государственный технологический университет им. В.Г. Шухова (БГТУ им. В.Г. Шухова);** 308012, г. Белгород, ул. Костюкова, д. 46; РИНЦ ID: 811292, Scopus: 57196246833, ResearcherID: AAC-4403-2019, ORCID: 0000-0001-7423-6866; marykrutilova@gmail.com;

Наумов Андрей Евгеньевич — кандидат технических наук, доцент, заведующий кафедрой экспертизы и управления недвижимостью; **Белгородский государственный технологический университет им. В.Г. Шухова (БГТУ им. В.Г. Шухова);** 308012, г. Белгород, ул. Костюкова, д. 46; РИНЦ ID: 683551, Scopus: 56448117200, ResearcherID: K-1704-2018, ORCID: 0000-0002-8162-1946; andrena@mail.ru.

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Manukhina L.A.
Yakubov H.G.

Analysis of current trends in the greening of urbanized territories

The article deals with the main aspects of greening and improving the quality and comfort in urbanized areas. Ecological problems are important for cities around the world. In the process of urbanization many environmental problems arise, including air, water and land pollution, lack of green spaces, loss of biological diversity, etc. The purpose of this article is to study the environmental problems related to urbanized areas and residential development and to identify effective methods for their solution. In particular, this article will consider practical application of modern standards of Green building, modern aspects of the introduction of energy-efficient technologies and issues of creating the recreational areas in urban areas.
Keywords: *ecologization, environmental problems, comfort of urbanized areas, "Green" building, environmental certification system, environmental protection, residential real estate*

Manukhina Lyubov Andreevna,
Candidate of Economic Sciences, Associate Professor, Associate Professor of Department of Construction Organization and Real Estate Management; Moscow State University of Civil Engineering (National Research University) (MGSU); 26 Yaroslavskoe shosse, Moscow, 129337, Russian Federation; ID RSCI: 676588, Scopus: 57194450337, ORCID: 0000-0003-4300-7002; ManuhinaLA@mgsu.ru

Yakubov Haris Galiulovich,
Doctor of Biological Sciences, Professor of the Department of Theory and Methodology of Public and Municipal Administration; Moscow State University named after M.V. Lomonosov; bldg 4, 27 Lomonosovsky Prospect, Moscow, 119991, Russian Federation; ID RSCI: 800345, ORCID: 0000-0002-2841-1202; yhg@bk.ru

Urban areas ecologization, as one of the goals of introduction the concept of sustainable development, is becoming an increasingly relevant and popular trend in urban development. However, the examples of real management solutions show the lack of a holistic view of the balance of interests as a method of solving the environmental problems of the city [1]. Therefore, some urban planning decisions implemented in recent years indicate the absence of a strategic vision of environmental consequences, although they fully characterize the priorities of economic considerations beyond common sense.

Based on data presented in Table, we can conclude that today, the amount of investments directed to environmental protection and the rational use of natural resources in the Russian Federation is constantly increasing, however, the problem of greening urban areas and improving the comfort of urban space remains the topical issue and requires an integrated approach, along with existing ones narrowly focused strategies in the sectoral aspect [2]. National projects in the field of ecology have a number of advantages that can significantly affect the quality of urbanized territories, the comfort of life of the population and nature conservation. For example, the National project "Ecology", which includes national goals and strategic objectives for the environmental development in Russia until 2024. The project will be financed not only from the federal budget, but also from large companies (in general, the project budget is estimated at more than 4.0 trillion rubles). This National Project is a government initiative intended to improve the environmental situation in the country. The national project "Ecology" includes a wide range of activities aimed at improving the environmental situation in the country [3]. It includes measures to protect the environment, improve water and air quality, reduce emissions of harmful substances, as well as increase the efficiency of energy use, its global goal is to change the impact on the environment by 2024 in 6 main areas: waste; fresh air; water and water bodies; biodiversity and ecotourism; forests; best available techniques (BAT), which should undergo significant changes by 2024. The national project "Ecology" includes 11 Federal Projects. For example, according to the concept developed in the Project, it is planned to reduce the negative impact on the environment through the construction and operation of 5 facilities for the thermal treatment of municipal solid waste (4 in the Moscow region and 1 in the Republic of Tatarstan) [4]. Based on the prognosis, these measures will reduce the volume of MSW disposal by 8 % by the end of 2023 on the territory of the Russian Federation, achieve "zero disposal" in Kazan with the simultaneous generation of

Investments in fixed assets aimed at protecting the environment and rational use of natural resources in the Russian Federation

Investments aimed at environmental protection	Years				
	2017	2018	2019	2020	2021
Atmospheric air	60,199	65,475	70,250	69,560	130,300
Water resources	66,496	62,750	71,805	91,275	92,511
Land resources	10,216	10,011	12,158	15,303	47,473
Total	154,042	157,651	175,029	195,962	299,408

electricity of 2.7 billion kW. hour a year. It is especially worth noting the result of reducing the priority environmental risks associated with objects of accumulated environmental damage, due to the elimination of 48 objects in 23 constituent entities of the Russian Federation, which will allow restoring 0.53664 thousand hectares of land by the end of 2025, as well as improving the environmental living conditions of the population in the amount of 5.63 million people — by the end of 2025 [5].

Today, one of the most urgent problems is the assessment of the ecological situation of urbanized territories [6]. This problem arose in connection with the development of industrial production, the extraction of a large amount of non-renewable raw materials, the creation of powerful energy sources, which leads to a decrease in environmental performance [1]. The task of improving the energy efficiency of residential development is one of the most essential today. The results of the analysis of current global trends show that the specific energy consumption per unit of products and services produced in Russia is several times higher than in most European countries. In this context, the "Energy Strategy of the Russian Federation for the period up to 2035" acquires special significance, in which the issues of energy saving and energy efficiency are considered as one of the main ones [7].

The priorities of the state energy policy of the Russian Federation are[1]:

- improvement of living conditions for the population (at least 5 million families annually);
- increasing the availability of power grid infrastructure, reliability and quality of power supply to consumers to a level comparable with the best foreign analogues;
- development of gasification of the constituent entities of the Russian Federation, taking into account the peculiarities of regional fuel and energy balances;
- improving the efficiency of district heating systems, taking into account the priority of increasing the level of cogeneration.

The main tasks for environmental protection and climate change counteraction for the branches of the fuel and energy complex (FEC) are:

1. Reduction of the negative impact of the activities of fuel and energy companies on the environment.

2. Reducing the negative impact of the activities of fuel and energy companies on the climate and their adaptation to climate change [8].

In accordance with the "Energy Strategy of the Russian Federation for the period up to 2035", in order to solve the above tasks, the following activities are envisaged, the effectiveness of which is confirmed by the analytical data presented in Fig. 1.

1. Transition in the branches of the fuel and energy complex to the principles of the best available technologies.

2. Creation of a national system for monitoring and reporting on greenhouse gas emissions, including from energy facilities.

3. Taking into account the risks of changing climatic and hydrometeorological conditions in conjunction with the traditional financial and economic parameters in the feasibility study of projects and their implementation.

4. Active participation in the formation of international environmental legislation and its harmonization with the norms of the legislation of the Russian Federation.

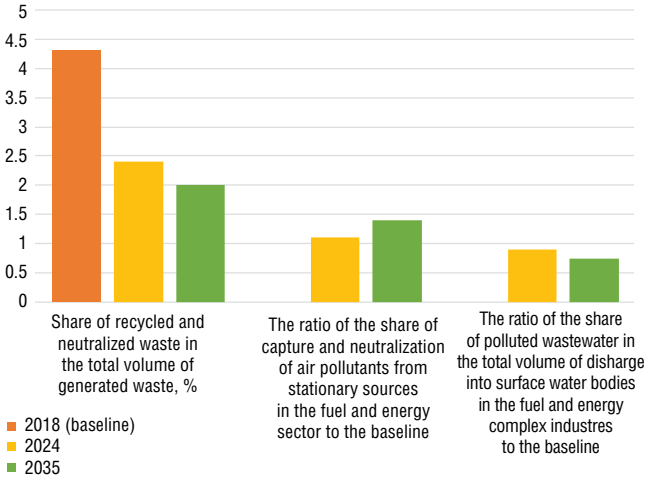

Fig. 1. Indicators of the implementation of the Energy Strategy of the Russian Federation for the period up to 2035

5. Stimulating the reduction of the generation of new and disposal of accumulated production wastes and ensuring their safe handling, carrying out land reclamation and other technical and organizational measures to compensate for damage caused to the environment, including an increase in the share of ash and slag waste involved in economic circulation.

6. Stimulation of scientific research and support for the development of promising technological solutions aimed at reducing the negative impact on the environment and minimizing environmental risks.

7. Implementation of state regulation of greenhouse gas emissions and other anthropogenic impact of the fuel and energy complex on the climate, taking into account the international obligations of the Russian Federation.

8. Implementation of the provisions of the Stockholm Convention on Persistent Organic Pollutants in the sectors of the fuel and energy complex (including the cleaning or disposal of equipment and waste containing persistent organic pollutants).

9. Ensuring openness and accessibility of environmental information, timely informing stakeholders about accidents, their environmental consequences and liquidation measures, strengthening interaction with public environmental organizations and movements.

Reducing the power consumption of residential buildings in cities and towns, industrial enterprises is a necessary condition for the greening of urbanized areas and the country's economy as a whole. By reducing the negative impact of the industries of the fuel and energy complex on the environment and adapting them to climate change, the Russian Federation will make a significant contribution to the transition to a low-carbon development of the world economy, to international efforts to preserve the environment and counteract climate change [9].

Green building is an industry that includes the construction of buildings and structures with minimal negative impact on the environment. The main objective of "green" construction is to reduce the level of consumption of resources (energy and material) throughout the entire life cycle of real estate [10].

At the same time, the main goal of "green" construction is to improve the quality of construction and the comfort of the internal

1 Draft Strategy for the development of the construction industry and housing and Communal services of the Russian Federation until 2030 with a forecast for the period up to 2035. URL: https://www.minstroyrf.gov.ru/docs/18723.

environment. This is achieved both by high-tech solutions (introduction of "green" technologies) and passive energy-efficient architecture solutions [11]. Reducing the negative impact on the environment and human health throughout the entire life cycle of a property can be achieved by:

- using of environmentally friendly building materials;
- efficient using of energy and water resources.

To assess the effectiveness of measures to reduce the harmful effects of buildings on the environment and human health in the world, there are many "green" standards, the main of which are Leadership in Energy and Environment Design (LEED) (USA), Building Research Establishment Environmental Assessment Method (BREEAM) (Great Britain), DGNB (Germany). Over the past few years, the BREEAM standard has been adopted in other countries, including Canada, Hong Kong and New Zealand.

Due to many political and economic problems, Russia is at the beginning of the path to the use of "green" technologies and ESG approaches, while the potential for their implementation by 2023 is estimated at 3 trillion rubles [12].

At the moment, more than a dozen different systems for environmental certification of real estate objects have been developed and are actively used in the Russian Federation: Corporate Olympic Green Standard; "Green standards", NP-SPZS 1.1.M–2011 "Low-rise construction"; CAP-SEC "Administrative buildings; STO NOSTROY 2.35.4–2011; GOST R 54964–2012; Eco Village; GREEN ZOOM; GREEN ZOOM City; "Green" standards. "Green" technologies of the living environment. Assessment of compliance with the requirements of "green" standards, General Provisions, etc.

One of the latest regulatory documents put into effect in this area is GOST R 70346–2022 "«Green» standard. «Green» residential building. Assessment method and criteria for design, construction and maintenance", developed with the participation of JSC DOM.RF.

This standard was developed in order to create comfortable and environmentally friendly living conditions for citizens in multi-apartment residential buildings [13].

The standard proposes specific criteria in the field of "green" building and housing and communal services for the construction and operation of "green" multi-family residential buildings, aimed at implementing the declaration "Transforming our world: the 2030 Agenda for Sustainable Development" and other foreign and Russian regulatory legal acts and documents, the action of which is aimed at creating a favorable environmental situation and combating climate change.

Thus, GOST R 70346–2022 introduces quantitative and qualitative characteristics of the evaluation of residential real estate in Russia according to "green" criteria, throughout all stages of the life cycle. Green criteria for multi-apartment residential buildings is formed in 10 categories, taking into account the best world practices of BREEAM, LEED, DGNB (Fig. 2). According to the data given in the Unified Information System for Housing Construction, today multi-apartment residential buildings are already marked according to 6 of more than 30 mandatory criteria given in the GOST R 70346–2022 Standard (in total, GOST R for multi-apartment residential buildings includes 81 "green" criteria, of which: 37 mandatory and 44 voluntary).

Based on the assessment for each group of criteria in accordance with GOST 70346–2022, the building is awarded a certain rating value (according to the percentage of points scored out of the total, Fig. 3).

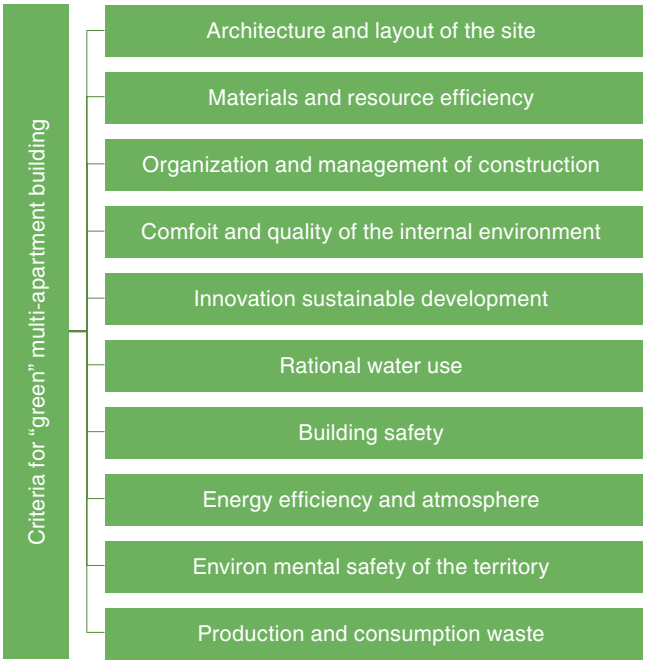

Fig. 2. Categories of evaluation criteria for "Green" real estate objects according to the GOST 70346–2022 Standard

To obtain a green certificate for multi-apartment residential buildings, it is necessary to meet the mandatory and part of the voluntary criteria. Voluntary criteria the developer chooses independently. Certification can be carried out at the design and construction stage.

The Russian Federation is just beginning to build its own system of "green" certification with an integrated approach to the relationship of resource saving, energy efficiency, environmental safety and comfortable living conditions [14]. The introduction of green building standards in our country is still quite difficult. This is caused, first of all, by the outdated normative and technical regulation of the construction complex. The emergence of new technologies, building materials and engineering equipment makes the task of harmonizing domestic and advanced foreign regulatory and technical regulation one of the priorities.

Green buildings aim to minimize their impact on the environment and promote sustainability, but they can face the following challenges.

1. Cost: Implementing green building practices can be expensive, particularly for retrofitting existing structures.

2. Lack of standards and regulations: There is a lack of universally accepted standards for green building, leading to confusion and inconsistencies in implementation.

3. Limited availability of green materials: Finding environmentally friendly materials can be difficult, especially in certain regions or for certain types of construction.

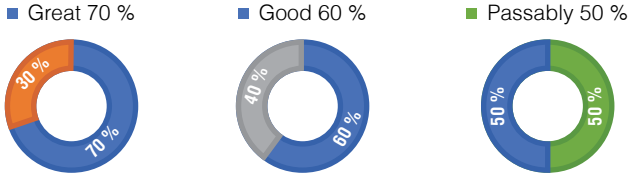

Fig. 3. Final rating values based on the results of the assessment

4. Resistance to change: Some contractors, architects, and building owners may be resistant to changing traditional building practices and incorporating new technologies.

5. Maintenance and upkeep: Maintaining green building systems and ensuring they continue to operate efficiently can require ongoing effort and investment.

6. Limited awareness: There is a limited understanding and awareness of green building practices and the benefits they can provide, which can limit adoption and investment.

To overcome the se challenges, a combination of education, policy support, and investment in green building research and development is needed.

In conclusion, green infrastructure and eco-urbanization play a crucial role in creating sustainable and resilient cities. Green infrastructure provides a range of benefits, including mitigating the impacts of climate change, promoting public health, and improving the quality of life for city dwellers. Eco-urbanization involves the integration of green infrastructure into the fabric of the city, creating a more sustainable and resilient urban environment. The implementation of green infrastructure and eco-urbanization requires investment, political will, and public awareness, but the benefits of these initiatives are numerous and far-reaching. By promoting eco-urbanization and the development of green infrastructure, cities can become more sustainable, resilient, and livable for all of their residents.

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Анализ современных тенденций экологизации урбанизированных территорий

В статье рассмотрены основные аспекты экологизации и повышения качества и комфортности урбанизированных территорий. Экологическая проблематика является важным вопросом для городов всего мира. В процессе урбанизации сталкиваются со множеством экологических проблем, включая загрязнение воздуха, воды и земли, недостаток зеленых зон, утрату биологического разнообразия и т.д. Целью данной статьи является исследование экологических проблем, связанных с урбанизированными территориями и развитием жилой застройки, и выявление эффективных методов их решения. В частности, в рамках данной статьи будут рассмотрены практики применения современных стандартов «зеленого» строительства, современные аспекты внедрения энергоэффективных технологий и вопросы создания рекреационных зон на урбанизированных территориях.

Ключевые слова: *экологизация, экологические проблемы, комфортность урбанизированных территорий, «зеленое» строительство, система экологической сертификации, охрана окружающей среды, объекты жилой недвижимости*

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Об авторах: **Манухина Любовь Андреевна** — кандидат экономических наук, доцент, доцент кафедры организации строительства и управления недвижимостью; **Национальный исследовательский Московский государственный строительный университет (НИУ МГСУ)**; 129337, г. Москва, Ярославское шоссе, д. 26; РИНЦ ID: 676588, Scopus: 57194450337, ORCID: 0000-0003-4300-7002; ManuhinaLA@mgsu.ru;

Якубов Харис Галиулович — доктор биологических наук, профессор кафедры теории и методологии государственного и муниципального управления; **Московский государственный университет имени М.В. Ломоносова (МГУ им. М.В. Ломоносова)**; 119991, г. Москва, Ломоносовский пр-т, д. 27, к. 4; РИНЦ ID: 800345, ORCID: 0000-0002-2841-1202; yhg@bk.ru.

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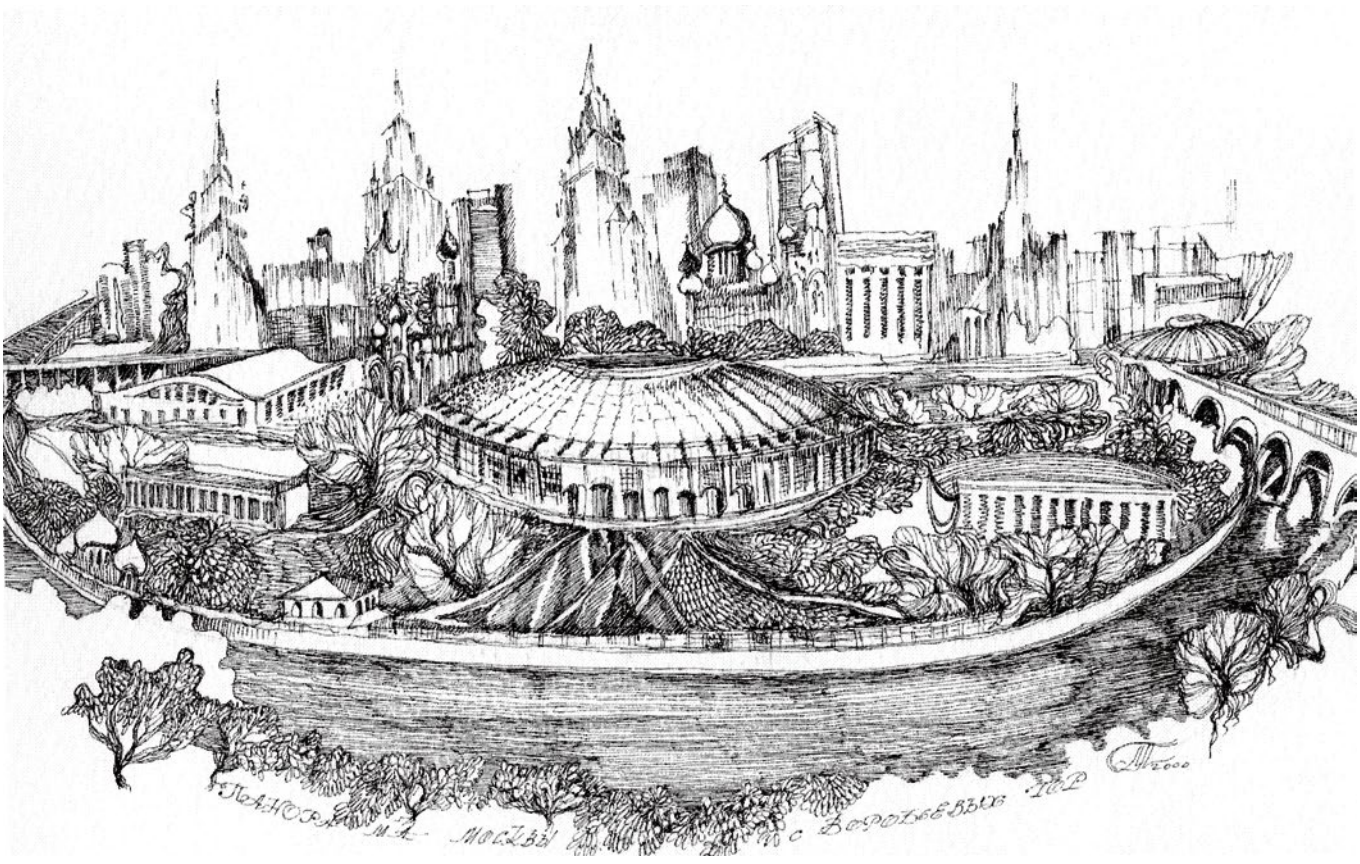

Л.И. Павлова. Панорама Москвы с Воробьевых гор. Рисунок, тушь перо.

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Grabovyy P.G.
Volkov R.V.
Volgin V.V.

Intelligent real estate management

The article analyzes the state and use of intelligent real estate management technologies. It is argued that intelligent real estate management is based on information and digital methods. The key factors in the transition to intellectual real estate management have been pointed out. Breakthrough technologies as a tool for the transition to intelligent management are considered. The analysis of digital assets, digital real estate, digital real estate passports is given. The importance of big data in real estate management is demonstrated. The influence of building information modelling (TIM) technology on the development of the intelligent property management, with the possibility of using artificial neural networks for real estate valuation, is noted. The application of multi-criteria real estate valuation methods, as well as the possibilities of multi-agent systems as a means of intellectual property management, are described. The application of nine modern technologies, called the "Big Nine", as a means of supporting intelligent real estate management is discussed in detail.

***Keywords**: management, real estate management, digital methods, intelligent management, breakthrough technologies*

Grabovyy Petr Grigor'evich,
Doctor of Economics, Professor, Head of the Department of Organization of Construction and Real Estate Management; Moscow State University of Civil Engineering (National Research University) (MGSU); 26 Yaroslavskoe shosse, Moscow, 129337, Russian Federation; ID RISC: 302471, Scopus: 57164862700, ResearcherID: AAE-7942-2022, ORCID: 0000-0002-8696-3718; GrabovyiyPG@gic.mgsu.ru

Volkov Roman Vyacheslavovich,
Candidate of Economic Sciences, First vice-rector; Russian University of Transport (RUT); bldg 9, 9 Obraztsova St., Moscow, GSP-4, 127994, Russian Federation; ID RISC: 872062; volkov-su4@mail.ru

Volgin Valentin Valentinovich,
Vice-Rector; Moscow State University of Civil Engineering (National Research University) (MGSU); 26 Yaroslavskoe shosse, Moscow, 129337, Russian Federation; ResearcherID: AAE-8862-2022, ORCID: AAE-8862-2022; VolginVV@gic.mgsu.ru

INTRODUCTION

Digital transformation of society and economy defined an approach to management in general and real estate management issues. Traditional management tools lose their competitiveness used apart from the new technologies. Real estate management (REM) shows current trend of implementing informational, digital and intellectual technologies. The intellectual technologies trend is most obvious. In terms of digital transformation of the society, researches on digital assets implementation and digital real estate are worth noting. There are also "smart cities" and "smart home" [1] methodologies. There is a smart real estate (SRE) new technology as well. The transition to the intelligent real estate management technologies is stipulated increased complexity of the real estate facilities and the situations these facilities face. Environmental and ecological factors, particularly in the cities, lay a great impact on the state of the real estate facility in modern real estate management. The intelligent technologies implementation calls for the revision of the real estate management. For example, there should be a shift from the facility management (FM) to a given spatial situation management. This implies change of the facility management to a situational real estate management (SREM) in some cases. This also means that in other cases the facility management should give place to the corporate real estate management (CREM) [2]. The complexity of the situational real estate management necessitates the implementation of intelligent technologies to reduce the data pressure on the manager.

EVOLUTION OF DISRUPTIVE TECHNOLOGIES FOR REAL ESTATE MANAGEMENT

Innovation and disruptive technologies are integral parts of management and production. Professor Clayton Christensen and his colleagues coined the term "disruptive technologies". It is interpreted as a set of technologies, displacing current technologies and transforming industries, providing new opportunities for innovations and business development. Revolutionary transformations are their positive side. Their challenge is the transformation of the traditionally inertial sectors of national economy such as construction and real estate. Their disruptive nature raises issues in terms of their implementation.

Disruptive technologies in real estate management emerged and evolve with reference to a number of factors: wide use of information and data technologies; digital real estate assets management; emergence of digital real estate models; big data; use of technologies information modelling (TIM).

The importance of information in real estate is determined by two factors. The *first factor* is associated with the widespread usage of information. Currently, information is used in all spheres of life, including the field of public real estate management. The world is becoming more localized and new information technologies are being used. Information serves as a means of globalization and helps to navigate in a localized society. The *second factor* is greater information accessibility. Society requires access to such systems, which a few years ago were available only to officials of federal agencies.

There is a new concept and a digital asset model in the real estate management system. The research considers the definition of a digital asset and examines its features in the real estate management system, in the result of it there is the transaction costs' reduction. The digital asset is aimed at data recording throughout the life cycle of a capital construction facility with a focus on the stage of operation and maintenance.

Recently, there has been an interest in the digital real estate technologies' usage [3]. They have different implementations, for example, innovations

that are often called Protect (real estate technology), efficient portfolio management (VTS), new ways of renting housing (Airbnb) or hassle-free service (Fixflo). These technologies have advantages and disadvantages. A critical analysis of the technologies is given in a paper [3].

It is indicated in the study [4] that the lack of a single pool of standardized property information turns out to be the most serious cause of delays in real estate transactions. The most promising technologies to mitigate this problem are digital property passports. They contain all relevant real estate information. However, their implementation faces significant obstacles in its path due to the radical transition from paper technology to a digital one.

Big data has also influenced the real estate market. Big data is not only huge amounts of data, but also the requirements of their processing speed, complexity and diversity of data, which hampers their analysis. On the one hand, they create processing problems, on the other hand, they provide a more comprehensive one. Cloud computing for big data is one of the ways to analyze and process them.

The emergence of Technologies of Information Modeling (TIM) of buildings has influenced the dissemination of information about the building among interested parties. Embedded TIMs in industrial buildings are an important part of the digital transformation of industrial assets. The development of executive TIM has enabled property owners to become not only owners of the assets themselves, but also owners of digital assets. The considered technologies perform the support functions or serve as the basis for intelligent real estate management [5].

Neural network is one of the typical intelligent technologies. It starts being also applied in the real estate sector [6]. The efficiency of the real estate industry using the BP neural network model is studied in this paper. The results prove the efficiency of the network used specifically in the construction industry. This is due to the variety of real estate objects and their operating conditions.

A neural network is just a tool, just like a spreadsheet. It contains the necessary algorithm or method. In particular, it is advisable to use it for complex methods, such as methods of multi-criteria decision analysis in the processes of real estate management and land management [7]. Multi-criteria Decision Analysis (MCDA) methods are listed among the verification and evaluation methods that the European Real Estate Management Community considers useful. Such analyses and methods are performed using methods aimed at achieving the synthesis of various input data forms necessary to identify decision-making issues of similar complexity. Consequently, one or more of the conclusions made enable to take reasonable, well-considered strategic solutions. In the field of land and real estate management, numerous questions often arise regarding such assessments. The study [7] describes the procedure of choosing a multi-criteria method most suitable for specific assessment tasks usually arising when solving problems related to decision-making. In particular, the issues of land and real estate management.

In the context of big data, the management of key resources with use of intelligent approach reveals additional advantages of corporate real estate management.

When appraising real estate in trying circumstances, one often has to deal with a complex system of unstructured data. Heuristic methods could be the only way out then. This problem is solved by multi-agent systems.

These studies [8] introduce the notion of a multi-agent system for providing support in real estate appraisal. The general architecture of the multi-agent real estate appraisal system (MAREA) is described. The estimated data bank is filled with original cadastral databases information. Data-driven evaluation models are created using various algorithms.

The “BIG NINE” AS A SUPPORT FOR REAL ESTATE INTELLIGENT MANAGEMENT

Intelligent real estate is associated with the use of nine smart technologies, called the “Big Nine” [5] (“Big9”). These are: drones (UAVs) , Internet of Things (IoT) , cloud technologies, Software as a Service (SaaS), big data, 3D scanning, mobile technologies, virtual and augmented reality (VR and AR), artificial intelligence (AI) and robotics. All these technologies are used differently depending on the context and objectives of real estate management. The “Big Nine” in terms of its application to real estate helps to provide consumers with high-quality and complete information [9].

In recent years, real estate around the world has attracted huge financial investments. Since 2012, real estate technology companies have raised almost 6.4 billion $ in 817 transactions in the United States alone [10]. Real estate technology is defined as hardware gadgets, online platforms and software tools used by various participants in the real estate industry, including lenders, brokers, property owners, investors and managers, as well as consumers to collect information and distribute data related to real estate[1].

Unlike its industrial counterparts, almost a third of the world's real estate industry worth is 11 trillion $ is managed by spreadsheets, not by special software; innovative tools of information technology (IT) are not in place. Nevertheless, innovative and breakthrough technologies are an integral part of the modern world. Breakthrough technologies are widely used in real estate management.

As a result, breakthrough technologies were considered and evaluated in various industries in accordance with criteria such as computing education and student perspectives, rapid advances in technologies in value-added supply chains, improving students' experience in a massive open online format, specialized courses, risk management using breakthrough technologies, social relations in higher school, clinical trials, and others. The above mentioned studies provide useful information on how breakthrough technologies can be applied, but so far, their application in real estate has not been considered [5]. This study examines the potential application of various breakthrough technologies in the field of real estate to underline their importance, current use, and application, as well as the possibility of their use to meet the needs of stakeholders in the field of real estate.

A specific term used in the field of real estate abroad is “regret”. This parameter characterizes customer dissatisfaction after a real estate transaction. The growing concern of the real estate industry caused by an increase in the number of regrets after buying or renting, which are reported by consumers[2]. According to Trulia[2], 44 % of real estate consumers (almost every second) regret their decision to buy or rent real estate facility. The main reasons for these regrets are the information asymmetry caused by the lack of information about the characteristics of real estate and

1 Insights C.B. Real estate tech funding reaches new highs in 2016. URL: https://www.cbinsights.com/research/real-estate-tech-startup-funding/

2 Trulia. Real Estate Regrets: Recovery Edition. URL: https://www.trulia.com/blog/trends/regrets-2017/

the complexity of the purchase process and as a result key information, including fees, remains hidden.

The technologies of the "Big Nine" eliminate the main regrets and information asymmetry of stakeholders in the real estate sector. In the work [5]:

- technological aspects of SRE are considered — its user orientation, sustainability and technological innovations;
- online distribution platforms such as websites, smartphones and social networks are studied;
- stakeholders in the real estate sector and their needs and information interactions are identified;
- technologies of the "Big Nine" are analyzed, the analysis of opportunities, potential losses and levels of operation for each technology is given;
- "Big 9" technologies, distribution platforms and the needs of stakeholders are considered with the help of a holistic technology adaptation model (TAM), which integrates them in online real estate platforms and leads to greater consumer satisfaction, as well as to regrets reduction.

Intelligent real estate management (IREM) uses the concept of key management components. This is the use of "Big9" to solve the problem of the lack of information provided to consumers; distribution of information among them through the conceptual structure TAM; the analysis of the possibilities of potential losses and levels of exploitation (opportunities, potential losses and exploitation levels OPLEL) for each technology.

Despite the fact that the global real estate industry has lagged behind information technology (IT)-based innovations and relies on traditional transaction methods, investment in real estate technologies is growing. This proves the business attractiveness of the industry for investors and potential customers. One and a half billion $ of global investment in 2015 and 1.6 billion $ invested in the first half of 2016 confirms the statement. In this context, the United States is seen as the center of commercial real estate and its technological progress. The report published by Forum [10] compared countries according to seven criteria related to technological progress and implementation opportunities. These include: the network availability, which measures the countries' potential to use the Internet and communication technologies (ICT) to increase competitiveness and well-being; the availability of the latest technologies, such as mobile 4G, 5G and big data availability; individuals using the Internet; the development of technologies at the corporate level; the innovation capacity; the use of the Internet linking businesses and the consumer and the government's success in promoting ICT.

In [5] it is noted that the USA, Great Britain and Australia occupy the first place among 139 countries in accordance with these seven criteria. These three countries were chosen because data was available for each criterion. There is a dominance of the USA in terms of technological progress and readiness for innovation, but the UK also leads when it comes to individual Internet use, namely, the use of the Internet as a link between business and customers and the success of the government in promoting ICT. The ratings show the overall position of the countries among the 139 countries studied. The value is outside of seven and shows the degree to which the criterion is accepted in the country being studied. In general, according to the report, Singapore, Finland and Sweden are among the top three countries in terms of readiness to implement technologies, respectively. All values were obtained using a global questionnaire; the assessment was based on how respondents scored a holistic value. The values show that the USA, Great Britain and Australia are actively implementing the latest technologies. The results also highlight the investment benefit perspectives in these countries, especially in relation to online real estate. These advantages are more likely because the Internet innovations have been successfully implemented and there is a willingness to accept them. The government's positive strategies further stimulate investors clarifying why countries like the US attract huge investments.

SRE technology is closely related to the "smart cities" evolution. The key factor determining the "smart city" is the usage of the cutting-edge breakthrough technologies. A smart city uses various sets of electronic data, as well as technologically advanced sensors to manage effectively its assets and resources. Although technologies change over time, becoming more and more complex, it is the implementation option and their open, innovative nature that make a city or real estate "smart". Due to this, SRE and intelligent management are necessary for the development of smart cities. It is essential to develop SRE evaluation criteria for their best implementation.

In the absence of a generally accepted definition of SRE, there are different aspects of its analysis and description, which are used, as well as key components, according to researchers, are identified.

In particular, they claim [11] that customer **orientation** is a key component, and an experiment based on virtual reality reveals the preferences of customers regarding the purchase or use of a smart home.

Another component is called sustainability and it is necessary if we want real estate to become smarter and attract more global investment. E. Miller[3] focuses on innovation and says that the industry should demonstrate its abilities by using virtual storefronts, crowdfunding, artificial intelligence, smart homes, online markets and smartphone applications.

D. Shulman[4], speaking about the technological needs of Smart Real Estate, cites the Airbnb case, stressing that at the beginning of 2014 it attracted 10 billion $ and, hence, received more market capital than such well-known hotels as Hyatt. Summarizing these findings and research, the study defines SRE as: "Real estate or land in which various electronic sensors are used to collect and provide data to consumers, agents and property managers that can be used for effective asset and resource management. The key features are customer orientation, sustainability and the use of innovative and breakthrough technologies in such a way as to obtain integral benefits that are otherwise unattainable".

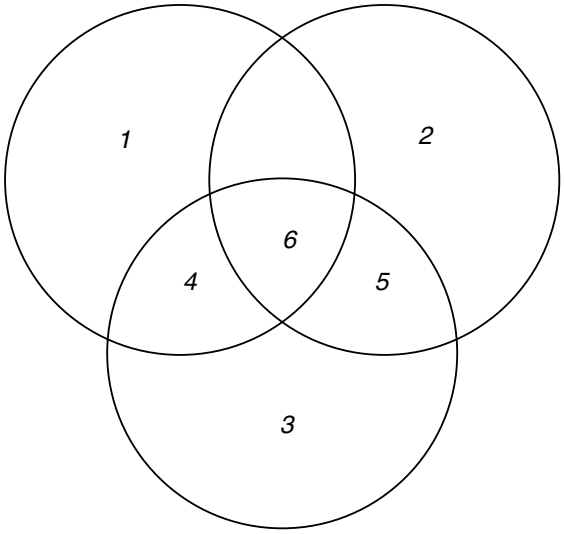
Intelligent real estate management refers to the cumulative management of SRE, which is based on the main principles of the innovative technologies' implementation, sustainability, and customer orientation. This is not limited to infrastructure only but includes asset and resource management.

Real estate agents use online platforms to present their facilities to potential buyers or tenants. The information they provide can prevent customer regret arising from ignorant decisions, and thus reduce disagreements between agents and customers after the purchase. Figure shows the conceptual SRE model.

In Figure the numbers *1–3* indicate the main domains: *1* — marketing and business; *2* — information distribution and

3 Miller E. Trends and Innovations in the Real Estate Industry. URL: http://www.innovationmanagement.se/2017/11/21/trends-and-innovations-in-the-real-estate-industry/

4 Shulman D. Technology vs. commercial real estate: Retail, office and hotel markets face major disruptions. 2014. URL: http://www.anderson.ucla.edu/lib/email/documents/econ_letter_june_2014.pdf



SRE conceptual model

communication; *3* — the main component of SRE. Numbers *4–6* indicate: *4* — sustainability; *5* — customer orientation; *6* — innovation technologies. It should be noted that considering spatial factors determines the usage of geo-marketing in addition to conventional marketing.

In the interests of consumers, smart cities, smart homes and SRE promote key spheres such as privacy, versatility, flexibility, the ability to work from home, teleactivity and time-saving measures. According to the triple principle, sustainability in cities should cover social, environmental and financial aspects.

METHODOLOGICAL AND INFORMATIONAL ASPECTS OF SRE FORMATION

Process-oriented planning is the basis for the SRE formation. Characteristic of SRE is the interaction between real estate objects. Therefore, the principles of corporate governance should be incorporated into the SRE methodology. Intelligent real estate is aimed at meeting the needs of the client. This requires defining the demand for objects of this kind. Information models of objects, processes and situations serve as the basis of the SRE field of activity. Therefore, such models should be used in the formation of intelligent property and the organization of the implementation field. Intelligent real estate, like other intelligent objects, uses not only data and information models, but also knowledge.

Intelligent real estate uses non-deterministic models that have freedom of action and the features of subsidiarity. Therefore, when forming a SRE, it is necessary to take into account risk factors and use risk-oriented technologies. Real estate objects are spatial, so it is necessary to use spatial and geo-knowledge for SRE. To study the algorithms dynamics, it is necessary to use the analysis of structural changes of real estate objects. Currently, the concept of "key indicator" is widely used in the economy. Because of this, intellectual real estate models should be formed based on key indicators. Analysis of the economic feasibility of innovative projects, including the creation of intellectual real estate is in the interests of construction enterprises. Strategy plays an important role in the management of any real estate.

Expert evaluations play an important role in the pilot operation of intelligent real estate. Therefore, expert evaluation should be incorporated in the form of rules in the intelligent real estate management. Intelligent real estate management and corporate real estate management are network-based. An important factor of intelligent real estate is the life cycle modelling. The advantage of intelligent real estate is that its life cycle is changeable.

CONCLUSION

Intelligent real estate management is a modern trend. It requires the use of breakthrough technologies and various intelligent models: smart city, smart home, smart real estate. Intelligent real estate management relies on information and digital methods. Intelligent real estate management is not feasible without proper informatization and digitalization. Intelligent real estate management, like many other smart technologies, requires support. The "big nine" technologies provide such support of intelligent real estate management. In the communication aspect, web sites should be noted as a tool for distributing information about real estate in the Internet. The concept of intelligent real estate management includes ensuring the sustainability of real estate management and customer orientation. As a perspective for the development of intelligent real estate management, we can recommend the usage of real estate information units models.

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Интеллектуальное управление недвижимостью

В статье анализируется состояние и использование интеллектуальных технологий управления недвижимостью. Обосновано, что интеллектуальное управление недвижимостью опирается на информационные и цифровые методы. Отмечены ключевые факторы перехода к управлению недвижимостью. Рассмотрены прорывные технологии как инструмент перехода к интеллектуальному управлению. Дан анализ цифровых активов, цифровой недвижимости, цифровых паспортов недвижимости. Показана важность больших данных в управлении недвижимостью. Отмечено влияние технологий информационного моделирования (ТИМ) зданий на развитие интеллектуального управления недвижимостью с возможностью использования искусственных нейронных сетей для оценки недвижимости. Описано применение многокритериальных методов оценки недвижимости, а также возможности мультиагентных систем как средства управления интеллектуальной собственностью. Подробно рассматривается применение девяти современных технологий, получивших название «Большая девятка», как средства поддержки интеллектуального управления недвижимостью.

Ключевые слова: *менеджмент, управление недвижимостью, цифровые методы, интеллектуальное управление, прорывные технологии*

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Об авторах: **Грабовый Петр Григорьевич** — доктор экономических наук, профессор, заведующий кафедрой организации строительства и управления недвижимостью; **Национальный исследовательский Московский государственный строительный университет (НИУ МГСУ)**; 129337, г. Москва, Ярославское шоссе, д. 26; РИНЦ ID: 302471, Scopus: 57164862700, ResearcherID: AAE-7942-2022, ORCID: 0000-0002-8696-3718; GrabovyiyPG@gic.mgsu.ru;

Волков Роман Вячеславович — кандидат экономических наук, первый проректор; **Российский университет транспорта (РУТ (МИИТ))**; 127994, ГСП-4, г. Москва, ул. Образцова, д. 9, стр. 9; РИНЦ ID: 872062; volkov-su4@mail.ru;

Волгин Валентин Валентинович — проректор; **Национальный исследовательский Московский государственный строительный университет (НИУ МГСУ)**; 129337, г. Москва, Ярославское шоссе, д. 26; ResearcherID: AAE-8862-2022, ORCID: AAE-8862-2022; VolginVV@gic.mgsu.ru.

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Volkov R.V.

The Verhulst equation in managing the life cycle of a real estate facility

Managing the lifecycle of a real estate facility is an important part of the reproduction process. A brief analysis of corporate lifecycle models is provided. As a scientific research hypothesis, it is assumed that the initial stage lifecycle is based on consumption of external resources, while at the final stage internal resources are consumed. The concepts of "resource consumption lifecycle model" and "resource consumption rate" are introduced. It is the rate of resource consumption that determines the end of the real estate facility lifecycle. The Verhulst differential equation for the population growth model is used as a mathematical basis. The lifecycle model has three phases: growth, stability, and degradation. This model can be applied to change the lifecycle of a construction facility. Synchronous and asynchronous types of management are described. It is proven that monitoring and forecasting are components of synchronous management of a real estate lifecycle.
Keywords: *real estate management, lifecycle, resources, lifecycle model of resource consumption, synchronous management*

Volkov Roman Vyacheslavovich,
Candidate of Economic Sciences,
First vice-rector; Russian University of Transport (RUT); bldg 9,
9 Obraztsova St., Moscow, GSP-4, 127994, Russian Federation;
ID RSCI: 872062;
volkov-su4@mail.ru

INTRODUCTION

According to GOST R 57271.1–2016, one of the real estate management advantages is "corporate development sustainability increase due to a service lifecycle analysis implementation"[1]. In this regard, analysis and development of real estate facilities' lifecycle models become relevant. A distinctive feature of regional real estate management, for example, territorial reproduction real estate systems of state institutions of higher professional education, is integration of construction process with further facility management. Such management is considered as the integral lifecycle management of headwork real estate, comprising groups of facilities.

Real estate objects can be considered as complex procedural and engineering [1] systems that solve one or more economic tasks. Real estate objects are part of urban, industrial or regional infrastructure. They can function autonomously and as part of a related facilities complex. Such complexes are characteristic of the higher education system. Being a part of the complex, real estate objects can create a synergy that is not characteristic of a separate object. An important characteristic of real estate objects is their lifecycle [2, 3], associated with viability and efficiency. An indispensable stage of any real estate object design and creation is the development of a conceptual description (information structure)[1] of the lifecycle model. Separate real estate objects have the possibility of lifecycle modification through repair, reconstruction, restoration, reengineering, etc. The possibility to prolong the lifecycle characterizes flexible and self-developing systems. The lifecycle and its modification methods research is a challenging issue for the real estate management. This work aims at creating a mechanism for managing the real estate object lifecycle and its adaptive model development.

RESEARCH METHODOLOGY

The system analysis together with the structural, comparative and qualitative ones, are the basis of the study. The materials used are publications in the field of development and management of the territorial-reproduction system of real estate of state institutes of higher professional education.

RESEARCH RESULTS

The specific feature of managing the objects of the territorial-reproductive real estate system of state institutes of higher professional education is not so much the maximum income for the owner, as the education quality improvement [4], the brand of the university and comfortable environment for the university staff. In other words, the social efficiency of a state university is more significant than profit. State universities use state-owned real estate. The dominant feature of their activity is the index of the quality of specialists' training. The situation differs for commercial universities. They are autonomous and their dominant is survival, sometimes to the detriment of the education quality.

Lifecycle models. There are different models of life cycles [5]. They are used in various fields: economics, construction, modeling, biology, cybernetics, design, transport, etc. The life cycle (LC) serves as a universal characteristic of objects, systems and processes. There are special organizational life cycle (OLC) models, among which there are five main ones. OLC models consider the functioning of an object or company as a sequence of different developmental stages. The most relevant OLC models shared the organism life cycle analogy. As the fundamental ones, we can consider the LC models proposed by Lippitt and Schmidt, Greiner, Adizes, Galbraith, Churchill and Lewis. Let's consider them briefly.

1 GOST R 57271.1–2016. Facility management. Part 1. Terms, definitions and scope. Enacted in 2022.

Lippitt and Schmidt [6] focused on the private sector. As part of the research, they developed one of the first OLC models. They suggest that companies move through three stages of development, facing six major 'managerial concerns' to progress from one stage to the next. At birth, critical challenges include creating a system and reaching the survival threshold. In youth, the main concerns are stability and reputation. During the period of functioning and maturity, achieving uniqueness and responding to a variety of social needs become the main problems. Management should resolve crises in a way that creates a solid base for dealing with future crises. When the problem is solved, companies move on to the next stage. Failures occur when managers fail to recognize serious crises arising in the life cycle of an organization.

Greiner assumed [7] that the life of a company passes through a sequence of five stages of evolution and revolution. A stage of evolution is a period of growth where no major shocks occur in organizational practice. On the contrary, revolution is a period of serious turmoil in the organization's life. The resolution of each revolutionary period provides the go-ahead to move on to the next stage. The growth stages include the following:

- creativity-driven growth is interrupted by a leadership crisis;
- direction-driven growth is interrupted by a crisis of autonomy;
- delegation-led growth is interrupted by a crisis of control;
- coordination-led growth is interrupted by a crisis of bureaucracy or a red tape crisis;
- collaboration-led growth is interrupted by a crisis of lack of internal solutions for growth.

The evolutionary periods range from 4 to 8 years depending on the industry: in fast-growing industries, the periods may be shorter, while in mature industries, the periods may be longer.

The Adizes model [8] assumes that firms go through stages due to changes in emphasis on four types of activities: achieving results (P), acting as entrepreneur (E), applying forma.rules and procedures (A) and integrating individuals into the organization (I). As the organization moves from one stage to another, it emphasizes different roles, and resulting roles combinations lead to varying organizational behaviour. Organizational decline is primarily due to excessive emphasis on bureaucracy.rules and procedures. The model assumes that organizations pass through 10 development stages: courtship, infant, go-go, adolescent, prime, maturity, aristocracy, early bureaucracy, bureaucracy and death. Progress through the stages occurs mainly due to overcoming the growth problems of successive stages.

The Galbraith model [9] is based on capturing the predictable dynamics of the organization development. The basic idea of LC is that firms move through predictable stages, but, in author's view, managers do not think in stage-wise manner, despite the predictability of these stages. His model focuses on start-ups. These companies develop a business idea consisting of a market to be served, products to be sold, a basis for niche dominance, as well as resources and their combinations to achieve dominance. The model [9] involves five stages: proof-of-principal prototype, model shop, the startup volume production, natural growth and strategic maneuvering. To move from one stage to another, firms must increase in size. Moreover, growth is guided by the product market and is related to the product lifecycle.

Churchill and Lewis [10, 11] used a combination of research and analysis of previous theoretical papers to develop a new OLC model. Their theoretical development derives from the identification of three weaknesses of the previous models. First, previous models assumed that a company must grow and go through all stages of development or die trying to do so. Second, a company is unable to grasp the important early stages of company's origin and growth. Third, they define company size mainly in terms of annual sales (although some mention the number of employees), while ignoring other factors such as value added, number of locations, complexity of the product line and rate of change in products or production technologies. Consequently, the model offers five stages: conception/existence, survival, profitability and stabilization/growth, take-off and maturity. Each stage is characterized by an index of size, diversity and complexity, described by five management factors: management style, organizational structure, the extent of formal systems, the main strategic objectives and the owner's involvement in the business. The model focuses on small businesses. To grow and increase in size and profitability, firms must adapt to the environment [12].

Not all the models reviewed are technically fully applicable to real estate lifecycle, but their ideas are applicable to the creation of conceptual model. The generalized life cycle shows a consistent set of time periods, on each of which the object is in a certain state, has different efficiency and manifests itself differently in relation to the external environment. For many types of technical objects, moral aging vs. physical wear and tear as the end of the life cycle are distinguished. The life cycle of a real estate object and many other objects significantly depends on the intensity of the object's operation. The link between the functioning efficiency of an object and its life cycle stages determines the importance of life cycle (LC) management and the importance of analyzing and constructing its models.

Any organization is concerned about LC increase. Its support and modification are carried out for this purpose. Modification can mean modernization, repair or repurposing. For example, an old one-story academic building can be converted into a garage or a training workshop.

Management and support of a real estate object's life cycle in education can be external and internal. Internal LC support typical for commercial educational institutions. It focuses on the survival of the university. External LC support is typical for state universities and state real estate.

There are typical life cycle models. The most common is the trapezoidal model. This LC model includes four stages. A more complex model is the "quality loop" (ISO 9001), which encompasses 11 stages. Cascade spiral models of LC are also used. The cascade model relies on additional external resources that increase the life cycle duration. The spiral model is based on the development of an additional resource in the process of cyclic functioning of a system or object. In this paper, we propose a mechanism for constructing the life cycle of a real estate object based on the concept of resource use. In addition, the initial stage of the creation of a real estate object and the final stage of its termination are considered separately.

Resources as the LC model basis. The resource consumption life cycle model [4] (RCLCM) is based on the fact that the rate of resource consumption during the creation of an object and the rate of their consumption by the object define the initial phase of growth and the final phase of degradation of most objects, including living systems as well as regional ones.

As a mathematical basis to construct a life cycle model, it is advisable to use the Verhulst (Pierre Francois Verhulst) equation, which he formulated to describe the growth model [13, 14]:

$$\varphi \frac{dR}{dt} = vR\left(1 - \frac{R}{K}\right). \quad (1)$$

Expression (1) shows the initial correlation of resource changes to the rate of their expenditure and the resources volume required to complete the growth process. In expression (1), parameter v characterizes the rate or intensity of external resources consumption (resource unit/time), parameter K is the resource capacity of the property, that is, the maximum possible number of resources for the creation of a real estate object (construction and functioning). The indicator φ is a dynamics indicator, that is, the phase of growth or degradation. It has two values +1 and –1. The value of φ reflects two opposite in essence processes following the same functional correlation.

The positive indicator φ value corresponds to the development of the real estate. It consumes an external resource and accumulates its own. The negative value of the dynamics indicator corresponds to the degradation of the system due to the consumption of its own resource and loss of the object sustainability. The exact solution of the equation (1) is an $R(t)$ sigmoid or an S-shaped curve:

$$R(t)=\frac{KR_0e^{vt}}{K+R_0\left(e^{vt}-1\right)}. \quad (2)$$

The $R(t)$ function has a limit due to the resource capacity of the real estate object:

$$\lim_{t\to\infty}R(t)=K. \quad (3)$$

This means that if $R(t) > K$, then there is a waste of resources. For comparability of different life cycles, the values of $R(t)$ and K are measured in relative units: either as a percentage or in the range [0; 1]. The latter option is preferable, since it allows the use of probabilistic characteristics and probabilistic models. Fig. 1 shows a graphical representation of the solution of equation (2) or the growth phase S of the real estate object. This solution describes an ascending sigmoid. The symbols indicate different periods: C — the period of conceptual design, D — design, B — construction, E — operation.

Operation corresponds to the maturity period (normal functioning) of R_{con}. Depending on the rate of resource consumption, the slope or straight-line section of the curve changes. Fig. 2 shows a graphical representation of solution (2) at different resource consumption rates.

In Fig. 2, the curves represent three situations. Standard construction S_1 corresponds to the standard delivery date t_1. Accelerated construction S_2 *corresponds* to an earlier delivery date t_2. Delayed construction S_3 corresponds to the delayed delivery t_3. For the rates of external resources consumption (Fig. 2) $v_2 > v_1 > v_3$ takes place, respectively, the commissioning time $t_2 < t_1 < t_3$.

Thus, the rate or intensity of consumption of v resources within certain limits changes the growth phase of the life cycle of the real estate asset. This mechanism is a lifecycle management tool. The shelf "R_{con}" is the period of operation of the facility.

If the object is operated, it is characterized by tear&wear and destructive effects of the external environment. In this case, the dynamics indicator φ = –1 and the solution takes the following form in expression (4):

$$R(t)=\frac{KR_0e^{-wt}}{K+R_0(e^{vt}-1)}. \quad (4)$$

In expression (4) there is a parameter w, which shows the internal resources' consumption rate. This solution corresponds to the descending curve presented in Fig. 3.

Fig. 3 illustrates the maturity R_{con} phase and the next degradation Q phase (dissipation). The degradation phase is caused by physical wear and tear or external impacts. It is obvious that the internal resources rate of expenditure at this stage determines the degradation time period. This situation is demonstrated in

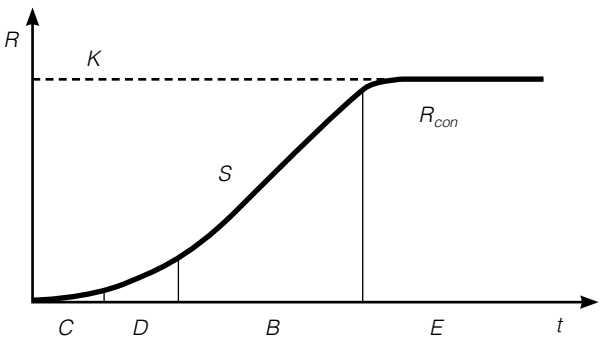

Fig. 1. Growth S phase of the real estate

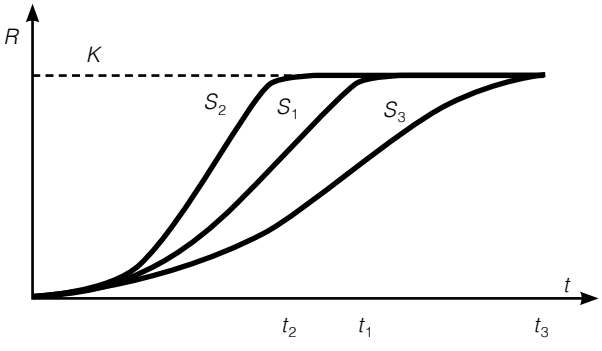

Fig. 2. Three variants of external resource consumption

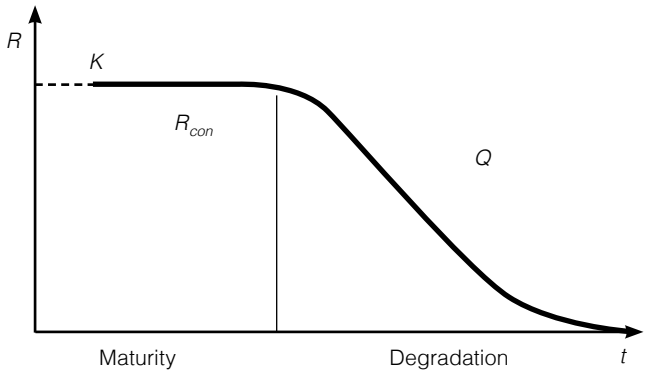

Fig. 3. Degradation phase Q of the lifecycle of the real estate object

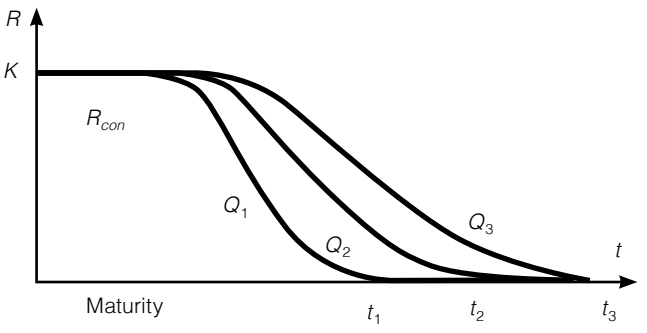

Fig. 4. Three options of the internal resources' consumption

Fig. 4. For the situation illustrated in Fig. 4, $w_1 > w_2 > w_3$, respectively $t_1 < t_2 < t_3$. Conclusion: the faster internal resources are consumed, the shorter the facility's service life.

The Verhulst equation proves it. Consequently, the patterns that this equation describes can be taken as the basis for constructing the lifecycle of a real estate object for the phases of growth and termination of operation.

The model in Fig. 3 comprises part of the maturity process R_{con} and the degradation process Q. The general model of the lifecycle of real estate (LCRE) is defined as the sum of the processes of growth S, maturity R_{con} and degradation Q, that is, the combination of expression (2) and expression (4):

$$\text{LCRE} = S + R_{con} + Q. \quad (5)$$

The degradation or dissipation often starts under the impact of external destructive forces. This situation is shown in Fig. 5. As a normal condition, destructive forces can have an impact on the real estate object.

An external negative impact entails the consumption of internal resources of the real estate object and generates a dissipation Q process (Fig. 3, Fig. 4). In order to support the LCRE, it is necessary to reduce or stop the Q degradation. For this purpose, an additional external reserve resource R^* is introduced, on which the condition $R^* = -Q$ is imposed. Under this condition, the additional resource neutralizes the Q degradation and modifies the lifecycle LCRE*:

$$\begin{aligned} \text{LCRE}^* &= \text{LCRE} + R^*_{con}, \\ \text{LCRE}^* &= \text{LCRE}. \end{aligned} \quad (6)$$

Degradation occurs due to wear&tear, internal failures, or external impacts. When the factors driving the Q degradation appear, it is necessary to use new resources R^*. The recursive use of expression (6) allows us to increase the lifecycle of the real estate object as long as there are resources to neutralize degradation or dissipation.

Synchronous and asynchronous LC management. We can talk about a modified and ordinary lifecycle model. The ordinary model is described by the expression (7):

$$\text{LCRE} = S + R_{con} + Q. \quad (7)$$

Modified model relates to the expression (6) and takes the form:

$$\text{LCRE} = S + R_{con} + Q + R^*. \quad (8)$$

The peculiarity of expression (8) is that the R^* value can be used repeatedly and thereby continuously increase the lifecycle of a real estate object. In transport, this corresponds to the regular track repair. In fact, repeated use of R^* means cyclic lifecycle management. We can talk about a modified R^* con maturity period or functioning of real estate.

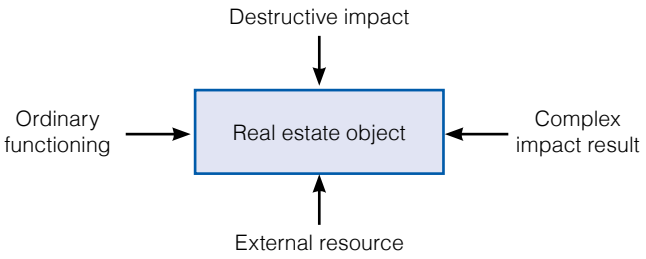

Fig. 5. A model of the resulting impact of destructive forces and external resources on a real estate object

The total value of R^* will depend on the number of management acts (repair and restoration work). Fig. 5 shows that an increase in LCRE is possible due to the use of external resource that compensates for external destructive effects. In theory, n number of such interactions are allowed. Their number cannot be large, since the amount of work and the cost of repairs increases over time, and the efficiency of the facility decreases. At a certain point it is more feasible to create a new object compared to the operation and repair of the old one. However, while it is possible, it is advisable to repair the old object instead of creating a new one. For the lifecycle repair or modification, two types of LC modification are possible: synchronous and asynchronous. Fig. 6 shows asynchronous LC correction.

Based on observations or monitoring, the presence of Q or its signs is detected. The rate of resource consumption w is estimated. Predicated on the experimental data, the appropriate rate of resource consumption v is selected under the condition:

$$v \approx w. \quad (9)$$

The process of correcting the S state begins. Fig. 6 illustrates the processes of Q degradation and S_i correction. The semi-bold line DR denotes the resulting process:

$$DR = S_i(v) + Q(w). \quad (10)$$

The time of the destruction initiation is indicated by t_q, the time of the correction initiation is indicated by t_s. There is a time gap between them Δt — the period of asynchrony. This is a typical situation when a destructive process begins, while the manager is not ready for it and did not expect its beginning. The shorter the asynchrony time, the faster the LC recovery, that is, regular operation.

Fig.7 illustrates the asynchronous correction.

In case of synchronous correction:

$$DR = R_{con}. \quad (11)$$

What makes synchronous correction possible? Its basis is spatial monitoring and forecasting. The costs of monitoring and forecasting compensate for the costs of synchronous correction and losses during the period of asynchrony. Thus, additional resources (reserve), monitoring and forecasting are needed for synchronous LC correction. Monitoring and forecasting can be considered as a support system for real estate lifecycle management.

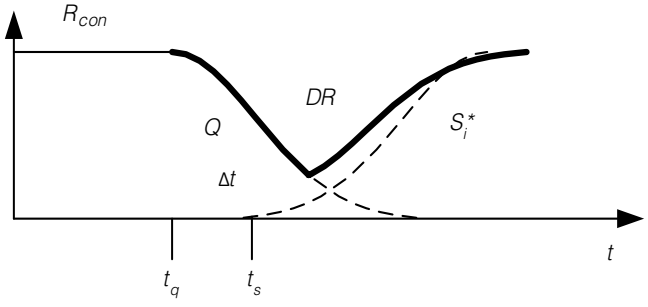

Fig. 6. Asynchronous LC correction

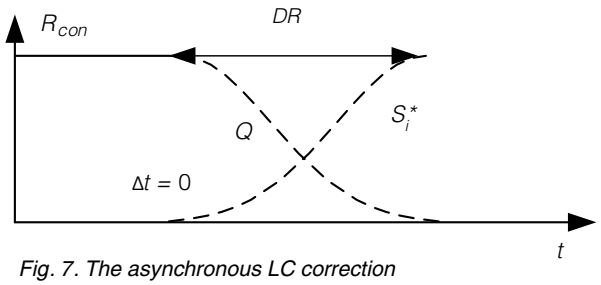

Fig. 7. The asynchronous LC correction

CONCLUSION

The fundamental difference between the phases of growth and degradation of real estate is that its growth is provided by a person, and degradation is caused by the impact of "nature". Therefore, this model of life cycle management is based on creation on the "man – nature" interaction. The parameters *v* and *w* are defined empirically. It varies for different types of objects. Usually, the standard construction time is estimated, for which *v* is assumed to be equal to 1. Resource consumption is estimated based on the standards of physical wear. In general, this model is comparative, which allows it to be used for various situations. The proposed LC model consists of qualitatively different processes but is described by similar mathematical equations. In the first case, the consumption of external resources is considered. In the second, the expenditure of internal resources. The analysis shows that the RCLCM offers a deterministic path of organizational development, demonstrating limited explanatory strength when faced with the issues of the real business environment. Therefore, it is proposed to consider RCLCM as a process "driven" by the resources reacting on the external environment behaviour. In response to these changes in the environment, companies spend resources from the reserve fund to ensure the functioning and development sustainability. It is proved that monitoring and forecasting are components of synchronous lifecycle management.

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Управление жизненным циклом объекта недвижимости с использованием уравнения Ферхюльста

Управление жизненным циклом объекта недвижимости является важной составной частью воспроизводственного процесса. Дается краткий анализ моделей жизненных циклов организации. В качестве гипотезы научного исследования предполагается, что жизненный цикл на начальном этапе строится на потреблении внешних ресурсов, а на завершающем этапе расходует внутренние ресурсы. Вводятся понятия «модель жизненного цикла расхода ресурсов» и «скорость расхода ресурсов». Именно скорость расхода ресурсов определяет окончание жизненного цикла объекта недвижимости. В качестве математической основы используется дифференциальное уравнение Ферхюльста, применяемое для модели роста популяций. Модель жизненного цикла включает три фазы: роста, стабильности, деградации. Показана возможность модификации жизненного цикла при использовании такой модели. Описано синхронное и асинхронное управление. Доказано, что мониторинг и прогнозирование являются компонентами синхронного управления жизненным циклом недвижимости.

Ключевые слова: *управление недвижимым имуществом, жизненный цикл, ресурсы, модель жизненного цикла расхода ресурсов, синхронное управление*

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Об авторе: **Волков Роман Вячеславович** — кандидат экономических наук, первый проректор; **Российский университет транспорта (РУТ (МИИТ))**; 127994, ГСП-4, г. Москва, ул. Образцова, д. 9, стр. 9; РИНЦ ID: 872062; volkov-su4@mail.ru.

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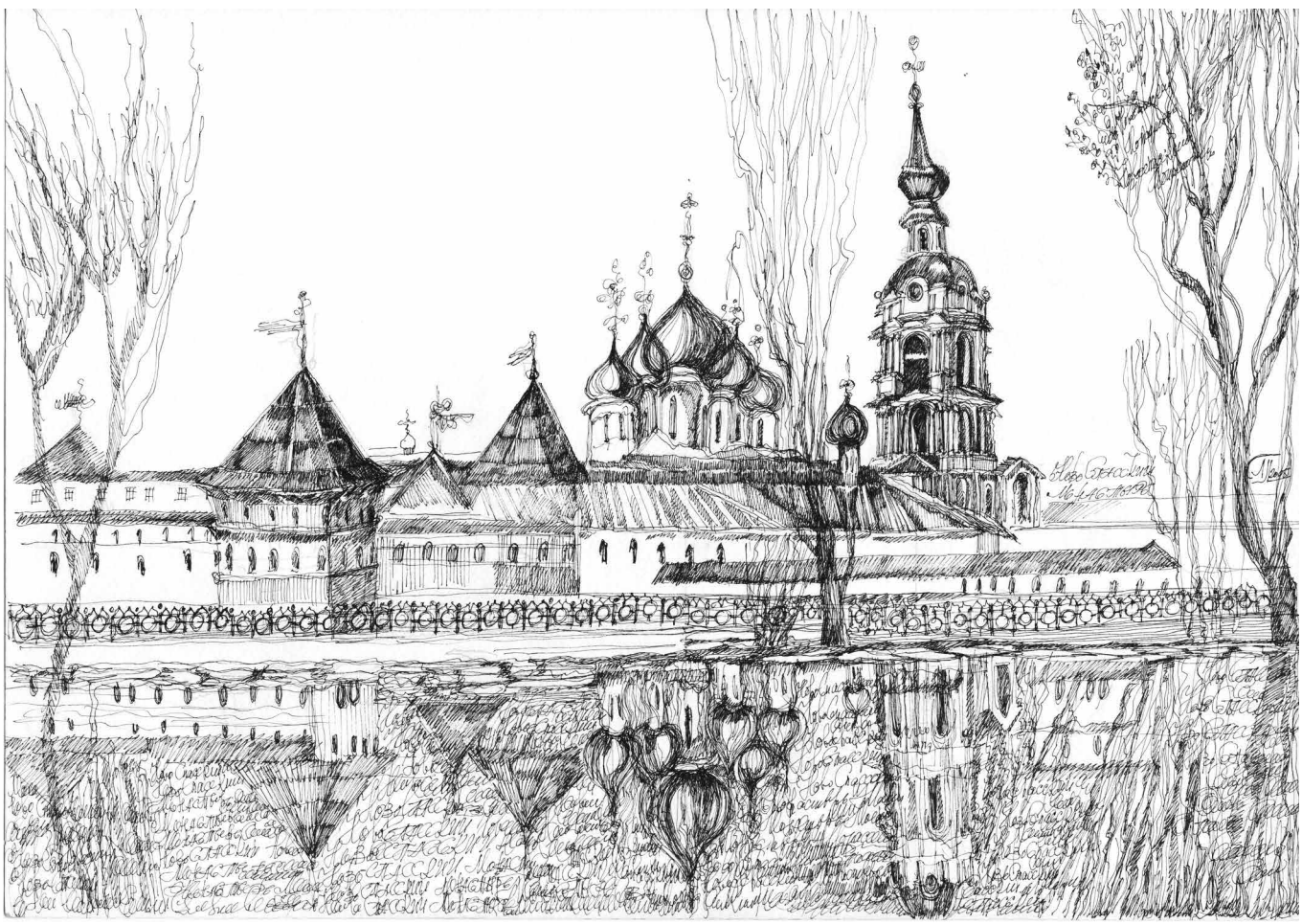

Л.И. Павлова. Москва. Новоспасский монастырь. Рисунок, тушь перо.

UDC 338.5

Uvarova S.S.
Belyaeva S.V.
Bolgov V.A.

Assessment and modelling the dynamics of building materials prices in the current conditions

Construction, which is the driver of economic development in the current crisis conditions, needs to determine the correct cost and sufficiency of material resources, as well as systematic forecasting of price dynamics in order to plan the implementation of investment projects. High material capacity of construction products, along with the specificity of its pricing, leads to the necessity of not only keeping sufficient accuracy of quantitative and cost calculations regarding basic construction materials but also predicting the dynamics of cost in order to determine the volume of capital costs and accounting for the cost of work. The unstable dynamics of the cost of construction materials in 2022, caused by foreign policy pressure, requires the systematization of the factor space in order to predict trends more reliably. The factor space of the price dynamics of construction materials has undergone fundamental changes, starting with the impact of the coronavirus pandemic, and further due to changes in the geopolitical situation, sanctions pressure from unfriendly countries and corresponding changes in the economic principles of globalization, the transformation of the global and domestic logistics system, as well as the actions of local country and industry scale predictors. The authors have proposed a system of factors affecting the cost of building materials, structures and products in modern conditions, on the basis of the factor analysis the prices of basic building materials (armature and concrete) have been corrected by the expert method, a scenario forecast of price dynamics has been made. The authors substantiate the necessity for calculation-expert forecasting in conditions of high uncertainty and variability of forecasting results. In general, in the short term, a moderate upward trend in the cost of basic building materials with a rather high value coefficient of variation, explained by the strong influence of non-economic factors on the price.
Keywords: *construction, forecast, factors, prices, building materials*

Uvarova Svetlana Sergeevna,
Doctor of Economic Sciences, Professor of Department of Economics and Management in Construction; Moscow State University of Civil Engineering (National Research University) (MGSU); 26 Yaroslavskoe shosse, Moscow, 129337, Russian Federation; SPIN-code: 3282-8871, Scopus: 57192670466, ResearcherID: W-4990-2018, ORCID: 0000-0002-9385-8182; uvarova_s.s@mail.ru

Belyaeva Svetlana Viktorovna,
Candidate of Economic Sciences, Associate Professor, Associate Professor of the Department of Digital and Sectoral Economics; Voronezh State Technical University (VSTU); 84 20-letiya Oktyabrya st., Voronezh, 394006, Russian Federation; SPIN-code: 8541-4739, Scopus: 56437610100, ResearcherID: W-1655-2018, ORCID: 0000-0002-0771-5661; Belyaeva-sv@mail.ru

Bolgov Vladimir Aleksandrovich,
Candidate of Economic Sciences, Associate Professor, Department of Digital and Sectoral Economics; Voronezh State Technical University (VSTU); 84 20-letiya Oktyabrya st., Voronezh, 394006, Russian Federation; SPIN-code: 2814-7129, Scopus: 571944440216, ResearcherID: AAD-3421-2022, ORCID: 0000-0002-6563-9783; v_bolgov@mail.ru

The current conditions of economic turbulence [1], resulting from of a rather sudden alteration in the foreign policy situation, characterized by a change in the Central Bank key rate, the presence of sanctions pressure and foreign trade restrictions, changes in logistics conditions [2], fluctuations in exchange rates and other related and derived factors[1] , have led to a rather sharp rise in the cost of construction and finishing materials.

The unstable dynamics of the cost of building materials, including some declines in market prices for a number of items, are largely due to government intervention and decreasing demand, along with the need to provide a certain volume of products for manufacturers. Various studies postulate an increase in the cost of building materials from 10 to 50 %[2, 3, 4,] and the production of some building materials is import-dependent. Under these conditions, the necessity of systematization, estimation and modelling of the factors determining the dynamics of building materials prices is revealed in order to predict them in future.

In current conditions, the geopolitical situation and the related sanctions policy affecting the construction and building materials market both directly (need for import substitution of a range of materials, structures and products) and indirectly (need for changes in logistics chains, import substitution of technological equipment), as well as market factors of demand dynamics and influence mediation activities, possible price cartel agreements and logistics costs [3, 4].

The main factors affecting the cost of building materials, structures and products have been systematized by us in the form of a diagram (Fig. 1).

Taking into account all these factors, prices for building materials are not expected to decrease in 2022: in the most optimistic scenario, their growth will slow down to a proportionate projected inflation of 7–9 %. However, in the baseline scenario, we predict a more significant rise — by 12–15 % in total.

Manufacturers and suppliers of raw materials and goods are not yet able to fully meet the increased demand, and transport and logistics companies are unable to cope with the increased buyer activity. At the same time, the prices of oil, gas, many metals and other raw materials, which take up a significant share of the cost of production of many goods, including construction materials, are rising. These factors negatively impact both global inflation and inflation rates in the Russian Federation. In addition, due to the increase in the key rate, the need for which is caused by the influence of geopolitical

1 World Bank (2022). Annual report 2022: Helping countries adapt to a changing world. Washington, DC.

2 How will import substitution affect the timing of construction and the cost of housing. URL: https://realty.rbc.ru/news/627ca82a9a7947e7150513b6

3 Forecasts of socio-economic development. URL: https://www.economy.gov.ru/material/directions/makroec/prognozy_socialno_ekonomicheskogo_razvitiya

4 Threat No. 1: Why are building materials becoming more expensive and how prices will be restrained. URL: https://realty.rbc.ru/news/622b60829a7947f7030079c3

factors and increased inflation, the cost of borrowed capital is also increasing[2].

One of the key materials used in construction is steel reinforcement. Its share in the cost structure of building materials averages 28 %, and prices directly depend on world steel prices. In the third quarter of 2020, after the cancellation of some of the restrictive measures caused by the pandemic, steel prices began to rise and jumped by 160 % from October 2020 to October 2021, while rebar prices in the domestic market rose by 52 % over the same period[5].

In 2021, despite the seasonal decline in demand for metal products and the export restrictions imposed, rental prices at the end of the year made a new high [5]. The unstable situation on the world stage, complicated by sanctions, Russia's progressive economic isolation and, as a consequence, currency fluctuations, led to an increase in prices for metal products in the domestic market during the first quarter of this year by 10–25 %, depending on the nomenclature[6].

The cost of rebar is directly related to the situation in steel production: higher prices for alloying elements, iron ore, transport and electricity leads to a jump in quotations. The Russian government has imposed a restriction on the margin for metal traders in the domestic market (7–12 %), banned the export of alloyed scrap to unfriendly countries and increased the export duty for the rest of the scrap[7]. On the one hand, the steel industry has faced a number of export restrictions due to the sanctions regime, affecting about 5 million tons of products, except raw materials, cast iron and steel semi-finished products, which is 15 % of the annual exports of the industry. Under these conditions, metal producers are reorienting export routes and increasing shipments to the domestic market, with direct long-term supply contracts. Accordingly, we believe that in the near future, it is difficult to expect

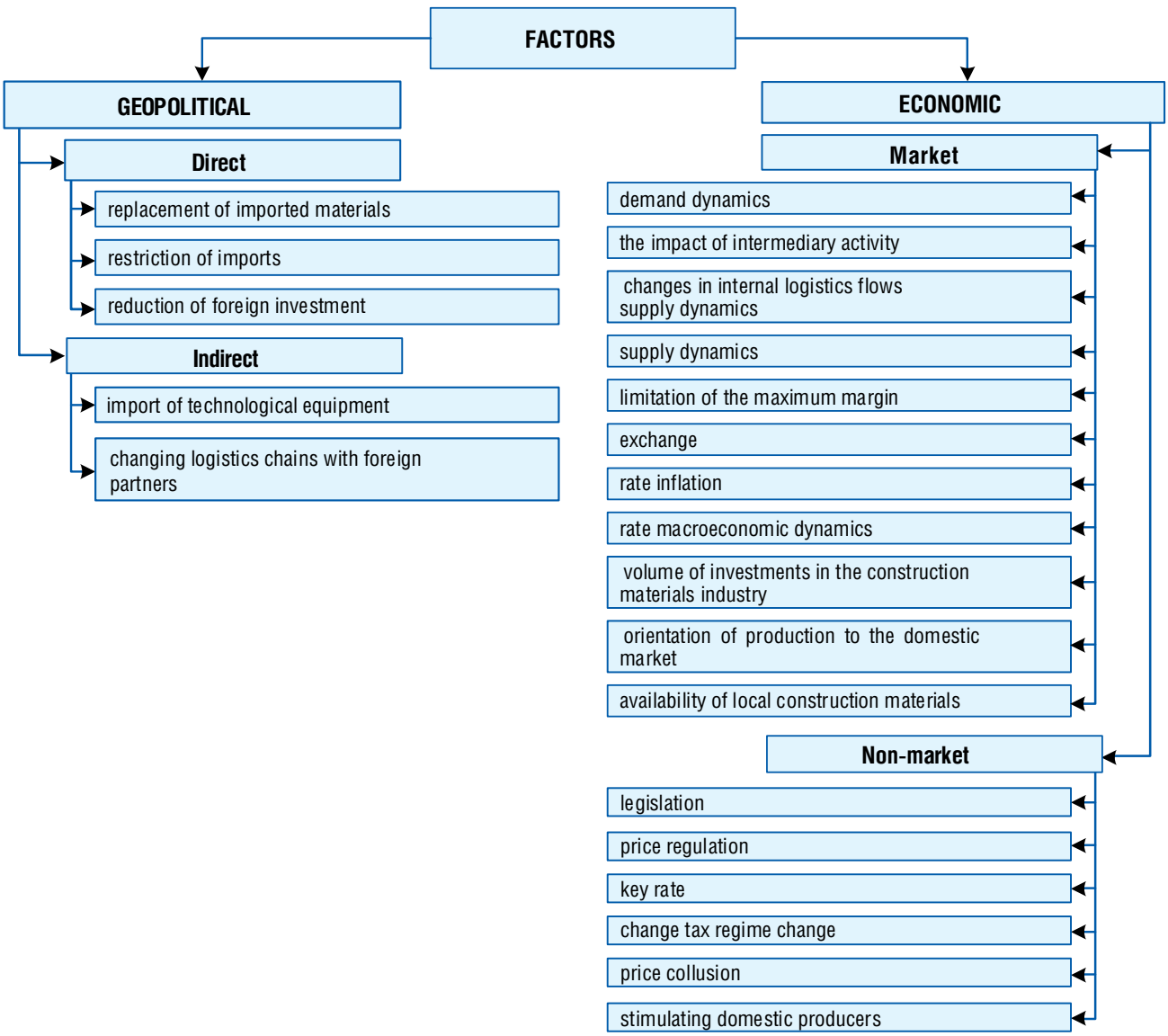

Fig. 1. System of factors affecting the cost of building materials, structures and products in the current conditions

5 METALSERVICE: official website. URL: tats/stats

6 GOSTMETALL: official website. URL: https://gostmetal.ru/dinamika

7 The Ministry of Industry and Trade against further restrictive measures for metallurgy. URL: https://mc.ru/news/nw/news_id/13687

a significant price decrease for rebar, but strong price rises are not expected either. It is not possible to accurately predict the position of rebar prices in 2022. However, there are factors contributing to the growth and decrease in the cost of steel products.

Among the price growth should be an increase in rail tariffs, increasing transport costs to bring raw materials to steel mills, which will increase the cost of production and the final cost to consumers.

The second quarter of 2022 adds increased demand due to the seasonality of construction in the central Federal District, which may also affect rebar prices.

However, the cumulative drop in domestic demand for metal products by the end of 2022 may reach 30 % (about 13 million tons)[7] due to the suspension of the automotive industry. On the other hand, under the conditions of sanctions restrictions, there is a reorientation of metallurgy towards the domestic market, which is likely to lead to lower prices. The increase in the export duty of scrap metal is intended to restrain the growth of the value of rolled metal products.

Regarding the influence of factors on the price of non-metallic building materials, including concrete and concrete mixtures, the driver of price growth is the growth of export quotations and changes in prices for raw materials. Moreover, the reasons for the price increase are market uncertainty and increased demand, the transport component, rising costs and access issues, foreign equipment and components for it.

Concrete prices have not increased as much as rebar prices. The share of concrete, products made from it, as well as cement in the structure of the cost of building materials in total is 28 %. The share of cement in the volume of work by type of activity "Construction" decreased from 4 % in 2014 to 2.5 % in 2021[4]. The main reasons for the increase in cement and concrete prices are the activation of the construction industry, the rise in the cost of raw materials used for concrete and the increase in the cost of freight transportation, as well as geopolitical factors.

The impact of the need to replace foreign technological equipment and materials used in the total volume of construction and installation works of Russian projects does not exceed 10 %. The "PIK" Group estimated the share of imports in housing construction to be even lower, at 5 %. However, in the high-budget segment, this figure can reach 50 %[8]. In March, Russian Deputy Prime Minister Marat Khusnullin said that the Russian construction industry is ready for import substitution, since the share of imports in road construction is 5 %, and in residential construction does not exceed 8–10 %[9]. Thus, import substitution is not a key price-forming factor for non-metallic building materials.

At the same time, many enterprises require investments in the modernization of technological equipment, which, along with geopolitical factors, may affect concrete and cement prices in the medium and long term.

Experts estimate that the sanctions will require 66 % more funds will be required for repairs and maintenance of equipment than a year earlier. Coal went up in price by 76–86 %, goods and materials — by 55 %, diesel fuel — by 30 %, oils and lubricants — by 83 %, transport and logistics costs increased by 14–24 %[4].

The Ministry of Construction and other relevant departments plan to reduce the mineral extraction tax (MET) for producers of inert building materials. These measures are designed to reduce the price of non-metallic building materials and concrete, among others.

In addition to a large number of intermediaries, the increase in final prices for building materials is affected by rising logistics costs, so, in the cost of crushed stone and sand, up to 90 % of the cost of transportation[10]. At the same time, suppliers of building materials are enable to enter into long-term contracts with railway carriers and are forced to work on the spot market. The increase in transportation tariffs leads to an increase in prices for the main components of the concrete mixture. However, the Russian Government is working on a number of measures to reduce the cost of transporting construction goods, including fixing railway tariffs for manufacturers of building materials, as well as booking a certain percentage of wagons for their needs[11].

A number of publications note that the Russian government has simplified the procedure for confirming the suitability of building materials and structures in order to bring goods to market more quickly. In particular, the validation period for domestic building materials has been reduced from 90 to 10 working days[12].

Production volumes in the cement industry always fall sharply in the times of crisis and the decline continues for several years. The crisis of 2022 is one of the most serious challenges for Russia since the 1990s, according to the Bank of Russia's monetary policy report. The drop in GDP in 2022, the report says, will be from 8 to 10 %[3]. "The measures taken by the Russian government and the Bank of Russia will support the structural transformation of the economy, the transition to new equilibrium trends", the report notes.

Based on the analysis and systematization of factors, the assessment of the dynamics of prices for building materials, the study of expert opinions on this issue, it was decided that it is expedient to calculate the expert assessment of the forecast dynamics of prices for building materials. Expert correction is necessary in conditions of a high degree of uncertainty and risk, which complicates the practical application of economic, mathematical and econometric models. In this situation, an expert assessment of trends and the main price change scenarios is possible.

As a result of the expert survey, the following estimates of possible price developments for rebar and concrete mixtures were obtained, and the corresponding estimated price adjustments were made (Table).

Based on the results of the expert assessment, it can be concluded that in 2022, prices for building materials (reinforcement and concrete) are not expected to decrease: in the most optimistic scenario, their growth will slow down to 7–8 %. However, in the baseline scenario, prices are projected to rise by a combined

8 The state and prospects of development of the industry of production of building materials and related industries // Investment portal of the Moscow Region. URL: https://investmoscow.ru/media/

9 RBC: official website. URL: https://chr.rbc.ru

10 SOYUZCEMENT: The cost of the basic building material lags behind the prices of other goods and services. URL: oyuztsement:-stoimost_-bazovogo-stroimateriala-otstaet-ot-tsen-na-drugie-tovari-i-uslugi.html

11 Mass media: to reduce the final prices for building materials, railway tariffs may be fixed. URL: troitel_nie_materiali/smi-dlya-snizheniya-konechnih-tsen-na-stroimaterialov-mogut-zafiksirovat-zhd-tarifi.html

12 Ministry of Construction, Housing and Utilities of Russia: Official website. URL: https://www.minstroyrf.gov.ru

Results of expert assessment of price variants for rebar and concrete mixtures

Expert	Increase in the cost of fittings, %	Increasing the cost of concrete, %	Forecast of the average cost of fittings in the Russian Federation, rub.	Forecast of the average cost of concrete in the Russian Federation, rub.
1	7	16	55,640	4,872
2	12	10	58,240	4,620
3	25	15	65,000	4,830
4	30	10	67,600	4,620
5	4	14	54,080	4,788
6	10	9	57,200	4,578
7	15	8	59,800	4,536
Average value	15	12	59,651	4,692
Consistency of experts	0.65	0.73	0.92	0.97

12–15 %. The pessimistic scenario provides for an even greater increase in prices by 16–25 %.

In 2022, concrete prices are expected to increase, and with a wide range of possible increases from 10 to 50 % due to the multiplicative accumulation of factor effects and the lack of practical methods of regulating prices for local building materials.

Along with the above scenarios, it is necessary to take into account the influence of all the identified factors, the results of an expert assessment of price trends, as well as measures taken by the Russian government to support the economy of the construction industry.

The impact of the factors mentioned above is taken into account and the forecasts obtained on the basis of the ARIMA model are adjusted to the value of the confidence interval, taking into account scenario analysis and variants of the influence of the factors identified in the study (Fig. 2).

The corresponding adjustments and consideration of the price range of concrete mix in the Moscow region, taking into account the scenario analysis, are shown in the figure below (Fig. 3).

Note that the range of forecast prices in each specific period of the time interval includes a variant of an optimistic scenario (minimum price), a realistic scenario (forecast price), and a pessimistic scenario (maximum price). The resulting trend does not take into account the direct force majeure influence of geopolitical factors, however, the scenarios were formed taking into account the influence of a set of factors systematized in this study.

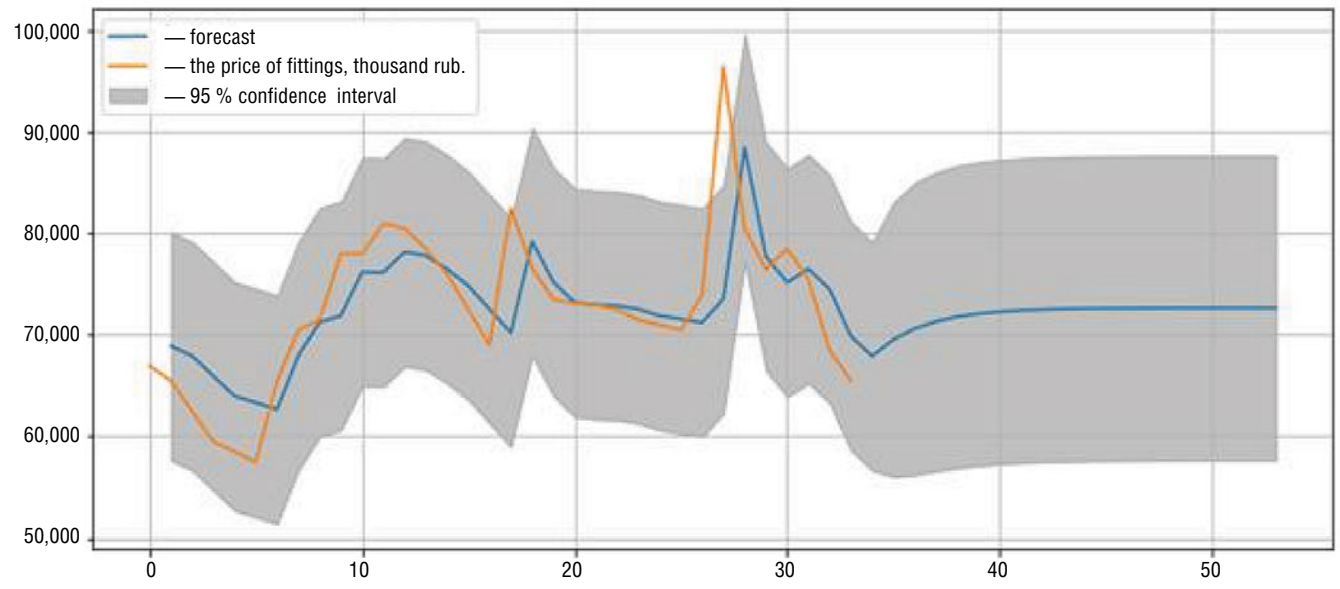

Fig. 2. Projected price graph of f12 A500C rebar in the Moscow region with 95 % confidence interval

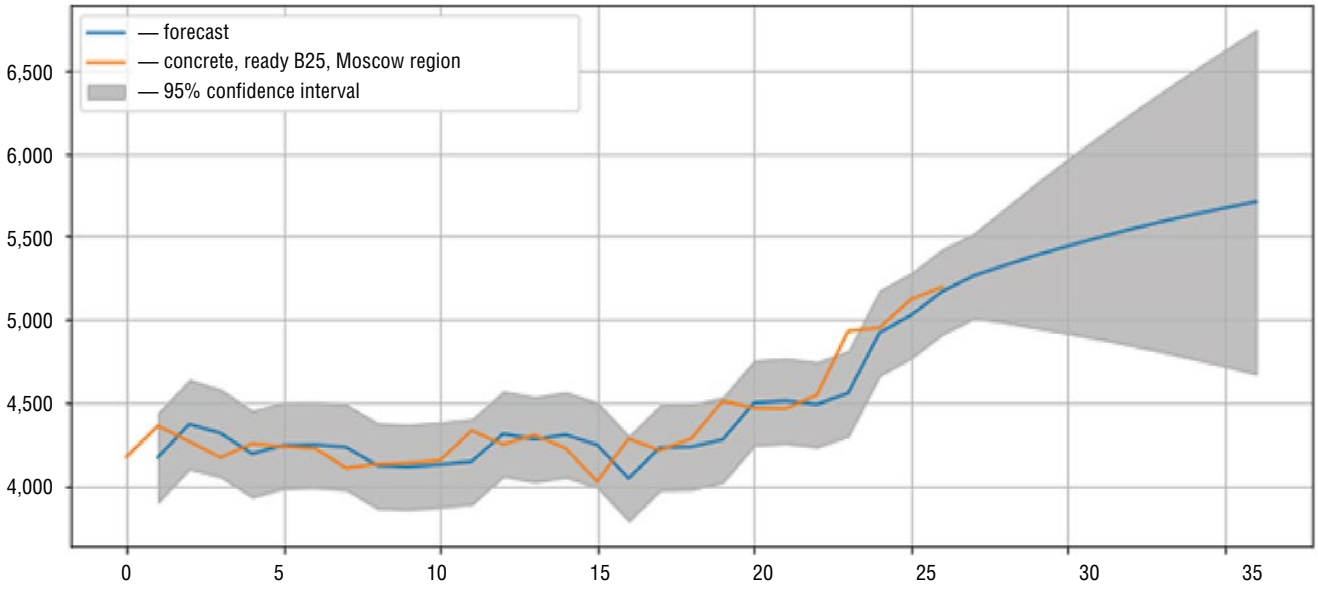

Fig. 3. Projected graph of concrete prices in the Moscow region with a confidence interval of 95%

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Оценка и моделирование факторов динамики цен строительных материалов в современных условиях

Строительство, являющееся драйвером развития экономики в современных кризисных условиях, нуждается в определении корректной стоимости и достаточности материальных ресурсов, а также в системном прогнозировании динамики цен в целях планирования реализации инвестиционных проектов. Высокая материалоемкость строительной продукции наряду со спецификой ее ценообразования приводят к необходимости не только соблюдения достаточной точности количественных и стоимостных расчетов относительно основных строительных материалов, но и прогнозирования динамики стоимости с целью определения объемов капитальных затрат и учета себестоимости работ. Неустойчивая динамика стоимости строительных материалов в 2022 г., вызванная внешнеполитическим давлением, требует систематизации факторного пространства с целью более достоверного прогнозирования тенденций. Факторное пространство ценовой динамики строительных материалов претерпело коренные изменения, начиная с влияния пандемии коронавируса, и в дальнейшем в связи с изменением геополитической ситуации, санкционным давлением недружественных стран и соответствующими изменениями экономических принципов глобализации, трансформацией мировой и внутрироссийской логистической системы, а также с действиями локальных предикторов странового и отраслевого масштаба. Авторами предложена система факторов, влияющих на стоимость строительных материалов, конструкций и изделий в современных условиях, на основе факторного анализа экспертным методом скорректирован прогноз цен основных строительных материалов (арматуры и бетона), построен сценарный прогноз динамики цен. Авторами обоснована необходимость расчетно-экспертного прогнозирования в условиях высокой неопределенности и вариабельность результатов прогнозирования. В целом в краткосрочном периоде ожидается умеренная повышательная динамика стоимости основных строительных материалов с достаточно высоким значением коэффициента вариации, объясняемым сильным влиянием на цену неэкономических факторов.

Ключевые слова: *строительство, прогноз, факторы, цены, строительные материалы*

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Об авторах: **Уварова Светлана Сергеевна** — доктор экономических наук, профессор кафедры экономики и управления строительством; **Национальный исследовательский Московский государственный строительный университет (НИУ МГСУ)**; 129337, г. Москва, Ярославское шоссе, д. 26; SPIN-код: 3282-8871, Scopus: 57192670466, ResearcherID: W-4990-2018, ORCID: 0000-0002-9385-8182; uvarova_s.s@mail.ru;

Беляева Светлана Викторовна — кандидат экономических наук, доцент, доцент кафедры цифровой и отраслевой экономики; **Воронежский государственный технический университет (ВГТУ)**; 394006, г. Воронеж, ул. 20-летия Октября, д. 84; SPIN-код: 8541-4739, Scopus: 56437610100, ResearcherID: W-1655-2018, ORCID: 0000-0002-0771-5661; Belyaeva-sv@mail.ru.

Болгов Владимир Александрович — кандидат экономических наук, доцент кафедры цифровой и отраслевой экономики; **Воронежский государственный технический университет (ВГТУ)**; 394006, г. Воронеж, ул. 20-летия Октября, д. 84; SPIN-код: 2814-7129, Scopus: 571944440216, ResearcherID: AAD-3421-2022, ORCID: 0000-0002-6563-9783; v_bolgov@mail.ru.

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Gvozdev E.V.

A rational–targeted model for the development of an integrated safety and security system at oil and gas enterprises in Russia

The article presents an analysis of existing approaches to ensuring integrated security at industrial enterprises. This research is focused on the use of an interdisciplinary approach in its provision at the enterprises of oil and gas sector (OGS) in Russia. In the article, the author presents a methodology developed for Russian oil and gas enterprises in the form of a comparative model and a flexible approach in the form of an existing and developing integrated security system to reduce various types of damage. The aim of the study is to solve the scientific problem of developing an integrated security system at the enterprises of the Russian oil and gas sector. The presented results of the study prove the feasibility of using the results of the assessment of the state of integrated security for the enterprises. Thus, the important problem in terms of rationally-targeted allocation of resources that can be used to eliminate exactly those procedures that have high impact of damage from accidents and fires, is solved. The monitoring results are presented in the form of using a new rational-target model for the development of Russian oil and gas companies. This model allows in practice solving the problem of reducing damage from accidents and fires in the integrated safety system of these enterprises.
Keywords: *oil and gas sector, integrated safety and security system, interdisciplinary approach, rational and targeted development, effective functioning*

Gvozdev
Evgeny Vladimirovich,
Candidate of Technical Sciences, Associate Professor, Associate Professor of the Department of General and Applied Physics; Moscow State University of Civil Engineering (National Research University) (MGSU); 26 Yaroslavskoe shosse, Moscow, 129337, Russian Federation; SPIN-code: 5787-2465, Scopus: 57213143299, ResearcherID: AAD-7686-2022, ORCID: 0000-0002-3679-1065; evgvozdev@mail.ru

INTRODUCTION

Today, an important place in the system of safe and reliable development in Russia is occupied by enterprises that are part of the oil and gas sector (OGS), the scale and importance of the sectoral functioning of which are simply undeniable not only in Russia, but also in any other country in the world. Russian oil and gas companies are actively involved in international trade, as in regard to 60 % of Russian oil and 90 % of gas are supplied to the countries of European Union (EU). In fact, the biggest oil and gas companies with large production volumes such as Rosneft, Gazprom and Zarubezhneft are owned by the Russian government [1].

The effective functioning of the considered enterprises of the oil and gas sector plays an exceptional role in creating conditions for the development and sustainable growth of the national economy. Currently, oil and gas companies belong to the main strategic potential for the development of the world economic system, their condition, security, and sustainable operation determine the prospects for the country's economic and social development, the performance of such essential functions as protecting the national sovereignty and security of the country and the livelihood of its population.

Reduction of accidents and fires damage in departmental (sectoral) subsystems of industrial safety (IndS), fire safety (FS), labour protection (LP) at the Russian OGS enterprises can occur in the case when, in general for integrated security (IS) of the enterprises in question will be selected for its targeted and comprehensive development. The development of the security of any enterprise is the change of the old, formed by years long approach to its management and the introduction of such a new approach, which would be based on the results of the introduction of innovation, advanced knowledge in science, application of new technologies, etc. The introduction of a new approach to safety management in the enterprise requires the development of an appropriate scientific and methodical apparatus (models, methods, etc.) to manage this condition [2].

The stable functioning of the safety of Russian OGS enterprises (as opposed to its development) is its ability not only to preserve its properties against accidents and fires, but also to return to equilibrium in the event of deviations. The article presents the system of IS, created at the Russian OGS enterprises, consisting of subsystems (IndS, FS, LP), designed to neutralize instability in the management of the enterprise security under the conditions of its resource limitations. The key idea in solving the problem of ensuring a high-quality level of safety at the Russian OGS enterprises is directly related to the development of a comprehensive interdisciplinary approach [3] based not only on the use of scientific and technical advances in the field of reliability of physical objects, but also in the development of new scientific results for the implementation of organizational and technical measures in the transition to a new qualitative level of development [4].

The above circumstances are characterized by a high degree of relevance, the author of the article offers to substantiate the use of a rational-target model of development of the IS system at the Russian OGS enterprises.

METHODS

In terms of integrated safety, multidisciplinary research aimed at improving the safety of industrial enterprises has been applied in various schools

dealing with the improvement of safety at various sites. The main schools in this scientific direction are:

- Mechanical Engineering Research Institute of the Russian Academy of Sciences (IMASH RAN);
- All-Russian Research Institute for Civil Defense and Emergency Situations of the Ministry of Emergencies of Russia (Federal Center for Science and High Technologies).

Interdisciplinarity refers to the unification of two or more scientific fields or to the development of subject areas or the unification of two or more professions, technologies, and the same method can be created for any strategic goal [5]. Under interdisciplinary approach the "principle of organization of new scientific knowledge" opens wide possibilities of interaction of many disciplines in solution of nature and society complex problems. Since the results obtained in them, it allows researchers to go beyond their discipline, to use known advances in a new production and to obtain new scientific results [6–8].

Using an interdisciplinary approach in the Russian oil and gas companies, it became necessary to find a method used for the rational-targeted development of the IS system at Russian oil and gas companies. The formed conviction as a non-standard approach allows to combine scientific achievements obtained in the different fields, the author of this article considered it necessary to use the mass center as a geometric point, the position of which is determined by the distribution of mass in the body, and the movement characterizes the movement of the body or mechanical system as a whole, in this regard oil and gas companies must use a flexible approach [9, 10].

If the entire volumetric resource of an enterprise, designed to ensure the stable functioning of subsystems (IndS, FS, LP) of Russian oil and gas companies, is considered as a content consisting of smaller volumes (masses), each of which in its own way affects the general condition of the IS at the enterprises under consideration, then the task of finding a rational target point for the development of an enterprise is reduced to the task of finding an existing

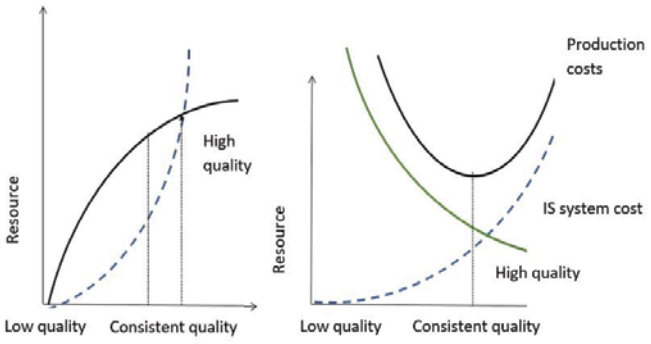

Fig. 1. Function to improve the performance of the IS system at the Russian Oil and Gas Sector enterprises

starting point, which is located in the coordinates of a stable functioning of the enterprise. The presence of two points allows to build a directional vector from the starting point towards the point indicating the direction to achieve a research purpose.

Between the quality of the functioning of the IS system and the resource of the enterprise in the Russian OGS, intended to ensure it, there is a relationship of the form in Fig. 1. The most rational will be the qualitative level at which a slight increase in efficiency will require a sharp increase in costs, which will provide a rational function between the resource volume invested in subsystems (IndS, FS, LP) and the indicator of damage reduction from accidents and fires. The option of the IS qualify level which is more to the right of the stable quality line adjacent to the resulting curve will be rational [11, 12].

The rational-target model for the development of the IS system at the enterprises of the oil and gas sector in Russia is considered on Fig. 2, which shows points with an integral indicator of the impact on reducing damage from accidents and fires, where the left side shows resources, each of which is characterized by an individual volume allocated to the safety subsystem (IndS, FS, LP),

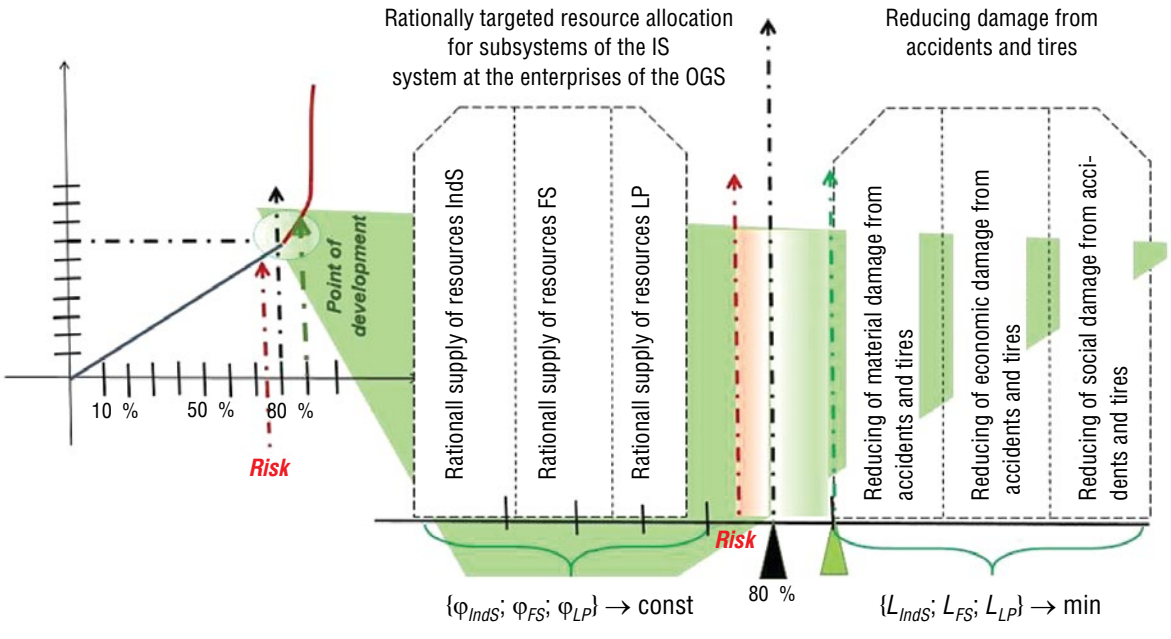

Fig. 2. The rational-target model for the development of the IS system at the Russian Oil and Gas Sector enterprises

formed from the summed volumes of its private indicators, corresponding to the property of proportionality of damage.

The presence of two points on the horizontal scale for the stable and developing states of the functioning of the enterprise makes it possible to determine such a rational amount of resource for each of the subsystems (IndS, FS, LP), so that the point moves to the right, tends to reach a level approximately equal to 90 %.

For instance, the scientific problem for the development IS system, created at the enterprises of the oil and gas sector in Russia was solved. To demonstrate it, the management of oil and gas companies in Russia make a decision to develop the IS system created at these enterprises, thus, in a certain period of time, transfer it from a state of stable (sustainable) functioning to a new qualitative state of development. The management of Russian oil and gas companies determined a dedicated time period for the transition, considered as the initial time reference point — t_0 and the goal achievement point — t_1, presented in a model of the form:

$$\sum_{i=1}^{N} P_{\varphi_{n1}}(t_0) \rightarrow \sum_{i=1}^{N} P^{*}_{\varphi_{n2}}(t_1), \quad (1)$$

where $P_{\varphi_{n1}}(t_0)$, $P^{*}_{\varphi_{n2}}(t_1)$ — values of indicators of the subsystem state (IndS, FS, LP) at the beginning and at the end of the transition period;

n_1, n_2 — values of resource volume indicators calculated for the initial time reference point t_0 and goal achievement point t_1.

If in the subsequent period t_1 the values of the indicators have changed and become equal $P^{*}_{\varphi_{n2}}(t_1)$, then the sum of all changes will be as follows:

$$\sum_{i=1}^{N} \left| P^{*}_{\varphi_{n2}}(t_1) - P_{\varphi_{n1}}(t_0) \right| = \Delta(t_1), \quad (2)$$

where $\Delta(t_1)$ — the total difference in changes for all indicators in the period t_1;

|…| — sign indicating that the number is taken modulo.

In this task, it is required to present a calculation of the effective impact on the SC subsystem, which would allow to testify to the fact of positive dynamics in reducing the damage caused to the considered subsystems. The solution of the problem is as follows: if the total difference $\Delta(t_1)$ in changes in all indicators in the period is known t_1, then the indicator of change in the level of development $L(t_1)$ in the goal achievement point — t_1 can be calculated using the formula:

$$L(t_1) = \frac{\Delta(t_1)}{E_n}, \quad (3)$$

where E_n — is the efficiency of the volumetric contribution of the resource to (1 – N) departmental (sectoral) subsystems (IndS, FS, LP, etc.). It is a value for the calculation that involves hundreds of indication.

To obtain adequate calculations in order to determine the effective volumetric contribution of the resource to (1 – N) departmental (sectoral) subsystems (IndS, FS, LP, etc.) is required to carry out the following calculations.

Assuming that the actual – $P^{risk}_{\varphi_{n1}}(t_0)$ – limit and $P^{Av}_{\varphi_{n1}}(t_0)$ – the average value of indicators of damage to subsystems (IndS, FS, LP) for the previous period. Next, the target for damage reduction considered for the forecast period is determined ($t_0 - t_1$) taking into account the deviation of actual damage indicators from average indicators:

$$\sum_{i=1}^{n} \left| P^{Av}_{\varphi_{n1}}(t_0) - P^{risk}_{\varphi_{n1}}(t_0) \right|. \quad (4)$$

Next, a rational-target indicator is determined $P^{prog}_{\varphi_{n1}}(t_1)$ reduction of damage to subsystems (IndS, FS, LP), compared as a ratio of the indicators of the current and forecast periods ($t_0 - t_1$), taking into account the deviation of the average damage indicators from the planned indicators:

$$\sum_{i=1}^{n} \left| P^{prog}_{\varphi_{n1}}(t_1) - P^{Av}_{\varphi_{n1}}(t_0) \right|, \quad (5)$$

where n — the total number of indicators taken into account in the calculations.

Coefficient influencing the reduction of damage from accidents and fires at Russian oil and gas companies λ_n, calculated for effective values, will be presented in the form:

$$\lambda_n(t_0) = \frac{\sum_{i=1}^{n} \left| P^{Av}_{\varphi_{n1}}(t_0) - P^{risk}_{\varphi_{n1}}(t_0) \right|}{\sum_{i=1}^{n} \left| P^{Av}_{\varphi_{n1}}(t_0) \right|}. \quad (6)$$

Coefficient influencing the reduction of damage from accidents and fires at oil and gas companies of Russia — λ_n, calculated for the period of development of the enterprise IS system, will be presented in the form:

$$\lambda_n(t_1) = \frac{\sum_{i=1}^{n} \left| P^{Prog}_{\varphi_{n1}}(t_1) - P^{Av}_{\varphi_{n1}}(t_0) \right|}{\sum_{i=1}^{n} \left| P^{Av}_{\varphi_{n1}}(t_0) \right|}. \quad (7)$$

Achieved system development target IS $L(t_1)$ can be calculated based on the difference in ratios of the coefficients λ_n, affecting the reduction of damage from accidents and fires at Russian oil and gas companies:

$$L(t_1) = \lambda_n(t_1) - \lambda_n(t_0). \quad (8)$$

RESULTS

The article considers an example using the results of assessing the state of IS at the Russian Oil and Gas Sector enterprises. In the current conditions of the functioning of the IS system at the Russian Oil and Gas Sector enterprises, without having the results of calculating the indicators of impact from an unfulfilled activity, distributes the resource allocated for subsystems (IndS, FS, LP) based on intuitive considerations. Under such conditions, errors may occur in the formation of priorities for activities included in the general list, for which priority allocation of resources is required.

During the experiments, a set of indicators included in the sample was carried out from the limiting minimum (from 0.003) to the maximum (0.201) values. During the experiments, an arbitrary exclusion of indicators was carried out (about 40 units in total) with a fixed variable step (from 3 to 5 units). Then the results obtained during the experiments were calculated for the average value. As for the calculation of the overall indicator for the sample of results obtained using the scientific and methodological apparatus for the rational and targeted development of the IS system at the Russian Oil and Gas Sector enterprises, the content of the sample included all activities from position 1 to 159 (volume 80 %) of all activities presented in the list (Fig. 3).

The ratio of the influence indicator $L(t_0)$ is shown on the Fig. 4 for the conditions of stable functioning of the IS system to the influence indicator $L(t_1)$, allowing to develop the IS system of Russian oil and gas companies. Positive dynamics in reducing damage from accidents and fires at Russian oil and gas companies will directly depend on an increase in the overall indicator of impact on

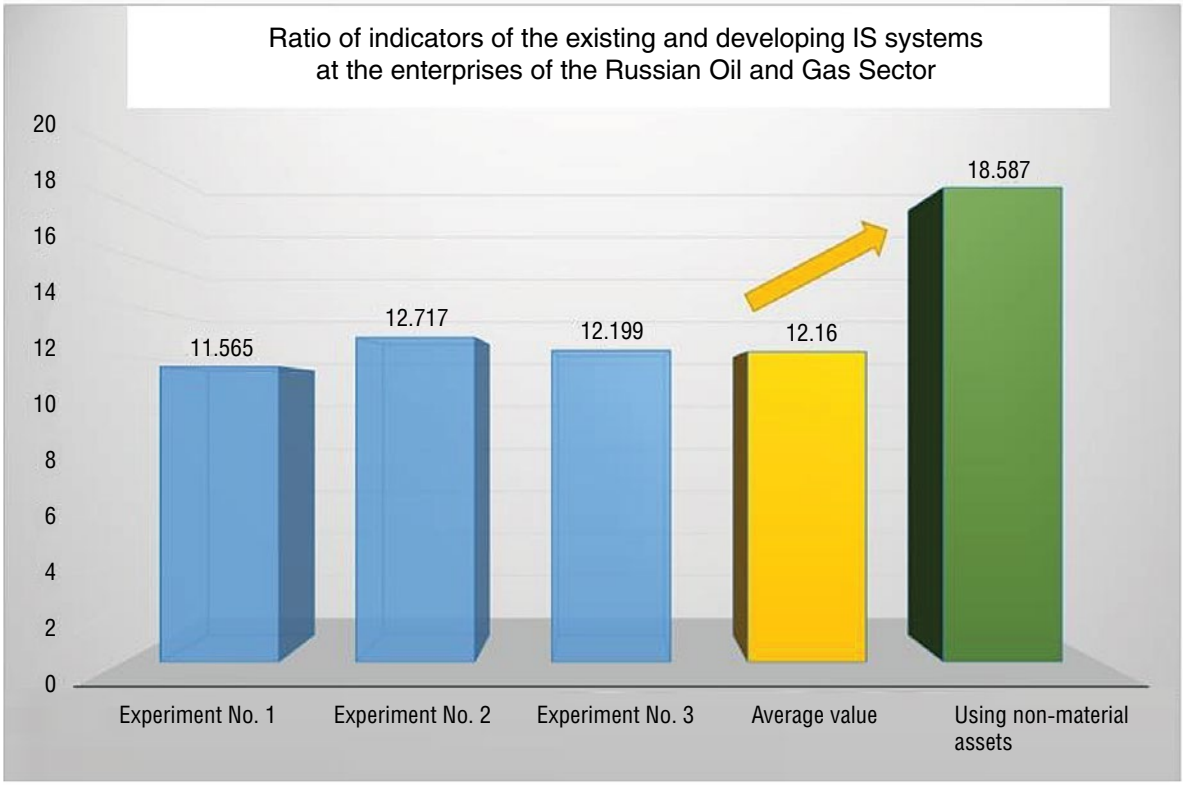

Fig. 3. Graph of the ratio of indicators of the existing and developing IS systems at the Russian Oil and Gas Sector enterprises

reducing damage from accidents and fires $L(t_1)$ (represented by formula (8)), which allows us to consider in the form of an expression:

$$m\lambda_n = \sum_{i=1}^{n}\left[Q_j^{\min} + \cdots + Q_j^{\max}\right] \approx 19, \quad (9)$$

where $m\lambda_n$ — the mathematical expectation of a general indicator that affects the reduction of damage from accidents and fires, calculated using numerical values taken from the sample (footnote (1));

$Q_j^{\min} + \cdots + Q_j^{\max}$ — numerical values with minimum and maximum values, taken from the sample (footnote (1)).

Expression (9) presents a general calculated indicator that affects the reduction of damage from accidents and fires and is directly related to the damage indicated in the reports on accidents and fires for the period of 2014–2020 for Russian oil and gas companies (Table).

Damage indicators (see Table) are directly related to the coefficient λ_n, which has an impact on reducing damage from accidents and fires at Russian oil and gas companies. When carrying out a simple calculation procedure, a result was obtained that makes it possible to tie social and economic damages to a conditional unit of the coefficient — λ_n, which has a direct impact on reducing damage from accidents and fires at Russian oil and gas companies (Fig. 4).

The presence of different planning periods for the development of the IS system at the Russian Oil and Gas Sector enterprises makes it possible to form a unified approach to the distribution of resources, as well as to carry out all approvals at the very beginning of this long process. Over the last 20 years, Russian companies have become the larger Liquefied Natural Gas (LNG) producers of global relevance [13]. So, according to statistic data,

Total damage caused by accidents and fires at Russian oil and gas companies in the period of 2014–2020

Category	Damage from accidents in the reports of the Federal Service for Environmental, Technological and Nuclear Supervision (Rostechnadzor)	Damage from fires in the reports of the EMERCOM of Russia	Total damage
Deceased, people	42	23	65
Victims, people	122	111	233
Economy damage, million rubles	19,756	16,710.1	36,466.1

Moscow is considered as an LNG “global force”, being the 4th largest exporter in the world [14].

The plans define the time horizon for achieving the strategic goal, which sets the time period for achieving sub-goals of the tactical and operational levels [15, 16]. Management sets a long-term strategic target, but the path to its achievement should be systematic (monthly, quarterly).

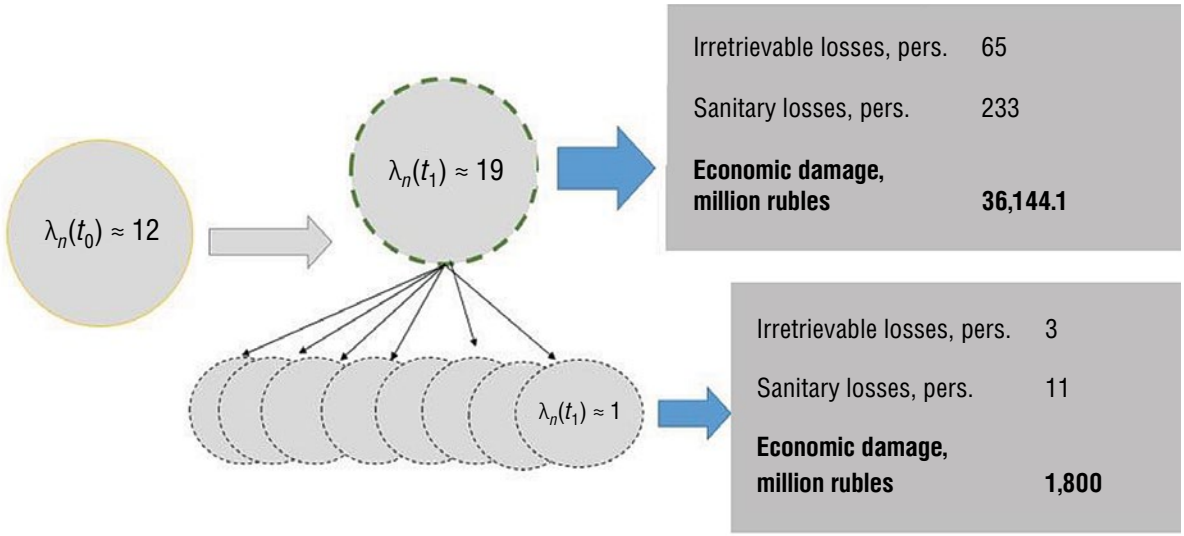

Fig. 4. The ratio of socio-economic damage to the indicator λ_n, equal to one conventional unit

At the tactical level, the horizon for determining future activities is limited to one year. As for the distribution of resources for subsystems (IndS, FS, LP) included in the enterprise IS system, then at this time interval coordination is carried out with all structural divisions authorized in the distribution of the enterprise resource. Moreover, at the operational level, all actions implemented during the month (quarter) are worked out, which is displayed in the target operational planning documents.

The plans developed on the basis of time horizons display: a list of ongoing activities; responsible executors; deadlines; officials exercising control, in a separate column of the planning document being developed, the approved amount of resource support allocated to a specific subsystem (IndS, FS, LP) included in the enterprise IS system is demonstrated.

CONCLUSIONS

The article substantiates and demonstrates the use of a new rational-target model for the development of the IS system at the enterprises of the Russian oil and gas sector, and shows an example proving the feasibility of its use. To achieve the predictive goals of the strategic level, which requires a significant reduction in damage from accidents and fires at the enterprises of the Russian Oil and Gas Sector, it is required to use a modern scientific and methodological base (models, methods, techniques, etc.).

The use of a new rational-target model for the development of oil and gas companies in Russia makes it possible in practice to solve the problem of reducing damage from accidents and fires in the integrated security system of these enterprises, solving a problem of great social and economic importance for Russia.

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Рационально-целевая модель развития системы комплексной безопасности на предприятиях нефтегазового комплекса России

В статье представлен анализ существующих подходов к обеспечению комплексной безопасности на промышленных предприятиях. Данное исследование ориентировано на использование междисциплинарного подхода при его обеспечении на предприятиях нефтегазового комплекса (НГК) России. Представлена методология, разработанная для российских нефтегазовых предприятий, в виде сравнительной модели и гибкого подхода подобно существующей и развивающейся комплексной системы безопасности для снижения различных видов ущерба. Цель исследования — решить научную задачу разработки комплексной системы безопасности на предприятиях НГК России. Представленные результаты исследования доказывают целесообразность использования результатов оценки состояния комплексной безопасности предприятий нефтегазового комплекса России. Таким образом, решается важная задача по рационально-целевому распределению ресурсов, которые могут быть использованы для устранения именно тех мероприятий, которые имеют высокие показатели воздействия ущерба от аварий и пожаров. Результаты мониторинга представлены в виде использования новой рационально-целевой модели развития нефтегазовых компаний России. Данная модель позволяет на практике решить задачу снижения ущерба от аварий и пожаров в системе комплексной безопасности этих предприятий.

Ключевые слова: *нефтегазовый комплекс, система комплексной безопасности, междисциплинарный подход, рационально-целевое развитие, эффективное функционирование*

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Об авторе: **Гвоздев Евгений Владимирович** — кандидат технических наук, доцент, доцент кафедры общей и прикладной физики; **Национальный исследовательский Московский государственный строительный университет (НИУ МГСУ)**; 129337, г. Москва, Ярославское шоссе, д. 26; SPIN-код: 5787-2465, Scopus: 57213143299, ResearcherID: AAD-7686-2022, ORCID: 0000-0002-3679-1065; evgvozdev@mail.ru.

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Zhelikhovskiy D.O.
Beliakov S.I.

Methodological approaches to the formation of flexible structures for managing construction groups

In the article the main aspects of the formation of flexible management structures of corporate associations of construction enterprises — construction groups are considered. The subjects of the investment and construction complex must quickly respond to changes in the external environment, should have possibility to adjust to possible changes in the economy and other spheres. Such an opportunity can be realized on the basis of the formation of flexible management structures of organizations. A flexible management structure is an organizational structure that allows an enterprise to respond quickly and effectively to the changes in the external or internal environment. In general, flexible management structures are a set of system elements that can adapt to changing environmental conditions in order to ensure an acceptable level of efficiency and production optimization and management processes under conditions of changing environment. In this case, the formation of organizational structures is implemented at the following levels: intra-company level, organizational and functional level, organizational and contractual level. Formation of flexible organizational structures for the management of a construction group should be realized within the limits of the certain strategy, while fulfilling the conditions for maximizing the level of strategic development while ensuring a sufficient level of general stability of the construction group.
Keywords: *construction companies, investment and construction complex, construction groups, corporate unions, flexible structures, management structures, adaptability*

Zhelikhovskiy Denis Olegovich,
Applicant of the Department of Organization of Construction and Real Estate Management; Moscow State University of Civil Engineering (National Research University) (MGSU); 26 Yaroslavskoe shosse, Moscow, 129337, Russian Federation; do.z@list.ru

Beliakov Sergei Igorevich,
Candidate of Economic Sciences, Associate Professor, Associate Professor of the Department of Organization of Construction and Real Estate Management; Moscow State University of Civil Engineering (National Research University) (MGSU); 26 Yaroslavskoe shosse, Moscow, 129337, Russian Federation; osun_kaf@mgsu.ru

Construction is a complex of organizational, survey, design, construction and installation and commissioning works, the ultimate goal of which is the construction of buildings (structures), capital or current repairs, as well as reconstruction and restoration. Construction processes are carried out on the basis of interrelated elements representing a set of enterprises, organizations, institutions involved in the value chain of finished construction products [1, 2].

The cooperation of various production systems into a single whole contributed to the development of an intersectoral construction complex, which in turn began to solve the basic needs of construction (from design work to finished buildings and structures). In this regard, it can be concluded that the "construction complex" is a developed system of enterprises and industries that perform common production, technological and economic ties for the creation, expansion, reconstruction and modernization of final construction products, buildings and structures [3–5].

The increase in the development level of the subjects of the investment and construction complex is influenced by [6–9]:

- level of investment attractiveness of the industry;
- quantitative, qualitative composition, degree of development and deterioration of the material and technical base;
- level of demand for the products of the industry;
- conditions of regulation of the industry by the state;
- quality and efficiency of management;
- level of innovation activity.

For a cumulative assessment of the functioning of the investment and construction complex as a whole and its individual elements, indicators are used, which can be conditionally divided into three groups:

1. Quantitative indicators assessing the volume of construction, the number of capital construction projects under construction, the volume of built-up areas, the number of functioning organizations, the number of employees employed in the construction sector, etc.

2. Qualitative indicators assessing the effectiveness of the development of ownership forms in the construction complex, the policy of investment distribution and their sources, the place of the construction complex in the state economy, etc.

3. Structural indicators that assess the structure and correlation of types and categories of objects being built, construction and installation works performed, construction materials used, types of organizations, types of investments, etc. [10].

The set of interacting subsystems and processes that ensure the specified functioning of the enterprise is an enterprise management system.

The general principles feature: unity of command, centralization of management, various types of moral and material interests, and the influence of elements of the external environment.

General management principles [11]:

- the principle of complexity. The principle assumes that all management tasks are solved in an interconnected way;
- the principle of purposefulness. The principle assumes that managerial influence should be aimed at achieving certain goals;

- the principle of democratization. Assumes direct participation in the management process of all employees of the organization;
- the principle of economy. According to this principle, decisions made in the management process should be studied for economic benefits;
- the principle of optimality. It involves a combination of the principles of centralization and decentralization in management decision-making;
- the principle of hierarchy. According to this principle, decision-making powers are distributed based on the levels of the management pyramid.

The subjects of the investment and construction complex should promptly respond to changes in the external environment, should be able to adapt to possible changes in the economy and other spheres. Such an opportunity can be realized on the basis of the formation of flexible management structures of organizations.

As a result, the key condition for ensuring the necessary level of controllability, stability and adaptability of the system functioning is the choice of adequate structures at various hierarchical levels of the management system in the current conditions of the internal and external environment.

A flexible management structure is an organizational structure that allows an enterprise to respond quickly and effectively to changes in the external or internal environment. In general, flexible management structures are a set of system elements that can adapt to changing environmental conditions in order to ensure an acceptable level of efficiency and production optimization and management processes in a changing environment.

An adequately constructed flexible management structure should create conditions in which management entities would have the opportunity to develop and implement effective solutions aimed at ensuring the necessary level or increasing the levels of productivity and efficiency of the organization's functioning, ensuring the stability of the production system as a whole in changing business conditions.

A relatively high degree of sustainability and effectiveness is demonstrated by large business entities with project portfolios and more developed resource bases. A steady trend towards a decrease in the share of small and medium-sized organizations — developers.

The tendency involving enterprises in sustainable cooperation within the framework of construction groups is significantly important, which allows them to benefit from combining their production potentials and specialized competencies.

Thus, the problematic area of ensuring the sustainable functioning and development of enterprises in modern conditions can be defined as insufficient development of mechanisms for strategic management of enterprises, including on the basis of planning activities, taking into account modelling of changes in the external and internal environment in conditions of macroeconomic instability and the lack of formed approaches to flexible management of enterprises.

A construction group is the most common form of corporate association of entities. A construction group may include contractors, design organizations, engineering and consulting companies, as well as companies specializing in the procurement and supply of construction materials and equipment and other functions. The group may include companies specializing in certain stages of construction, for example, design, construction, procurement, project management, etc. At the same time, the key element of the organizational structure of the construction group, as a rule, is the management link — organizations that perform the roles of customers-developers and management functions in relation to the entire system of the construction group.

The formation of construction groups can occur on various grounds [12, 13].

1. Specialization by type of work. A group can be formed from companies specializing in certain types of work, for example, design, construction, installation, supply, etc. This allows us to ensure a high level of specialization of each participating company.

2. Geographical localization. A group can be formed from companies located in the same region or on a close territory. This facilitates interaction between group members and allows you to quickly respond to changes in the external environment.

3. Technological solutions. A group can be formed from enterprises using the same technologies and methods of construction. This allows you to reduce the cost of training and training of personnel and increase work efficiency.

4. Financial decisions. The group can be formed on the basis of financial mechanisms, for example, by creating special funds to finance construction.

5. Partnership. The group can be formed on the basis of an established partnership between enterprises that have successful experience in joint implementation of projects. This allows for deeper interaction and a high level of trust between the group members.

The content of the activities of construction groups includes the following main types of work and services:

- design and development of project documentation;
- preparation of the construction site, including geodetic works and infrastructure preparation;
- supply of construction materials, equipment and mechanisms;
- execution of construction works, including foundation construction, installation of structures, finishing works, etc.;
- project management and coordination of work between group members;
- quality control of work, compliance with deadlines and budget of implemented projects.

The typical composition of the construction group involves 4 blocks combined into a single whole based on the choice of various organizational and contractual models of functioning:

- core of the construction group (management unit): developer (customer-developer, developer);
- investment block: investors of various organizational and legal forms;
- production unit: design, construction and installation organizations, manufacturers and suppliers of materials and equipment, etc.;
- enterprises of related industries: operating organizations, real estate firms, research, development, engineering organizations, insurance companies, etc. Enterprises that are not directly related to the construction complex, but are related to the chain of creation of construction products, i.e. enterprises from related industries that create additional effects within the framework of investment and construction activities.

At the same time, the formation of organizational structures is implemented at the following levels:

1) intra-company level;

2) organizational and functional level;

3) organizational and contractual level.

The intra-company level presupposes the choice of optimal organizational forms of management at the level of the core of the construction group and individual subjects of its structure.

In terms of the organizational-functional and organizational-contract levels, the processes of forming optimal organizational and contractual models of interaction between the participants of the construction group during the implementation of its strategic management plans are considered [14].

The content of the main organizational and contractual models of construction is shown in Figure.

A characteristic feature of the development of organizational forms at the organizational-functional and organizational-contractual levels at the present stage is the coexistence of traditional, based on the general contracting scheme, and modern, based on the principles of the concept of project management, organizational forms of management. At the same time, the choice of one or another organizational form depends on many factors and, first of all, is determined by the characteristics and parameters of the construction projects being implemented [15].

A comparative assessment of alternative organizational management models in terms of the strategic development of the construction group in accordance with the concept of project management should be carried out based on the availability and rational combination of four main blocks of parameters that determine the time, cost and quality performance features of functioning.

Each of these blocks is characterized by a system of indicators and parameters, while it is possible to describe each of them, their specifics and the range of their changes:

Block A_1 — characteristics of finished construction products made by enterprises operating within the construction group.

Block A_2 — characteristics of the production and economic potential of ISC enterprises operating within the construction group.

Block A_3 — characteristics of the adaptability of the management system of ISC enterprises operating within the construction group.

Block A_4 — characteristics of the investment potential of enterprises operating within the construction group.

$$C_v = f(A_1, A_2, A_3, A_4) \rightarrow \max, \quad (1)$$

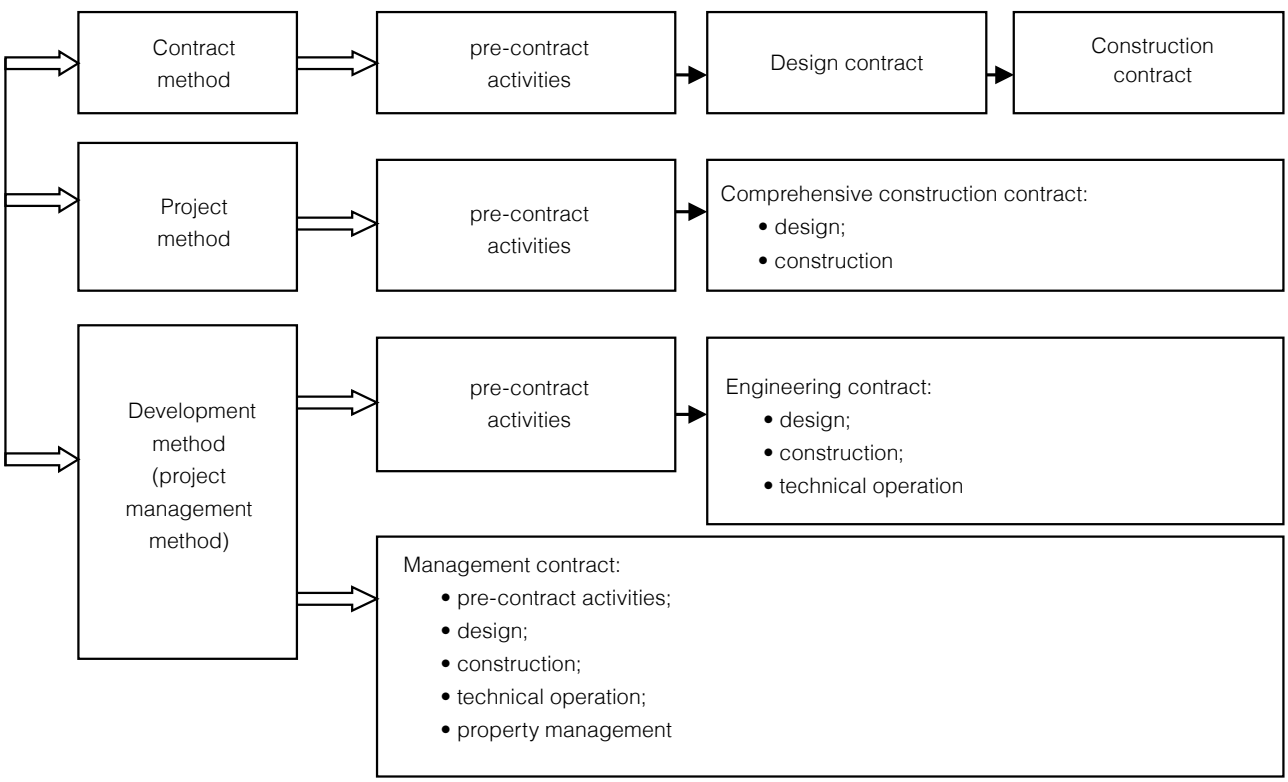
where C_v — a variant of the formation of flexible management structures for enterprises operating within the construction group.

The strategic development of enterprises as part of a construction group can occur in several directions:

- vertical (transition to new markets) — market strategy;
- horizontal (product (service) improvement) — innovative strategy;
- internal (capacity building, improvement of management relations) — internal company strategy;
- diagonal (simultaneous improvement of the product (service) and transition to new markets by attracting investments) — investment strategy.

At the same time, the formation of flexible organizational structures for the management of a construction group should be implemented in terms of a certain strategy, while fulfilling the conditions for maximizing the level of strategic development while ensuring a sufficient level of general stability of the construction group.

A range of values is defined as the boundary condition of the general stability of the construction group: $0.75 \le K_{st} \le 1.0$.



The content of the main organizational and contract models of construction

$$K_{st} = K_r \cdot K_{sp} \cdot K_o \cdot K_s \cdot K_p, \quad (2)$$

where K_{st} — coefficient of general stability of the construction group;

K_r — the level of capital return of production;

K_{sp} — specialization level;

K_o — output per employee;

K_s — stability of the staff number;

K_p — the level of profitability of production.

Thus, it is possible to compare different options for the strategic development of the construction group not only at each step, but also the effectiveness of the entire chain of development stages.

The flexible management structure of the enterprises of the investment and construction complex as part of the construction group should ensure effective interaction of all stages of the production of finished construction products. It should ensure effective interaction of the main institutions of innovation, investment and production activities in construction.

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Методические подходы к формированию гибких структур управления строительными группами

В статье рассмотрены основные аспекты формирования гибких структур управления корпоративными объединениями строительных предприятий — строительными группами. Субъекты инвестиционно-строительного комплекса должны оперативно реагировать на изменения внешней среды, должны иметь возможность подстраиваться под возможные изменения в экономике и других сферах. Такая возможность может быть реализована на основе формирования гибких структур управления организациями. Гибкая структура управления — это организационная структура, которая позволяет предприятию быстро и эффективно реагировать на изменения во внешней или внутренней среде. В общем виде гибкие структуры управления представляют собой совокупность элементов системы, способных адаптироваться под изменение условий внешней среды с целью обеспечения допустимого уровня результативности и оптимизации производственных и управленческих процессов в условиях изменяющейся среды. При этом формирование организационных структур реализуется на следующих уровнях: внутрифирменный уровень, организационно-функциональный уровень, организационно-контрактный уровень. Формирование гибких организационных структур управления строительной группой должно реализовываться в рамках определенной стратегии при выполнении условий максимизации уровня стратегического развития при обеспечении достаточного уровня генеральной устойчивости строительной группы.

Ключевые слова: *строительные предприятия, инвестиционно-строительный комплекс, строительные группы, корпоративные объединения, гибкие структуры, структуры управления, адаптивность*

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Об авторах: **Желиховский Денис Олегович** — соискатель кафедры организации строительства и управления недвижимостью; **Национальный исследовательский Московский государственный строительный университет (НИУ МГСУ)**; 129337, г. Москва, Ярославское шоссе, д. 26; do.z@list.ru;

Беляков Сергей Игоревич — кандидат экономических наук, доцент, доцент кафедры организации строительства и управления недвижимостью; **Национальный исследовательский Московский государственный строительный университет (НИУ МГСУ)**; 129337, г. Москва, Ярославское шоссе, д. 26; РИНЦ ID: 587836, Scopus: 39763951700; osun_kaf@mgsu.ru.

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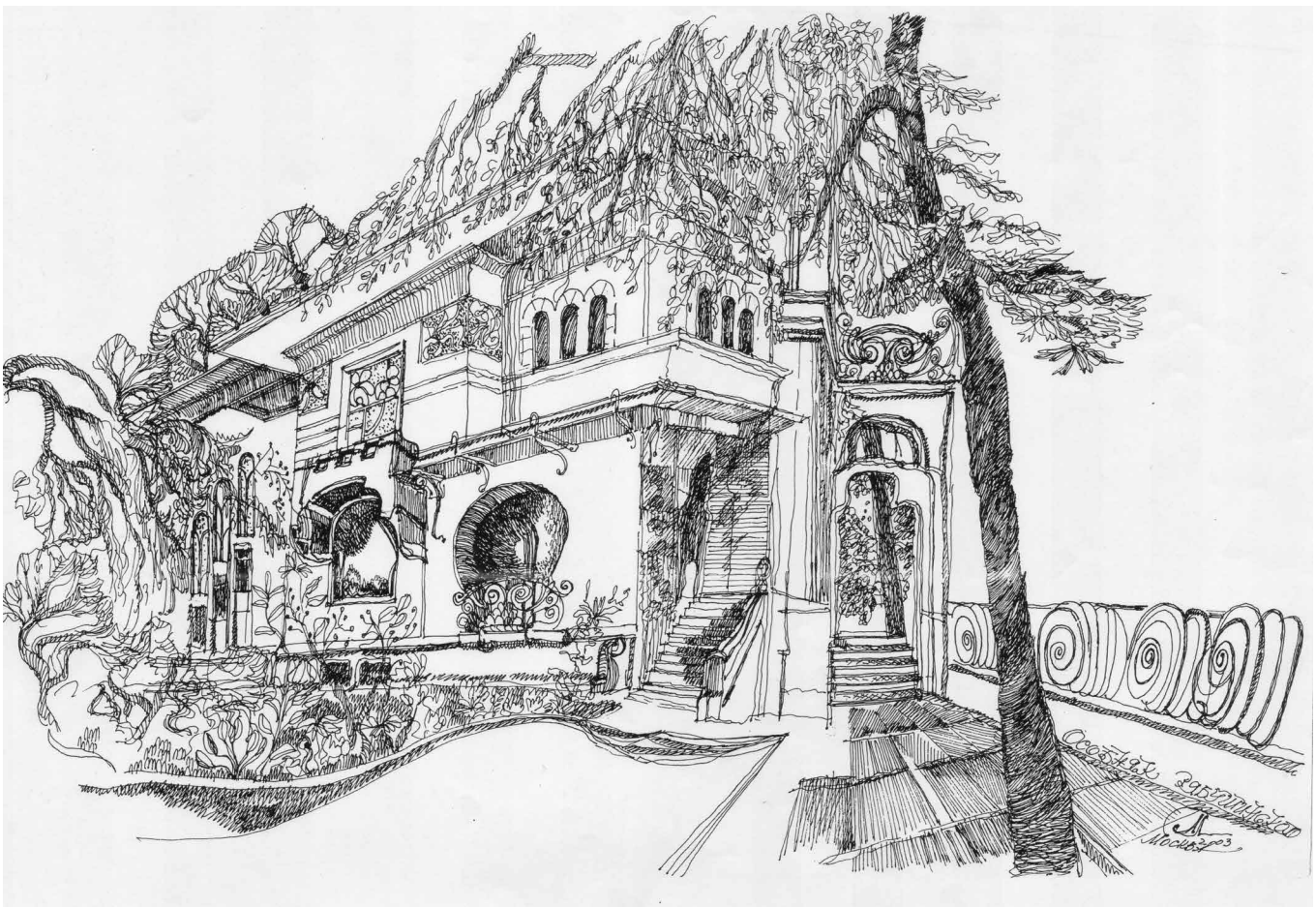

Л.И. Павлова. Москва. Особняк Рябушинского. Рисунок, тушь перо.

UDC 332.025+333.14+332.812.123

Ovsiannikova T. Yu.

Renovation of residential buildings in the regions: organizational and financial mechanisms and constraints

Ovsiannikova Tatiana Yurievna,
Doctor of Economic Sciences, Professor, Head of the Department of Expertise and Real Estate Management; Tomsk State University of Architecture and Building (TSUAB); bldg 2, 2 Solyanaya Square, Tomsk, 634003, Russian Federation; tatovs@mail.ru

The article deals with the problems of comprehensive renovation of residential development in the regions of the Russian Federation, which, despite the implementation of the national project and state programs, do not lose their relevance. Due to the heterogeneity of the socio-economic conditions in Russia, first of all, the existing territorial imbalances in distribution of housing investments and differences in the structure of the existing housing stock, the regions have different opportunities in solving the problem of residential development renovation. On the basis of the data of the Fund for Assistance to Reformation of Housing and Communal Services reform (at this time — Territorial Development Fund) of the Siberian Federal District were analyzed. The main factors acting as organizational and financial constraints in the implementation of programs for the elimination of emergency housing have been identified. It is shown that the existing organizational and financial mechanisms, based on the regional programs of capital repairs of the common property of apartment buildings and the federal project of liquidation of uninhabitable housing, do not provide a comprehensive renovation of housing stock and development of built-up areas. Implementation of projects of selective capital repairs and spot demolition of emergency buildings does not solve the problem of qualitative improvement of residential areas, as even the resettled emergency buildings remain in the structure of residential development due to the low urban development potential of the released land plots. It is shown that the new mechanism of complex development of territories, despite the established legal framework and institutional support, is not properly developed now, as there are also a number of organizational and financial constraints. The main constraints are the undeveloped regional regulatory framework, the lack of regional institutions and low marginality of the existing housing renovation projects, which makes such projects unattractive for potential investors. This demonstrates the need to develop regional mechanisms for integrated renovation of urban development and integrate financial resources of all stakeholders of renovation projects.

Keywords: *housing stock, renovation of residential developments, emergency housing, integrated territorial development, organizational and financial mechanisms of renovation*

INTRODUCTION

There is no denying that the state housing policy in recent years has significantly improved the living conditions of Russian citizens. The implementation of the national project, using new organizational and financial mechanisms, has expanded the opportunities for the population to improve their living conditions. Thus, according to the results of the survey of citizens' housing conditions carried out by Rosstat (Federal Service of State Statistics) in 2011, 10.4 % of the respondents described their housing conditions as "poor" and "very poor" while in 2020 the share of such households was only 3.6 %[1]. Preferential mortgages and project financing have enabled an increase in housing construction. However, the achieved rate of housing construction does not allow for a significant renewal of the housing stock in Russia. Thus, according to Rosstat[2, 3], by the end of 2020 Russia's housing stock amounted to 4044 million sq. m, with 92.6 million sq. m commissioned in 2021, i.e. the new housing stock amounted to 2.3 % of the existing one[4]. Although, according to the UN, there are no dwellings recognized as slums in Russia, there are 112,365 blocks of flats in which 1.61 million people live, have the status of emergency housing[5], 3.6 % of apartment buildings do not have a centralized sewage system, and 1.7 % of them do not have a toilet at all, 2.3 % of citizens living in the blocks of flats have bath or shower. Even in regional capitals, a significant part of residential development consists of residential buildings that have not yet been recognized as emergency, but are significantly dilapidated. They are wooden cinder block residential buildings of the first post-war years.

Therefore, the problem of housing renovation does not lose its relevance and the search for new mechanisms of realization of citizens' rights to affordable and adequate housing, the formation of a comfortable and safe living environment remains the most important scientific task and the subject of research for many scientists.

The search for new tools of effective housing policy continues in countries with developed

1 Results of comprehensive monitoring of living conditions of the population. *Rosstat*. URL: https://rosstat.gov.ru/itog_inspect

2 Housing conditions. *Rosstat*. URL: https://rosstat.gov.ru/folder/13706

3 Housing construction. Commissioning of residential buildings in the Russian Federation. URL: https://rosstat.gov.ru/folder/14458

4 Rosstat indicates the arrival of more than 125 million square meters of housing in the housing stock assets in 2021. Starting from 2021, residential buildings located on land plots intended for gardening are included in the total area of residential premises. In order to analyze renovation of the housing stock, we take into account only the commissioning of new housing.

5 Emergency Fund on the territory of the Russian Federation. *Housing and Utilities Fund*. URL: https://www.reformagkh.ru/relocation/programs/houses

economies as well[6, 7]. The study of foreign experience in urban redevelopment [1, 2], assessment of implementation conditions and consequences of such projects [3] are of considerable interest among experts in the field of housing policy.

CURRENT HOUSING RENOVATION MECHANISMS

The national project "Housing and Urban Environment" has made it possible to increase the rate of elimination of uninhabitable housing stock. However, due to the heterogeneity of Russia's the socio-economic conditions, differences in the level of income of the population and budgetary provision, differences in the structure of the existing housing stock and different investment attractiveness and capacity of regional housing markets, opportunities of the constituent entities of the Russian Federation to solving the problem of housing renovation are different.

Currently, there are two main mechanisms of large-scale renovation of the housing stock in the Russian regions: regional programs for capital repairs of the common property of apartment buildings and programs for liquidation of emergency housing. However, while capital repair programs are aimed at maintaining the technical condition of buildings and ensuring their maintainability, programs for the liquidation of emergency housing should contribute to the renovation of the existing residential development.

According to the Housing and Utilities Fund (currently the Territorial Development Fund)[8], as of 1st September 2022, 8 constituent entities of the Russian Federation had fully implemented plans to relocate citizens from emergency housing included in the 2019–2025 programs. However, the program has been completed by less than 50 % in 20 regions. Fig. 1 shows the results of program implementation in the regions of the Siberian Federal District. As can be seen from the graphs, almost all of the regions except for the Altai Territory are implementing the program later than planned. At the same time, it should be noted that in the Altai Territory the share of emergency housing is insignificant — 0.2 % of the existing housing stock, unlike in Irkutsk region or Kemerovo region (Kuzbass) where the share of emergency housing is0.7 and 0.74 % of the total housing stock respectively.

Of all the houses recognized as emergency in the Russian Federation less than 12 % were demolished and a just over 17 % were resettled. In the Novosibirsk region, 14.7 % of emergency houses were demolished and 14.7 % were resettled. In the Irkutsk region, 14.4 and 15.6 %, respectively. In the Tomsk and the Omsk regions, these figures are much worse: in the Tomsk region, only 7 % of emergency buildings was demolished, 9 % was resettled, while in the Omsk region, only 5.5 % of the housing stock recognized as emergency was demolished and 28 % was resettled.

The analysis of financial security of the programs for elimination of emergency housing shows that there are currently no financial constraints that would restrain implementation of these programs. All regions have sufficient financial resources, including those received from the Housing and Utilities Fund, the programs are funded with a large margin, but the allocated financial resources are not being mastered. What are the reasons for delays in the implementation of the national project programs? There are several main factors that act as organizational and financial constraints in implementation of programs to eliminate emergency housing:

1. The capacity of the housing market, especially the secondary housing market, is low in many regions. Therefore, providing citizens being resettled from emergency housing stock falling under demolition with equivalent housing becomes quite a challenge. As well as the actual task of providing equivalent housing which requires simultaneous compliance with several boundary conditions: the area of residence, the area of provided housing, the number of rooms, and the level of housing amenities. The analysis of the results of the implementation of programs for elimination of

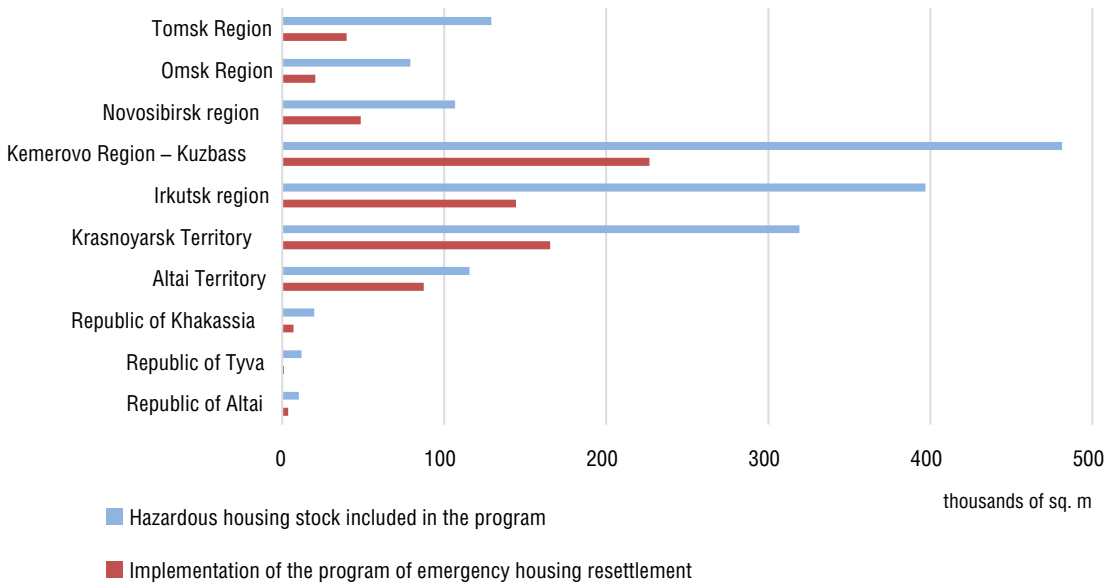

Fig. 1. Implementation of emergency housing resettlement programs 2019–2025 in Siberian regions as of September 2022 (source: compiled by the author according to the Territorial Development Fund)

6 Housing2030. Effective policies for affordable housing in the UNECE region. URL: ites/default/files/2021-10/Housing2030 %20study_E_web.pdf

7 Renovation in practice. Best practice examples of voluntary and mandatory initiatives across Europe. URL: ites/default/files/remourban_renovation_in_practice_-_best_practice_examples_of_voluntary_and_mandatory_initiatives_across_europe.pdf

8 Progress in implementation of resettlement programs on the territory of the Russian Federation. Housing and Utilities Fund. URL: https://www.reformagkh.ru/relocation/programs-realisation (rus.).

unsuitable housing presented on the website of the Housing and Utilities Fund by methods of resettlement of citizens, shows that the main way is the construction of new housing or purchasing of housing on the primary market (Fig. 2).

However, conducting procurement for the conclusion of state contracts (municipal contracts) for construction of housing for citizens being resettled from the emergency housing becomes a difficult problem. Developers do not want to participate in this program because, despite the new methodology for determining the standard cost per 1 sq. m of the total area of residential premises by Russian constituent entities, developed by Minstroy (the Ministry of construction of the Russian Federation)[10], this indicator remains significantly below the market price. The consequence of this is that the tenders have failed and not a single bidder has applied.

2. If it is impossible to provide absolutely equivalent housing to the resettled citizens, the resulting difference in the cost of the withdrawn and provided housing can be refunded to the citizens being resettled from the emergency building. It is obvious that for many households living in dilapidated buildings, even the cost of one extra square meter is unaffordable while municipalities do not have the financial capacity to subsidize households to compensate for the difference in the cost of housing.

3. According to the law, citizens who own premises in block of flats that have been declared dangerous can claim compensation for the cost of the withdrawn housing. However, often the purchase price of housing does not satisfy the owners, and the procedure of challenging this cost in court requires additional expenses and time, which significantly delays the process of evicting residents from the emergency housing.

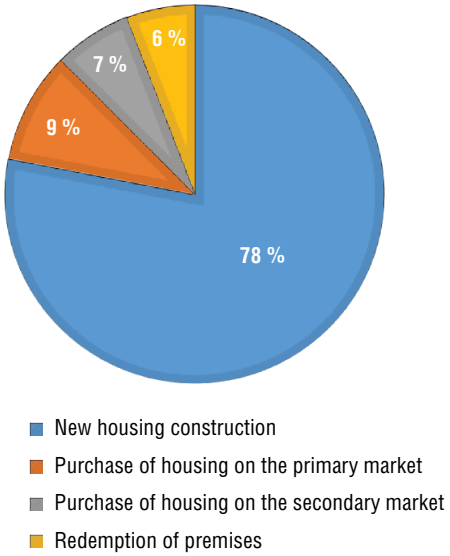

Fig. 2. Methods of resettlement of citizens in the framework of implementation of programs for elimination of hazardous housing (source: compiled by the author according to the Housing and Utilities Fund[9])

4. As it is shown above, even resettled dilapidated houses are often not demolished, which not only worsens urban appearance of the settlement, but also poses a threat to the life and health of citizens. However, the demolition of these buildings requires financial expenses, which are not feasible — land plots released as a result of the demolition of such houses due to their small size mostly have no urban development potential and are not of interest to potential developers.

DEVELOPMENT OF MECHANISMS FOR COMPREHENSIVE RENOVATION OF RESIDENTIAL BUILDINGS

Previously it has already been pointed out that the existing organizational and financial mechanisms based on regional programs of capital repairs of the common property of apartment buildings and the federal project of sustainable elimination of uninhabitable housing stock (emergency housing) do not solve the problems of renovation of residential buildings and development of built-up areas which require complex organizational and financial mechanisms [4].

In this respect, the mechanism of integrated development of the area introduced by the inclusion of the new Chapter 10 in the Urban Planning Code of the Russian Federation could be a big step towards comprehensive renovation of residential development[11]. However, despite the creation of a specialized institute (public not-for-profit organization "Territorial Development Fund") and the support of the new mechanism provided by a number of normative legal acts, methodological documents and even standards[12, 13], this mechanism is not yet fully operational though the potential for development of built-up areas in the country is huge. According to the experts [5], the potential of new housing construction in built-up areas in large cities with a population of more than 250 thousand people alone is about 260 million sq. m. Thus, Siberian regions have announced more than 100 land plots for implementation of comprehensive development projects, including 9 plots in the Altai Republic, 1 in Tyva, 1 in Altai Territory, 6 in Krasnoyarsk Territory, 22 in Kemerovo region, 42 in Novosibirsk region, 25 in Omsk region and 2 in Tomsk region.

According to the Ministry of construction of the Russian Federation[14] as of December 1, 2022 constituent entities of the Russian Federation are working on the application of the mechanism of comprehensive development of territories in relation to 799 land plots with a total area of about 26 thousand hectares. As part of the application of this mechanism, it is planned to erect capital construction facilities with a total area of about 153 million sq. m of which about 118 million sq. m of residential accommodation.

9 Resettlement of citizens from emergency housing. Housing and Utilities Fund. URL: https://www.reformagkh.ru/analytics?geo=reset (rus).

10 The Ministry of Construction of Russia for the first time determined the indicators of the average market value per square meter of housing according to the new methodology. Ministry of Construction of the Russian Federation. Official website. URL: https://www.minstroyrf.gov.ru/press/minstroy-rossii-vpervye-opredelil-pokazateli-sredney-rynochnoy-stoimosti-kvadratnogo-metra-zhilya-po/?sphrase_id=1719971 (rus.).

11 On Amendments to the Urban Development Code of the Russian Federation and Certain Legislative Acts of the Russian Federation in Order to Ensure the Integrated Development of Territories : Federal Law No. 494-FZ of December 30, 2020. (rus.).

12 Ministry of construction of the Russian Federation. Official website. Comprehensive development of territories. URL: https://www.minstroyrf.gov.ru/trades/kompleksnoe-razvitie-territoriy

13 Methodological recommendations for the comprehensive development of residential areas. The Institute for Urban Economics. Moscow, 2022; 466.

14 Monitoring the implementation of the mechanism for comprehensive development of the constituent entities of the Russian Federation. Ministry of construction of the Russia Federation. URL: https://www.minstroyrf.gov.ru/trades/kompleksnoe-razvitie-territoriy/1-monitoring-realizatsii-mekhanizma-kompleksnogo-razvitiya-territoriy-subektami-rossiyskoy-federatsii/ (rus.).

However, the analysis shows that developers prefer non-built-up areas for development and implementation of comprehensive development projects or land plots with non-residential buildings, mainly the territories of former industrial zones. As of the end of 2022 out of 173 signed agreements on comprehensive development of the area, only 39 are the agreements on comprehensive development of residential areas. This is also evidenced by experience of other countries[15].

Financial justifications made by the author of this article on the example of Tomsk show that projects of complex renovation of residential buildings with demolition of emergency houses and residential buildings with a high degree of dilapidation and relocation of citizens to equivalent housing have very low or even negative marginality. This leads to investment unattractiveness of such projects for potential developers. Similar conclusions are made by Novosibirsk Union of Builders: according to their calculations on the example of Novosibirsk, resettlement of houses of standard series with more than three floors at the expense of investors is not profitable [6].

The marginality of an integrated development project of the territory depends on the ratio of the amount and value of housing being withdrawn and the amount and value of new housing being built within the project. The latter directly depends on the number of floors of residential buildings in the area of comprehensive development of the territory. However, in many cities, primarily in cities with the status of the historical settlement, there are restrictions on the height of new buildings. Therefore, territories occupied by dilapidated residential buildings that do not belong to cultural heritage but fall within the boundaries of a historical settlement will continue to degrade, since the renovation project of such development cannot be feasible and, consequently, attractive for a potential developer in terms of investment. This is exactly the situation that is developing in Tomsk where a significant part of the emergency and dilapidated housing has fallen into the borders of the historical settlement. In addition, the standard for the development of built-up areas offered by the Ministry of construction of the Russian Federation together with Dom.RF and Strelka Development Laboratory[16] set the 9-floor limit for local buildings. Therefore, the financial outcome of such projects will not allow developer to reimburse the costs of project development, resettlement of citizens, demolition of existing buildings and construction of new ones.

Consequently, it becomes clear that it is not reasonable to consider private developers as main stakeholders and driving force of regional housing renovation programs.

The lower the marginality of urban residential renovation project is, the greater the financial participation of the state and municipality should be in its implementation. This is also confirmed by a comparative analysis of the first results of implementation of housing renovation programs in the cities of Moscow and St. Petersburg carried out by the authors of the article [7]. It was shown that one of the reasons for non-fulfillment of the housing renovation program in St. Petersburg is the reliance on extra-budgetary sources of financing i.e. funds of private developers.

It is obvious that, when choosing a comprehensive development territory, municipalities have the right to independently determine the number of floors and the nature of new development on the basis of urban planning analysis and a thorough feasibility study in order to maximize the investment attractiveness of the territory for a potential developer.

Experts name the lack of insufficient elaboration of the regional regulatory framework the development of which is provided by Urban Planning Code of the Russian Federation the most important factor constraining implementation of projects for the comprehensive development of territories. To ensure implementation of comprehensive development of territories mechanism at the level of the constituent entity of the Russian Federation, a regulatory framework is to be worked out. It will determine, among other things, the criteria for including apartment buildings in the project of comprehensive development of residential areas:

1) the level of physical dilapidation of main structural elements (roof, walls, foundation) of apartment building;

2) the amount of excess of the total cost of capital repair works of structural elements of apartment buildings and domestic utility systems that belong to the common property of apartment buildings in comparison with the marginal cost of capital repairs accepted in the region;

3) a series of standard projects according to which apartment buildings were built during the period of industrial housing construction or other types of residential construction that can be included in the project;

4) a list of utility systems within apartment buildings the absence of which is the basis for including the house into the project.

An important constraint in implementation of comprehensive territorial development projects is the lack of appropriate institutions in the regions. For implementation of regional comprehensive development projects appropriate regional development institutions should be created to ensure vertical integration with the federal institution called Territorial Development Fund. However, currently there is no such regional institution in most of the constituent entities of the Russian Federation. Functions of organizing and coordinating projects for comprehensive development of territories, conducting feasibility studies of the efficiency of such projects, and often functions of a technical client are assigned to municipalities that do not have appropriately trained personnel.

CONCLUSIONS

The solution of the problem of residential buildings' renovation is possible only on the basis of a comprehensive approach to development and implementation of regional housing renovation programs as the main organizational and financial mechanism of modern urban policy. Development of such programs will ensure integration of all methods of housing renovation on the territory of the settlement. First of all, it is necessary to develop a system of territorial planning documents defining potential areas for the comprehensive development of the territory. Restrictions on the issuance of permits for infill construction of both multi-apartment housing and individual housing should be established in these territories. Residential buildings located in such territories that do not meet the criteria for demolition are to be subject to major repairs as a priority. It is necessary to ensure vertical integration of federal and regional development institutions, which would ensure coordination of actions of all participants in comprehensive territorial development projects and consolidation of financial resources.

The most important condition for the implementation of comprehensive residential buildings' renovation programs should be guaranteed observance of citizens' rights to affordable and

15 Experience of redevelopment in foreign countries. *Dom.RF*. URL: https://www.xn--d1aqf.xn--p1ai/analytics/interesting-on-the-market

16 Standard of comprehensive development of territories. *Dom.RF. Strelka Design Laboratory*. URL: tandards/printsipy-kompleksnogo-razvitiya-territoriy/?ysclid=l94eo4xdsd229460234

adequate housing. Secure property rights for housing are one of the key drivers of economic development, environmental sustainability and social stability[17] and correspond to the fundamental goals of sustainable urban development.

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Реновация жилой застройки в регионах: организационно-финансовые механизмы и ограничения

В статье рассматриваются проблемы комплексной реновации жилой застройки в регионах Российской Федерации, которые, несмотря на реализацию национального проекта и государственных программ, не теряют своей актуальности. В силу неоднородности социально-экономического пространства России, прежде всего, сложившихся территориальных диспропорций в распределении жилищных инвестиций, различий в структуре существующего жилищного фонда возможности регионов в решении проблемы реновации жилой застройки разные. На основе данных Фонда содействия реформированию ЖКХ (ныне — Фонд развития территорий) выполнен анализ результатов выполнения региональных программ переселения граждан из аварийного жилья на примере регионов Сибирского федерального округа. Выявлены основные факторы, выступающие организационно-финансовыми ограничениями в реализации программ ликвидации аварийного жилья. Показано, что существующие организационно-финансовые механизмы, основанные на региональных программах капитального ремонта общего имущества многоквартирных домов и федеральном проекте ликвидации непригодного для проживания жилья, не обеспечивают комплексной реновации жилищного фонда и развития застроенных территорий. Реализация проектов выборочного капитального ремонта и точечного сноса аварийных зданий не решает проблемы качественного улучшения жилой застройки, поскольку даже расселенные аварийные дома остаются в структуре жилой застройки из-за низкого градостроительного потенциала освобождаемых земельных участков. Показано, что новый механизм комплексного развития территорий, несмотря на созданную нормативно-правовую базу и институциональное обеспечение, в настоящее время не получил должного развития, поскольку также существует ряд организационно-финансовых ограничений. Основными ограничениями являются неразработанность региональной нормативно-правовой базы, отсутствие региональных институтов и низкая маржинальность проектов реновации существующей жилой застройки, что делает такие проекты инвестиционно непривлекательными для потенциальных инвесторов. Это свидетельствует о необходимости развития региональных механизмов комплексной реновации городской застройки и интеграции финансовых ресурсов всех стейкхолдеров проектов реновации.

Ключевые слова: *жилищный фонд, реновация жилой застройки, аварийное жилье, комплексное развитие территорий, организационно-финансовые механизмы реновации*

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Об авторе: **Овсянникова Татьяна Юрьевна** — доктор экономических наук, профессор, заведующая кафедрой экспертизы и управления недвижимостью; **Томский государственный архитектурно-строительный университет (ТГАСУ)**; 634003, г. Томск, пл. Соляная, д. 2, корп. 2; РИНЦ ID: 504255, Scopus: 6603240723, ResearcherID: E-6457-2016, ORCID: 0000-0002-0771-7114; tatovs@mail.ru.

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Zvonov I.A.
Kashirina N.V.

The registry principle and SMART documents as conditions for the digital transformation of technical building operation

The transition to “Industry 4.0” or the “Fourth Industrial Revolution” is a difficult step, within which automated technologies are being introduced into all areas of production industries. The aim of this introduction is to provide the exchange of data between devices, databases and systems of varying difficulty level without human intervention. This transition is also a transition to formalization and standardization, and therefore requires the use of new formats of regulatory and regulatory-technical, organizational-technical documents. It becomes obvious that these formats should be not only human-readable, but also machine-readable. They will allow documents to be systematically and effectively formed, applied and adjusted at all stages of the building's life cycle. The technical operation of buildings does not stand aside. Effective operational activity is impossible without effective management of its regulatory and technical documentation and regulatory requirements for operated buildings, their elements and systems. The same applies to improving the efficiency of all organizational, production, and technological processes of operation.
Keywords: *SMART document, a register of regulatory documents, a register of regulatory and technical requirements, technical operation, automation, digital tools, unified information system*

Zvonov
Ilya Alexandrovich,
senior lecturer of the Department of Construction Organization and Real Estate Management, director of the Scientific and Educational Center “Digital Construction and Operation”; Moscow State University of Civil Engineering (National Research University) (MGSU); 26 Yaroslavskoe shosse, Moscow, 129337, Russian Federation; ID RISC: 820141, ORCID: 0000-0002-4854-9903; ZvonovIA@mgsu.ru

Kashirina
Natalia Vladimirovna,
leading marketing specialist; Kodeks; lit. X, 3 Instrumentalnaya st., Saint Petersburg, 197376, Russian Federation; SPIN-код: 2752-6270; ORCID: 0000-0003-1787-441X; kashirina@kodeks.ru

FROM DOCUMENTS TO REQUIREMENTS

The technical standards base regulating the issues of technical operation of civil buildings and structures in our country is characterized by the absence of a systematic approach, the presence of prescriptive norms, a significant number of duplication and contradiction cases. This situation does not contribute to the development of innovative processes not only in operation, but also in construction, creates administrative and technical barriers, and prevents the rapid introduction of new materials and technologies into practice. This has led to the appearance of field-of-use restrictions on the areas of application of codes of practice [1]. However, on February 23, 2021, at a meeting of the Council of the International Organization for Standardization, the project of “SMART” standards (Standards Machine Applicable, Readable and Transferable) was approved, which becomes one of the priorities for the development of international standardization until 2030. The SMART standard assumes a substantially new format for the presentation of a document — the so-called “machine-readable” text (text whose content is easily perceived, processed and transmitted by computer systems). It is assumed that information systems will be the main user of such a standard, but at the same time, the work of a human operator will also be available. Documents in the new format can be used at all stages of the product life cycle in order to automate and consequently optimize and increase the efficiency of all organizational, technical and production processes. The core of the new format of the regulatory document is the requirements, i.e. a single documented necessity to be met by a specific design, product or process. Accordingly, in order to translate regulatory documents into a so-called “smart” format, requirements need to be extracted from the texts and formalized, and in order to create a standard that is already “smart”, requirements orientation is again required. Modern experts define a SMART-standard as a complex digital structure that can contain text, graphic and numerical data, as well as digital models [2].

Requirements related to specific constructions, elements, systems, operating measures, works and processes are extracted from the regulatory documents and entered into internal documents of the enterprise in order to be guided by them at each stage of the life cycle. And since the responsibility for the operation of facilities in the social sphere, for example, is mainly assigned to state customers, then this task turns out to be a state one [3]. Nevertheless, in most cases, these requirements are used in isolation from the external document. Meanwhile, checking the relevance of a requirement is a more resource-intensive process than checking the relevance of a standard [4]. There are several reasons for this:

- the document may contain a different number of requirements;
- one document may contain requirements for different processes;
- the document may contain both mandatory and recommended requirements;
- the document may continue to be valid, but the requirements may change;
- the document may continue to be valid, but the requirements may be cancelled;
- new requirements may be added to the text of the document;
- the text of one document may contain requirements related to other requirements in other documents.

The allocation of requirements from regulatory and technical documents and regulatory legal acts and the creation of registers of requirements will solve the above-mentioned problems and, as a result, will improve the quality of work performed by optimizing the compliance verification process. The effective structure and correct algorithmization of the system of requirements in regulatory and technical documents and regulatory legal acts can solve these and other tasks.

REQUIREMENTS FROM THE STATE

In recent years, the Ministry of Construction and Housing and Utilities of the Russian Federation has been systematically working to reduce excessive and irrelevant standards. To date, more than ten thousand requirements have already been transferred from mandatory to voluntary application in the construction industry. Mechanisms are being prepared and formed to implement optimal solutions with shorter deadlines and uniformity of procedures. Instead of the exhaustive list of documents, materials, information and approvals required for construction and subsequent operation approved by the Russian government, a draft law aimed at digitalizing the legal, regulatory, and technical regulation of the industry through the introduction of the state information system "Stroykompleks.RF", implies the introduction of a Digital register of documents, materials, information and approvals[1]. It is planned that the register will be maintained by the Ministry of Construction and Housing and Utilities in the "Stroykompleks.RF" system, which will ensure its openness and the possibility of operational updating.

An organizational and managerial algorithm has been prepared, according to which digital registers, construction information classifier (CIS), information on issued permits for construction or reconstruction and commissioning, as well as many other documents, information, materials established by the Government of Russia will be included in the unified information system "Stroykompleks.RF" based on the State Information System for Urban planning activities of the Russian Federation[2].

The register format, adopted in accordance with the Decree of the Government of the Russian Federation dated February 6, 2021 No. 128, is a federal state information system created in order to ensure the systematization of mandatory requirements and to inform interested persons about mandatory requirements that have established their regulatory legal acts, about the duration of their validity, as well as in order to ensure the maintenance in electronic form of the register contained in regulatory legal acts of mandatory requirements and databases on regulatory legal acts containing mandatory requirements.

The purpose of creating a register is to automate processes:

1. Formation, maintenance and updating of the register of mandatory requirements contained in regulatory legal acts.

2. Allocation of mandatory requirements from the texts of regulatory legal acts.

3. Informing interested parties about mandatory requirements [4].

The formation of a modern, coherent system of regulatory and regulatory-technical documents establishing uniform requirements for capital construction projects at all stages of the life cycle and eliminating possible contradictions in the system will be accelerated by the introduction of the registry principle of development, adjustment and application of regulatory and technical requirements.

In December last year, under Federal Law No. 541-FZ of December 19, 2022, the Unified Information System (UIS) took shape, which, among other things, will include registers of documents and registers of requirements in the field of engineering surveys, design, construction, operation and demolition. The UIS ensures integration with the Unified State Register of Real Estate, the unified information system of housing construction, other information system and resources determined by the Government of the Russian Federation. At the same time, the requirements contained in the documents included in the register of documents are included in the register of requirements [5].

REGISTER OF REQUIREMENTS

In the context of current development, the centralized formation of new types of requirements presentation in the form of a "register of mandatory requirements" is carried out in accordance with Federal Law No. 247-FZ dated July 31, 2020 "On Mandatory Requirements in the Russian Federation" and Decree of the Government of the Russian Federation No. 128 dated February 6, 2021 "On Approval of the Rules for the Formation, Maintenance and updating of the register of mandatory requirements". The vast array of existing industry regulatory and regulatory-technical documentation regulating the stage of operation determines the need to create registers of requirements right now, without waiting for ready-made solutions from abroad or existing experience from other industries. This is also due to the fact that each organization in the field of construction or operation works with a different list of standards[3]. In addition to the mandatory requirements in the activity, recommended requirements are also used, which are included in the organization's Standard.

Supporting these sides of digital transformation, the Scientific and Educational Center "Digital Construction and Operation" of the NRU MGSU together with "Kodeks" have initiated and are implementing a project to create a register of requirements in the form of a "knowledge cloud" in the NRU MGSU for educational purposes. Modern professional reference systems, such as the Techexpert system of "Kodeks", contain specialized services and functions that allow you to create your own registries and "knowledge clouds" right now, adjusting them to current tasks. The main condition for working with smart format documents is the classification of requirements, because without a single conceptual framework, the transition to global automation and digitalization is impossible, since different systems simply will not understand each other. The creation of ontological models of industrial and construction products does not exclude the formation of requirements management systems for software engineering, for the management of professional competencies, control and supervisory activities and collective work on documents [6]. It can be said that this is already a technology for managing the essential part of the document, which can adapt to the customer, while covering exactly his needs.

1 News of the Ministry of Construction and Housing and Public Utility Services of the Russian Federation. URL: http://www.minstroyrf.gov.ru (rus.).

2 Portal of the construction sector of the Russian Federation. URL: http://www.stroi.gov.ru (rus.).

3 Requirements management system on the Techexpert platform. URL: http://www.tehexpert.online (rus.).

CREATING A REGISTRY

For a pilot project to create a digital register of regulatory and technical requirements for the operation of civil buildings, Techexpert systems were selected, which approaches regulatory documents as a "data container" [7]. This is a digital document that combines a whole set of data:

- different attributes intended for both human and automated systems;
- hypertext with the capabilities for contextual search, hyperlink placement, table of contents, as well as the ability to create various additional services based on verbal and textual analysis, which can later serve for machine analytics;
- graphics (including a scanned copy of the original);
- 3D models of the building, its systems, elements and other attached files of various formats. All changes and amendments, as well as all versions and revisions of the document with the possibility of their comparison;
- metadata;
- indices.

The main tasks that specialists face in real-world requirements environment (taking into account the use of "digital documentation" in reference systems) and the standard services and functions by which these tasks can be solved taking into account different conditions are summarized in Table.

The main block of work on the requirements register is undoubtedly the structure of the register with their connection to the system of automated control of the relevance of regulatory documents and further transition to the machine-readable format of SMART documents [8]. In this case, relating it to a specific practical task or a set of tasks — construction or operation quality management.

In order to create an appropriate register, the main processes were identified for which the primary selection of regulatory and technical documents regulating technical operation was made. After that, the documents were grouped by their status, and then the texts were searched for requirements, distributed into groups — mandatory, and recommended. Related requirements were marked with the appropriate designations in the text. In addition, the search was performed according to the requirements without reference to specific standards, and the "Knowledge Cloud" was formed in the folders of

Solving problems using services and functions

Main tasks	Standard services and functions
Search for requirements in systems (when a specific regulatory document is unknown)	4 search options and annotations to documents
Search for a requirement in the text of the document	3 types of search within the document
Selecting a requirement and moving it to a folder	Bookmarking, adding comments to a requirement
Creating a "knowledge cloud" or a requirements registry in system folders	Creating in user folders
Document status tracking	Putting documents for control
Tracking the status of the requirement (valid, replaced/canceled)	Comparison of norms and standards, comparison of editions, review of changes
Tracking the relevance of regulatory documents in the texts of materials	Integration with MS Office, AutoCAD, nanoCAD, etc.

users inside the "Techexpert" systems. This task is more promising to solve by downloading data from the building information model. After all, the application of information modelling in the process of construction and operation is intended to improve the quality of process management and improve the quality of control over compliance with existing norms an.rules, the organization of interaction of participants in the formation of a digital twin of a building [9]. In turn, the methodological basis for the application of data from information models at various stages of the life cycle of the object, the formation of requirements for them is implemented within the framework of the set of UIMS standards (Unified Information Modelling System), which forms the terminological basis for the regulatory legal system of the Russian Federation in the field of information modeling [10].

The implementation of the project is progressive, starting with steps to introduce the practice of digital technologies in the educational process at the stage of checking student final qualifying papers for references to irrelevant regulatory documents. This is due to the fact that the automation of the process of working with documents is relevant and, at the same time, new for technical specialists. Meanwhile, for example, future lawyers devote a lot of time to the study of professional reference systems within the framework of a separate academic discipline "Information technologies in professional activity". But it cannot be said that students of construction professions rarely use regulatory documents in their activities, rather, they need other methods of working with documentation of all stages of the building's life cycle in digital form. It is now obvious that real and tangible effects from the introduction of information modeling can only be achieved only if all stages are transferred to such a format [11].

In creating the algorithm, these reasons have been taken into account and step-by-step instructions are provided on how to ensure a clear binding of a specific requirement from the required regulatory document to a fragment of an organization's Standard, technological map or any other document. Clearly linking the requirement to the text also provides the ability to quickly check and monitor the requirements (cancelled, replaced, changed). Moreover, this solution does not require new IT-developments, but can be performed using standard services of professional reference systems. By integrating the systems with MS Excel, in addition to monitoring requirements, automatic calculation of the compliance of the actual values with the parameters of the standard has been provided.

CONCLUSIONS

The practice of mass use of information reference systems in the creation requirements registers defining digital transformation will allow specialists to acquire useful "digital skills" and will contribute to improving the quality of operational activities. In the future, this will ensure a rapid transition to SMART standards, which provide ample opportunities for accelerating, optimizing and automating the application of regulatory requirements. And without compliance with the requirements, it is impossible to imagine the operation of the future and ensuring its technical safety.

At the moment, there is no consensus on how to automate the process of working with regulatory documents in construction using digital solutions. Most often, companies work as it is convenient for their employees or develop their own algorithms, and the implemented format of operation requires, among other things, skills in working with application software, information databases and reference systems [12]. Therefore, if the project of NRU MGSU and "Kodeks" will have a real application in the industry, by incorporating these practices in the educational process, it is possible to improve

the quality of construction and operation of works, as well as to optimize the costs of specialists at their workplaces.

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Реестровый принцип и SMART-документы как условия цифровой трансформации технической эксплуатации зданий

Переход к «Индустрии 4.0» или «Четвертой промышленной революции» — это сложный шаг, в рамках которого во все сферы производственных отраслей внедряются автоматизированные технологии. Целью этого внедрения является обеспечение обмена данными между устройствами, базами и системами разной степени сложности без участия человека. Этот переход является также переходом к формализации и стандартизации, и, следовательно, требует применения новых форматов нормативных и нормативно-технических, организационно-технических документов. Становится очевидно, что эти форматы должны быть не только человекочитаемыми, но и машиночитаемыми. Они позволят системно и эффективно формировать документы, применять и корректировать на всех этапах жизненного цикла здания. Не остается в стороне и техническая эксплуатация зданий. Эффективная эксплуатационная деятельность невозможна без эффективного управления ее нормативно-технической документацией и нормативными требованиями к эксплуатируемым зданиям, их элементам и системам. Это же касается повышения эффективности всех организационных, производственных, технологических процессов эксплуатации.

Ключевые слова: *«SMART»-документ, реестр нормативных документов, реестр нормативно-технических требований, техническая эксплуатация, автоматизация, цифровые инструменты, Единая информационная система*

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Об авторах: **Звонов Илья Александрович** — старший преподаватель кафедры организации строительства и управления недвижимостью, директор научно-образовательного центра «Цифровое строительство и эксплуатация»; **Национальный исследовательский Московский государственный**

строительный университет (НИУ МГСУ); 129337, г. Москва, Ярославское шоссе, д. 26; РИНЦ ID: 820141; ORCID: 0000-0002-4854-9903; ZvonovIA@mgsu.ru;

Каширина Наталия Владимировна — ведущий специалист по маркетингу; **АО «Кодекс»**; 197376, г. Санкт-Петербург, ул. Инструментальная, д. 3, лит. Х; SPIN-код: 2752-6270; ORCID: 0000-0003-1787-441X; kashirina@kodeks.ru.

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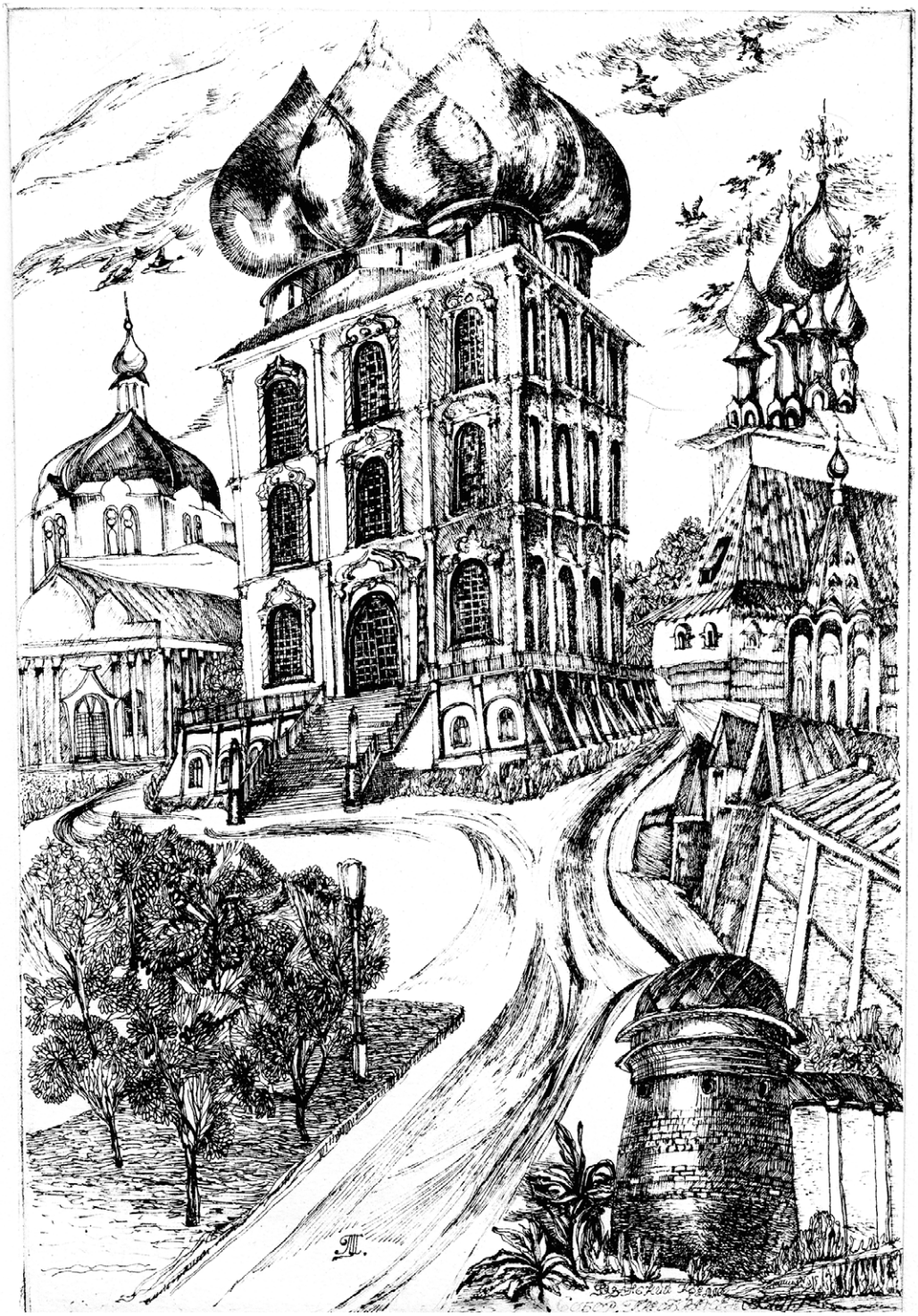

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Maksimov S.N.

Integrated development of territories and its bottlenecks

The article addresses the new practice of the Integrated Development of Territories (IDT) in furtherance of changes in federal and regional legislation, following the adoption of Federal Law No. 494-FZ "On Amendments to the Urban Planning Code of the Russian Federation and Certain Legislative Acts of the Russian Federation to ensure the integrated development of territories", December 2020. The article is based on the analysis of some provisions of these changes and the discussion that has begun in this regard at the regional level, in particular, in St. Petersburg. The article highlights the main problems of both applied and fundamental issues of the discussion, including criteria for classifying residential areas subject to demolition due to IDT projects implementation, residential areas under the IDT zone, issues of determining the form and amount of compensation to owners and tenants premises seized under the IDT, the expediency of IDT as a form of renovation of the housing stock, the issue of invasion of property in the implementation of the IDT, and the role of the population as a subject of the IDT. Based on the analysis, several proposals, aimed at improvement of legislation and IDT practices, were suggested.
Keywords: *integrated development of territories (IDT), renovation, property, equivalent premises, market value, fair value*

Maksimov Sergey Nikolaevich,
Doctor of Economics, Professor, Professor of the Departments of Land Management and Cadastre; Saint-Petersburg State University (SPbSU); 7-9 Universitetskaya Embankment, St. Petersburg, Russian Federation, 199034;
ID RSCI: 626621,
Scopus: 56673813200,
ResearcherID: M-2051-2015,
ORCID: 0000-0003-2709-2462;
msn1@mail.ru

The subject of the article is the issues of the formation of the practice of integrated development of territories (IDT), primarily in relation to the land of residential areas, and the related public opinion. In our case we will basically consider St. Petersburg after adoption of the regional law on the IDT of residential areas.

The author of the article has already addressed issues related to this problem in connection with development processes ("development and re-development" — in international terminology) of urban areas [1, 2].

A new reason for addressing this problem is the practical development of the provisions of Federal Law No. 494-FZ "On Amendments to the Urban Planning Code of the Russian Federation and Certain Legislative Acts of the Russian Federation in order to ensure the Integrated Development of Territories", published in December 2020 [3]. The Law introduced a new concept for the legislation, the "Integrated Development of Territories", its definition, types, sequence of steps for the implementation of projects and programs of the IDT. After that, there was begun the gradual adjustment of regional legislations in accordance with the federal one, and practical development of opportunities, arising in connection with the adoption of the Law. In 2022, the turn came to St. Petersburg, where there was adopted the law of St. Petersburg No. 444-59 "On Amendments to some laws of St. Petersburg on the issues of integrated development of Territories in St. Petersburg", dated June 30, 2022 [4]. In this case St. Petersburg was far from being in the first ranks of regions in terms of the adoption time of regional laws supplementing the federal ones. Quite a few regions have made appropriate changes to their regional legislation back in 2021. To date, many regions of Russian Federation initiated the practical implementation of IDT projects (see Table below). Detailed information on the progress of IDT projects implementation in regions of Russian Federation can be found on the Institute for Urban Economics website [5].

Yet in St. Petersburg, the Law was adopted only in the middle of 2022. It appears, it happened only at the very end of the spring-and-summer parliamentary session after the strong recommendation of the Governor of the City to consider the bill as a matter of priority.

The adoption of the Law was the impetus for a very heated discussion of IDT problems and their resulting consequences for population of urban communities. Here, we are talking about the IDT projects of residential areas, since the issues of IDT of non-residential areas and undeveloped territories, even if discussed — are discussed in camera. The list of the supposed territories was formed (22 territories, as of the beginning of September, 2022), but information on them is rather insufficient [6]. However, there is not much public interest in this topic either. The situation with residential areas is different. Here, even the alleged territories, as if there are no, but passions on this subject have flared up very seriously.

Development of the IDT practice in the Russian Federation regions (Data as of December 2022) [5]

Number of IDT decisions under consideration	Planned volume of buildings commissioning (1,000 sq.m.)	Number of adopted IDT decisions	Number of construction permits issued
761	143,000	226	70

Discussion of regulatory documents being adopted or planned for adoption in social networks has become already a regular practice, but in this case, the discussion activity significantly exceeded usual parameters. In social networks like "VK", "Telegram" in St. Petersburg a great number of resources for the exchange of opinions were created in first days after the adoption of the Law from 30.06.2022 and some of them reached quite significant sizes. For example, a number of channels and groups appeared in the Telegram network: "IDT (Renovation) SPB" (about 8,000 participants at the beginning of August 2022), "Stop IDT" and many other groups of residents from individual residential areas, neighbourhoods, houses, etc.

Analysis of the discussions in these groups shows that the level of legal knowledge on this issue is quite low: most of discussion participants have the very modest understanding of the federal and regional legislation, their subordination and interrelation, and have difficulty mastering the legal language and terminology.

For example, with regard to the situation in St. Petersburg, most don't see the difference between the various renovation programs that were adopted in the city: a program called "Development of built-up areas" — according to the law of St. Petersburg, adopted in 2008 [7] and a new program, "Integrated development of territories" (IDT), in accordance with the Federal Law No. 494-FZ [3], only realizable in the lon.run, if ever. These concepts are mixed very often, (especially since they actually coexist in time) which leads to a misunderstanding of the current situation. Quite often, the term "renovation" is added to all this, although it is not mentioned at all in any regulatory act of St. Petersburg. There is also a widespread confusion of federal and regional legislation provisions, as well as the time of adoption of the regional law and the time of practical actions started for its implementation. This finds its expression in something like this reasoning: "Here, people are sitting in dachas now, and when they arrive, there is no apartment, and there is no house — they have been demolished!", and sometimes it seems that some kind of joy is evident in these statements. As for legal illiteracy, then, not so often, but still there is even a certain bravado: "Yes, I need an interpreter to understand the law". However, as the discussion progresses and over time, the level of awareness is increasing gradually, and judgements become more balanced.

In general, all participants of the discussion can be divided into several groups: a first group — people who really want to understand the problem and find a way out of it, and they are still the majority; a second group — a kind of "provocateurs" who constantly strive to "raise the degree" of discussion; a third group — specialists who "hone" their skills and collect materials for their professional activities; a forth group — people who find pleasure in the discussion itself, considering it as a kind of game, that allows them to have fun and distract themselves from routine worries.

Let's focus on the substantive side of the problem and highlight the main issues being discussed, and which, indeed, are key in the transition to the practical implementation of projects and programs for IDT. The whole set of problems that pop up during the discussion can be conditionally divided into two levels in terms of scale and nature — applied and fundamental.

The first group includes such issues as determining the criteria for assigning objects that fall under IDT legislation, in addition to dangerous buildings. Federal legislation takes, in fact, the position of an outsider here, shifting the solution of this issue to the regions of the Russian Federation. The corresponding article of the Urban Planning Code of the Russian Federation is full of references to the regional level: "criteria are determined by the region of the Russian Federation", "the value is determined by the region of the Russian Federation" [8]. In short, the responsibility is shifted to "one floor below". In some cases, this may be justified, for example, if we are talking about the presence or absence of centralized engineering and technical support systems, since the housing stock in different regions of the country differs both in age structure and in technical parameters. However, this is not always advisable. For example, it is hardly possible to agree that regions have a right to independently determine the degree of physical wear and tear at which it is advisable to include buildings in IDT projects. Why, for example, for Voronezh, as indicated in the relevant regulatory act of Voronezh region, 65 % wear is the basis for inclusion in IDT projects [9], and for Vladivostok, with regard to panel houses, 60 % is already enough, and 70 % is needed for brick ones [10]. It is clear that with the same physical age, wear may be different due to differences in climatic conditions, quality of operation, etc., but the degree of wear as a criteria for inclusion in IDT programs should still be, in our opinion, the same, which corresponds to a unified technical policy in the country. At the same time it should be noted that in many regions (including St. Petersburg), legislators generally preferred to circumvent this issue by assigning the duty to determine the necessary level of wear to the executive authorities. As for St. Petersburg, the legislators here, apparently, have become the most special ones in the country, introducing into the law a word from colloquial jargon — "Khrushchevki panels" houses, although these "Khrushchevki" houses have a lot of series (GI, 1-335, 1lg-504, 1lg– 507, OD, etc.), noticeably different from each other in terms of the type of panels used, design and, as a result, comfort, service life, energy intensity, heat- and sound insulation. So that some of them, indeed, have a high degree of wear and need to be demolished, while others are quite amenable to modernization, which has experience including in St. Petersburg and can be operated for more than a dozen years.

The second group of issues from the "applied" group are about the area of resettlement of residents, whose housing is being withdrawn as a result of the territory falling into the scope of IDT program in accordance with Article 32.1 of the Housing Code of the Russian Federation. As we know, the wording of the Housing Code is as follows: "… the residential premises are in an apartment building located in the same settlement or urban district in which the apartment building included within the boundaries of the area of residential development subject to integrated development" [11]. This provision aroused the strongest resistance when it was discussed in social networks of St. Petersburg, where it was perceived as a significant violation of the rights of owners and tenants. In this regard, it's important to draw attention to two circumstances. Firstly, this provision was born on the basis of the wording set out in the Law of Moscow "On Additional Guarantees of Housing and Property Rights of Individuals and Legal Entities During the Renovation of the Housing Stock in the City of Moscow"; the exact wording was as follows: "… the residential premises are located in the same area in the City of Moscow in which the corresponding apartment building subject to renovation is located ….". Secondly, the same article 32. 1 of the Housing Code states: "The regulatory legal act of the Russian Federation, the regulatory legal act of the region of the Russian Federation, municipal legal acts may provide additional support measures to provide residential premises to the owners of residential premises". Thus, this is exactly the case when Moscow as a subject of the Federation by its normative and legal act introduced additional support measures compared to the provisions of federal legislation, and not only for owners, but also for tenants. Other regions of the Russian Federation could

have done this, but they did not. For example, this is what lawmakers in St. Petersburg did, leaving unchanged the wording of the Housing Code of the Russian Federation, which caused justified indignation, since in terms of its location, the saturation of social and other infrastructure, the quality of the urban environment in general. Possible relocation sites may be significantly less attractive than the area of residence at present. The Housing Code of the Russian Federation states: "the residential premises are in an apartment building that is located in the same settlement, urban district…", although federal legislation allows this provision to be clarified [11].

Directly related to the issue of the proposed relocation area for residents from territories of the integrated development, there is the problem of determining the type, form and amount of compensation for the withdrawal of housing in the process of the IDT. The issue of compensation for the withdrawal of housing due to state and municipal needs, although it already has a certain history in our country (for example, it had to be solved in preparation for the 2014 Olympic Games, during the implementation of the renovation program in Moscow), but it has not yet become a subject of the detailed understanding, and, moreover, it has not found a satisfactory theoretical and practical solution. Two circumstances seem essential here. Firstly, when determining the type of compensation, two concepts are used, "equivalent" and "the same value", which partially overlap each other, but at the same time they have noticeable differences. Initially, the provision on the possibility of withdrawal of property in the interests of the state and the corresponding compensation was formulated in Article 35 of the Constitution of the Russian Federation: "Compulsory alienation of property for state needs can be carried out only on condition of prior and equivalent compensation" [12]. It was then deployed in the Land Code of the Russian Federation, where in Article 49 the term "alienation" is already replaced by "withdrawal" and lists the grounds "for the withdrawal of land plots for state or municipal needs", which, in particular, means the grounds provided for by "federal laws" [13]. At the same time, in the future, the market value of the withdrawn property is indicated everywhere as the basis for determining the amount of compensation for the withdrawal of property, which allows to say that it is an equivalent compensation.

As for the concept of "equivalence", it is mentioned for the first time in the draft Federal Law No. 141-FZ "Law on Renovation in Moscow" from July 1, 2017 [14]. At the same time, in the original version of the law, this term is used: "equivalent residential premises", "equivalent non-residential premises". It is important to mention that the concept of "equivalence" in the text of this document had different contents for residential and non-residential premises.

For residential premises, it was determined as follows: "an equivalent residential premises means a well-maintained residential premises, the total and living area of which is not less, respectively, than the total and living area of the vacated residential premises and the number of rooms in which is equal to the number of rooms in the vacated premises. Equivalent residential premises should be located in the area of Moscow, in which the corresponding residential building is located…." [14].

For non-residential premises, the concept of "equivalent premises" was interpreted significantly differently: "an equivalent non-residential premises is a non-residential premises located on the territory of the City of Moscow, the area of which is not less than the area of the vacated non-residential premises" [14]. As it is evident that the terminology is clearly unsettled, which is not surprising. Strictly speaking, equivalence means complete identity of consumer characteristics and therefore only this room itself can be equivalent to one room (object), since, at least by one essential parameter – location – any other room will differ from this one. Therefore, this term cannot be considered quite satisfactory for the real estate sector and it needs to be more accurately determined. In this sense, the concept of "equal value" is more universal and appropriate for use, since it is based on the cost, which is originally intended for measuring goods with different consumer characteristics.

In this case, equivalent apartment is an apartment equal in value to this one. It may differ significantly from this one in individual parameters (for example, by area, number of rooms, etc.), but in all totality of parameters equal to it in cost (for example, losing to the first in area, but winning in transport accessibility and comfort). However, the question is what kind of value we are talking about, since several types are distinguished in the valuation of real estate (and not only real estate). Article 32.7 of the Housing Code answers this question as follows: "When determining the amount of compensation for residential premises, it includes the market value of residential premises, the market value of communal property in an apartment building, including the market value of the land plot on which the apartment building is located, taking into account its share in the right of common ownership of such property, as well as all losses caused to the owner of the residential property by its withdrawal, including losses incurred by him in connection with the change of the place of residence, temporary use of other residential premises before acquiring ownership of another residential premises (if the agreement specified in part 6 of this article does not provide for the preservation of the right to use the withdrawn residential premises before acquiring ownership of new residential premises), relocation, search for another residential premises to acquire ownership of it, registration of ownership for another residential premises, early termination of their obligations to third parties, including lost profits" [11]. The definition is quite extensive, but it clearly states the basis of the amount of compensation — the market value of the property. It would seem that it would be possible to stop there, but the market value is significantly influenced by the expectations of the real estate buyer, from whose position the market value should be determined. If we are talking about an ordinary transaction in which both the seller and the buyer are free to sell or not to sell, to buy or not to buy, this is quite reasonable, but in the case of the withdrawal of property, this is not the case at all. The conditional seller — the owner of a residential (or non-residential) premises has no choice. Therefore, the use of market value as a basis for determining the amount of compensation is incorrect.

In this regard, by the author's opinion the most suitable basis for determining the amount of compensation is a concept of the fair market value. This concept has appeared relatively recently in domestic practice and is distinguished by the fact that a fair market value (as well as "market value on market data") assumes that when determining its value, the interests of the "seller" should also be taken into account, for example, in the acquisition of alternative real estate.

This means that the compensation, received for withdrawal of premises in connection with the implementation of IDT projects, should be sufficient for the "seller" to be able to buy a property on the market that, according to the totality of its consumer characteristics, is equivalent to the one being withdrawn, i.e. on the basis of fair market value.

The second level of IDT "pain points" and problems are fundamental issues related to expediency, to "nature", the essence of renovation and its social significance and consequences.

The first of such issues is the question of the expediency of IDT as a whole. In most cases, a negative answer is given to it according to the principle: "I'm fine as it is". Gradually, however, quite rare, but sound statements are beginning to appear that, in principle, IDT is needed in a number of city districts, but it is necessary to approach this issue selectively and after a preliminary examination. In the previous note, it was already said that "Khrushchevki" houses are different and there may be various options for their renewal. Therefore, the first thing to start with is to conduct an "audit", an inventory of "Khrushchevki" houses or, more correctly, "Residential houses of the first mass series". There are about 2,400 such houses in St. Petersburg. At the same time, not only the residential buildings themselves should be analyzed, but also the engineering infrastructure that ensures their functioning, i.e. the entire territory of the blocks with their "improvements".

Of course, this task is large-scale, but there are both the organization specialized in inventory of buildings in the city (State Institution for Inventory and Valuation of Real Estate (GUION)) and a number of design organizations specialized in housing construction. At the same time, it would be possible to determine the level of wear, which is a necessary and sufficient reason for inclusion in the IDT program. At the same time, it may not always be necessary to resort for demolition of buildings, somewhere, as once planned, their reconstruction would be enough.

Another fundamental issue, often raised in discussions, concerns property rights. In many cases IDT projects are considered as encroaching on property rights (which is a true) and contradicting the Constitution of the Russian Federation (which is no longer entirely accurate). Yes, renovation certainly affects property relations and this is not the first time this issue has arisen in recent years.

For the first time, it sounded loudly enough during the preparation of the Olympics — 2014, then during the "hunt" for stalls and pavilions near metro stations in Moscow during the winter of 2016 ("night of long buckets"), when the mayor of Moscow said the historical phrase: "You can't hide behind pieces of paper about property acquired obviously fraudulently". After that, he surfaced again during the preparation for the "Sobyanin renovation", and now it is the same in St. Petersburg. There is no simple answer to it. One thing is certain: the definition of property rights from the XIX century — "Property is the complete and undivided domination of a person over a thing", has lost its relevance in the XXI century [15].

And finally, the third issue on the list, but not by the importance. Perhaps it is the first one, or even the only truly fundamental one. This is a question about the role of residents of "Khrushchevki" houses and the neighbourhoods in which they are located, and the entire population of the city in determining the feasibility, scale, directions and methods of renovation. The prevailing opinion here among the discussions' participants in social networks is that, for the population, it is intended the role of extras. "They want to deport us for the ring road", "they want to cash in on us again" — these are still the mildest of the statements encountered on this topic. And this is the main problem.

The population of the city wants to be an active actor in the transformation processes taking place in the city, and not their object, and here they are absolutely right. It is worth thinking seriously over the solution of this problem, and not to dismiss the opinion of residents, even if it is not always correct and relevant.

In conclusion, it is important to formulate several specific proposals which, by the article author's opinion, would make it possible to remove the problems associated with the implementation of IDT programs and projects, at least partially.

Let's formulate three sentences, which, in my opinion, should begin with (in fact, of course, there are more, but for now at least limit ourselves to them).

Firstly, it is necessary to introduce a mandatory stage of a comprehensive survey of specific territories, buildings belonging to them, structures of infrastructure elements for the expediency of their inclusion in the IDT program. The results of the survey and recommendations should be published in open public resources, and the population should be informed about the possibility of getting acquainted with the results of the survey.

Secondly, the draft decision on the IDT submitted for discussion should contain a detailed Master plan of the future territory (indicating the functional zoning of territories, the placement of real estate objects, their number of floors, building density, etc.), as well as information about demolished and reconstructed real estate objects, including apartment houses, and proposals for the area of settlement residents evicted in connection with the implementation of the IDT program.

Thirdly, the draft decision on the IDT should undergo mandatory public discussions, after which, and taking into account their results, it should be put to a vote, in which all owners, holders of other rights to real estate, as well as tenants of real estate on the territory included in the IDT project (and not only demolished houses) should participate. In order to make a positive decision on the implementation of IDT project, it is necessary that more than 2/3 of the owners/tenants of real estate in the area vote in favor "For". Only after that it is possible to arrange a vote on individual houses on the inclusion / non-inclusion of this house in the IDT program.

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Комплексное развитие территорий и его «болевые точки»

Статья посвящена вопросам становления новой для современной России практики комплексного развития территорий (КРТ) на основе изменений в федеральном и региональных законодательствах, произошедших после принятия в декабре 2020 г. Федерального закона № 494-ФЗ «О внесении изменений в Градостроительный кодекс Российской Федерации и отдельные законодательные акты Российской Федерации в целях обеспечения комплексного развития территорий». Проведен анализ некоторых положений этих изменений и начавшейся в связи с этим дискуссии на региональном уровне, в частности в Санкт-Петербурге. Выделены основные проблемы прикладного и фундаментального характера, выявленные в ходе этой дискуссии, в том числе прикладные, такие как: критерии отнесения жилых домов к категории, подлежащей сносу при реализации проектов КРТ; районы расселения жителей, чьи дома попадают в зону КРТ; вопросы определения формы и размера возмещения собственникам и нанимателям помещений, изымаемых в ходе КРТ; фундаментальные — целесообразность КРТ как формы реновации жилищного фонда, вторжение в отношения собственности при реализации КРТ и роль населения как субъекта КРТ. На основании проведенного анализа формулируется несколько предложений, направленных на совершенствование законодательства и практики в сфере КРТ.

Ключевые слова: *комплексное развитие территорий, реновация, собственность, равнозначные помещения, равноценные помещения, рыночная стоимость, справедливая стоимость*

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Об авторе: **Максимов Сергей Николаевич** — доктор экономических наук, профессор кафедры землеустройства и кадастров; **Санкт-Петербургский государственный университет (СПбГУ);** 199034, г. Санкт-Петербург, Университетская наб., д. 7–9; РИНЦ ID: 626621, Scopus: 56673813200, ResearcherID: M-2051-2015, ORCID: 0000-0003-2709-2462; msn1@mail.ru.

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Mishchenko V.Ya.
Semenov A.L.
Titova L.N.
Loboda D.V.

The effect of three–stage ionization on the structure formation of a concrete mixture during shotcrete

The article deals with the problem of reducing rebound and dust formation, as well as increasing the strength of shotcrete. It is known that with "dry" shotcrete, the rebound is especially significant, since the mixture does not have time to acquire sufficient adhesive properties when mixing different phases. As a result, there is an irreparable loss of a significant part of the applied material. The formation of crystal centers that ensure the strength of concrete also occurs slower than with "wet" shotcrete, since the contact of the binder with water in the nozzle of the shotcrete machine is too short. This leads to a decrease in strength characteristics, slowing down the setting of shotcrete. To solve this problem, a method was developed for applying a concrete mixture to enclosing structures using a previously patented experimental nozzle and electrostatic treatment. This method, for a long time, has been successfully used for painting various surfaces, and its modernization will allow the introduction of electrostatics in shotcrete. A systematic ionization of the binder and then the finished mixture is proposed, as a result of which the shotcrete will be attracted to the shotcrete structure along the power lines. To obtain empirical data and confirm theoretical calculations, laboratory tests were carried out, during which the samples of both the initial shotcrete and those exposed to electrostatics were formed. During the application of the mixture, the magnitude of the rebound was recorded at various distances of the nozzle with the nozzle fixed on it from the shotcrete surface. Samples of the resulting concrete were examined on universal testing machines in order to determine the specific heat release, as well as the compressive and bending strength. The experiments showed that electrostatic treatment allows to speed up the time of the initial setting of the cement dough due to faster hydration of the mixture. An improvement in the strength of shotcrete and a significant reduction in rebound were recorded.
Keywords: *shotcrete, electrostatics, ionization, corona electrode, material rebound, particle charging, shotcrete density, shotcrete strength*

Mishchenko Valery Yakovlevich,
Doctor of technical Sciences, Professor, Head of the Technology Department, Organization of Technology, Organization of Construction, Expertise and Property Management; Voronezh State Technical University (VSTU); 84 20-let Oktyabrya st., Voronezh, 394006, Russian Federation; ID RSCI: 386458, Scopus: 57195990417, ResearcherID: AAB-9505-2019, ORCID: 0000-0003-2385-5426; oseun@yandex.ru

Semenov Alexey Lvovich,
Candidate of technical Sciences, Associate Professor of the Technology Department, Organization of Construction, Expertise and Property Management; Voronezh State Technical University (VSTU); 84 20-let Oktyabrya st., Voronezh, 394006, Russian Federation; SPIN-code: 5933-2800, ORCID: 0000-0001-9454-4823; ala_sem@mail.ru

Titova Larisa Nikolaevna,
Candidate of technical Sciences, Associate Professor of the Electromechanical Systems and Power Supply Department; Voronezh State Technical University (VSTU); 84 20-let Oktyabrya st., Voronezh, 394006, Russian Federation; РИНЦ ID: 451324, Scopus: 56626385200, ResearcherID: AFE-9498-2022, ORCID: 0000-0001-8461-0591; tln64@mail.ru

Loboda Dmitry Vladimirovich,
Leading Engineer in the Engineering Center "ProektStroyEngineering"; Southwest State University (SWSU); 84 20-let Oktyabrya st., Voronezh, 394006, Russian Federation; loboda.dv@novomor.org

INTRODUCTION

When shotcreting by the "dry" method, a ready-made factory mixture is often used, delivered in bags, or by dump truck, where the ratio of "cement – filler" is on average 300 kg per 1,000 liters. With this composition, you will get about 350–360 kg. per cubic meter of shotcrete concrete. This is due to taking into account the rebound, that is, the loss of the mixture during the production of works. Moreover, the shotcrete of enclosing structures varies in the degree of losses: applying shotcrete to walls with maximum compliance with technology makes it possible to reduce losses by up to 15 %, and working with the ceiling can lead to losses of up to 35 %. If we take into account that manufacturers of ready-made mixtures do not recommend reusing the rebound material, which is fully justified by a sharp decrease in strength characteristics, then the still unresolved problem of irretrievable losses of the finished shotcrete mixture is relevant, and the search for its solution is economically more than justified.

One of the ways to regulate the properties of shotcrete is the use of alkali-free setting accelerators based on aluminum sulfates and hydroxosulfates. It is proposed to mix such additives in a ratio of 1–5 % of the binder weight, which makes it possible to increase the rate of formation of the primary structure by a factor of 2–3.5 (such data is given, for example, by the manufacturer) [1]. However, manufacturers everywhere recommend using a plasticizer to achieve the most optimal result. In addition, these additives are toxic to humans, especially in the form of powder and dust, fire and explosion hazardous, the effect on metal in the presence of water is also negative [2]. Taking into account the cost of such additives, the issue certainly remains unresolved and open.

There is another problem of "dry" shotcrete, as the water-cement ratio and workability of the mixture are, in fact, under the control of the nozzle operator: because he directly regulates the water supply and, by his own decision, its volume can be increased or decreased[1]. It is easy to make a mistake here: too liquid shotcrete concrete, when applied, will not achieve sufficient adhesion to the shotcrete surface and will begin to slip; too thick concrete will not have enough water for hydration, which is discussed in detail by A. Neville in an extensive work on the properties of concrete and further in the Jensen-Hansen model [3]. Of course, this is more relevant when using a filler of larger sizes, but it is also true for shotcrete. It is believed that the structure formation of concrete ends on the 28th day after application, but in fact, even under normal conditions of sealing and application of shotcrete, samples can often contain non-hydrated cement grains containing calcium silicates of both C_3S and C_2S [4, 5]. In such cases, the amount of

1 Guidelines for the use of shotcrete in the construction, repair and restoration of building structures of buildings and structures. Moscow, Tsniipromzdaniy Publ., 2007; 31.

$Ca(OH)_2$ is not enough, and the strength may not correspond to the vintage.

In addition, lack of water leads to increased dust formation, which again (especially in the presence of fiber and accelerators) can lead to negative consequences up to poisoning the operator.

The solution to the rebound problem is also important on the other hand: "dry" shotcrete does not allow applying large volumes of the mixture (up to 4 m^3/h), the work can be significantly delayed by the execution time [6]. It is also necessary to take into account the factor that shotcrete contains more binder for better workability, so, it is more expensive than conventional mixtures. Thus, the loss of material is more noticeable here.

Improving the strength of concrete is an equally urgent task that has been studied for a long time. There are many ways to activate the binder and concrete mixtures of solution methods, which are described in detail in one of the review articles [7].

First of all, we note that, as it was already mentioned above, in order to increase the strength characteristics, the importance of the water content in the shotcrete mixture cannot be overestimated, since it is the water molecules that lead to the formation of calcium hydroxide, whose crystal structures are comparable in size to the crystal lattice of the main minerals. As a result, the destruction of the surface layers of the initial cement occurs during the formation of the cement dough and the formation of its structure. On the other hand, water molecules create hydrate shells. The active centers of the particles are separated by energy barriers on the surface of these particles, so it is already obvious that it is necessary to influence various activating technologies that would speed up the process of joining water molecules and hydration of cement in order to increase strength characteristics.

In addition, the shotcrete process itself requires improvement to reduce rebound and dust formation, as well as overall material savings.

GENERAL PRINCIPLE OF ELECTROSTATIC TREATMENT OF SHOTCRETE

One of the solutions to the problem is the three-stage ionization of the shotcrete mixture in the technological scheme created using the previously developed experimental nozzle (Fig. 1) and completed on the basis of the "Duo-mix 2000" mixer pump [8]. This

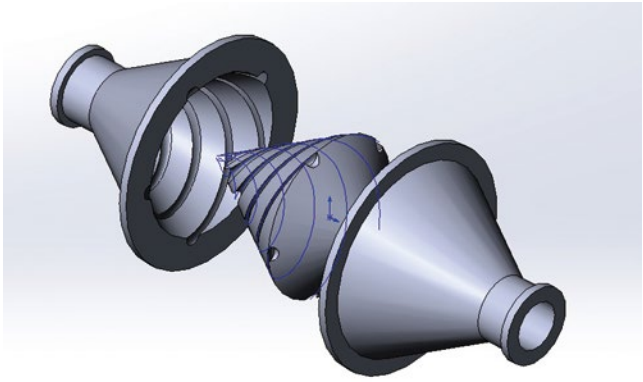

Fig. 1. Scheme of the experimental nozzle for the mixing pump "Duo-mix 2000"

invention was based on the principles of a long-established and successfully proven electrostatic painting, based on the discoveries of the American scientist Gerald Ransburg. With this method of application, the paint and varnish material passes through an electrostatic field formed by the electrodes and receives a negative charge. As a result, the sprayed material moves along the force lines between the spraying device and the surface to be painted, it is attracted to the latter, which allows to sharply reduce the rebound and loss of paint particles of the precipitating paint-air mixture. Moreover, this technology has been recently used for liquid paint material.

Of course, the principle of shotcrete has similarities with staining, but also numerous differences that need to be taken into account. Let us consider in detail the developed technological scheme for the application of shotcrete using electrostatics (Fig. 2). For convenience and simplification, we will take for 100 % charging during electrostatic painting, comparing similar processes in the processing of sand-cement suspension.

The first stage. The dry shotcrete mixture enters the receiving hopper of the "Duo-mix 2000" mixer pump *1*, where compressed air is supplied from the compressor *2*. Then the air-powder fraction is sent to the ejector pump *3*, where, according to the Bernoulli principle, ionized negative ionized air is supplied from the ionizer *4*, equipped with a crane *5*. It is experimentally determined that at

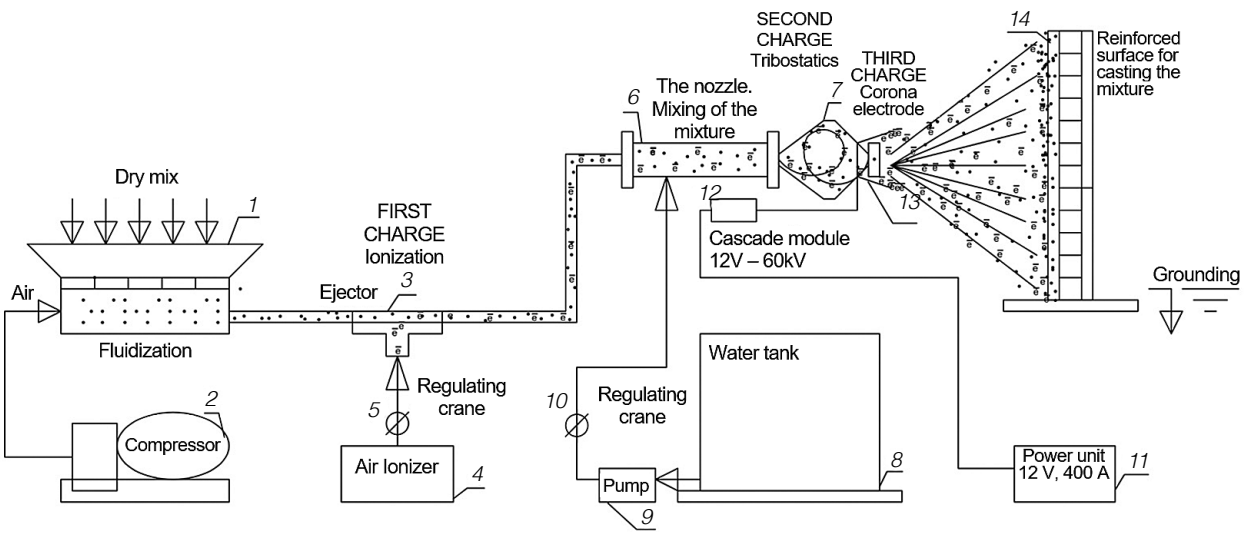

Fig. 2. Scheme of shotcrete cement-sand mixture using three-stage electrostatic charging

the first stage, the mixture is charged by 30–45 %, depending on the composition.

The second stage. The negatively charged mixture enters the sprayer *6*, consisting of an inlet nozzle *7* and a vortex nozzle *7*, where water is supplied from the tank *8* by a pump *9* through a shut-off valve *10*, which is calculated to be necessary for mixing with the dry mixture and forming shotcrete. At the inlet to the nozzle, the dry mixture is combined with water, while part of the charge is lost. To compensate for these 15 % losses, the resulting three–phase suspension is stirred by vortex motion in a nozzle made of special plastic, where due to the resulting tribostatic friction it is charged again with negatively charged electrons.

The third stage. A voltage (12 V) is supplied from the voltage generator *11* and through the cascade module *12* to the corona electrodes *13* mounted on the nozzle and insulated from breakdown by fluoroplast [9]. At this stage, the mixture passes through the ion corona and is additionally charged with negative charges by about 20 %, which in total gives a 50 % charge of the cement-sand mixture relative to the electrostatic coloring. Further, at the moment of settling on the thrown and grounded shotcrete surface *14*, two processes occur simultaneously: a change in the force vector of the aerodynamic motion of the mixture to the opposite and the discharge of negatively charged electrons. The first process causes the rebound of the finished mixture from the shotcrete surface. The second one, according to Coulomb's law, compensates for this due to three–stage ionization and, accordingly, an increase in the Coulomb force of attraction.

In addition to solving the problem of reducing the rebound, it was also assumed that the electrostatic activation of the mixture would lead to a more active wetting of the binder, acceleration of the cement dough setting without the introduction of accelerators and its more complete hydration, as well as an increase in the strength of the final shotcrete [10–12]. The introduction of electrostatics should also reduce dust formation during “dry” shotcrete due to the attraction of the gas-dust fraction to the surface to be thrown.

PROCEDURE FOR CONDUCTING EXPERIMENTS

After the development and implementation of this scheme, the authors began field tests and laboratory experiments to confirm the theoretical calculations. The research was conducted on the basis of the Voronezh State Technical University.

The water-cement ratio, V/C, was taken as 0.38. The working pressure in the sprayer was maintained in the range from 0.2 to 0.6 MPa, the departure speed was 150 m/s. The adjustment of the mortar torch was based on an assessment of the uniformity of the mixture and the characteristic greasy gloss. 6 layers 1.5–2 cm thick were applied to the vertical surface to bring the total thickness to 10 cm for further extraction of experimental samples. The layers were applied at a distance of 1 m to 50 cm at an angle of 900 to the vertical surface being thrown. Since no setting accelerator was used, the interval between applying layers ranged from 20 min to 4 hours. Shotcrete was carried out from the bottom up, the rebound material was removed and weighed in order to plot the rebound for each material.

When evaluating the results, the parameters set by GOST standards and Labor Protection Rules for the operation of electrical installations were taken into account.

Shotcrete of the enclosing surface was carried out with the application of ready–made mixtures of two types intended for “dry” shotcrete — SHOTCRETE B25 and SHOTCRETE B30, the main parameters of which are given in Tables 1 and 2.

Table 1. Main characteristics of mixtures used for experiments on electrostatic charging of shotcrete

Name of the mixture	Composition 1 (SHOTCRETE B25)		Composition 2 (SHOTCRETE B30)	
Basic Description	Dry construction for the repair of large defects by dry shotcrete method		Using high-quality cement	
Concrete class	B25 F200 W10		B30 F400 W12	
Appearance	Dry, loose grey homogeneous mixture		Dry, loose homogeneous mixture of gray color	
Filler size, mm	2.5		2.5	
The amount of mixture per 1 m^3 of shotcrete, kg	200		200	
Thickness of application of one layer, mm	4		4	
Material consumption, kg/m^3 (with a layer thickness of 10.0 mm)	~20		Before 20	
Average compressive strength:	MPa	kg/sm^2	MPa	kg/sm^2
1 day, at least	10	102	15	153
2 day, at least	15	153	20	203.9
28 days, at least	32.7	333.4	35	356.9
Water resistance	W18		W10	
Frost resistance, cycles	F1200		F1300	
Adhesion strength to the concrete surface, MPa, not less	1.5		1.5	
Water absorption, kg/m^2h 0.5, no more	0.4		0.4	
Shrinkage	Unshrinkable		Unshrinkable	
Modulus of elasticity, GPa	20		25	
Content of chlorine ions, %, no more	0.1		0.1	
Class in accordance with GOST 56378–2015	R3		R3	

Table 2. Composition for the preparation of a control standard mixture of shotcrete

Indicators	Composition 1 (SHOTCRETE B25)	Composition 2 (SHOTCRETE B30)
Type of binder	Cement grade PC 400 (GOST 10178)	Cement grade PC 500 (GOST 10178)
Type of placeholder	Sand according to TU 5745-001-162168921–06	Sand according to TU 5745-001-162168921–06
Size of filler particles, mm	2.2	2.2
Compliance of the filler with the sieving curve	Respond	Respond

The efficiency of electrostatic treatment was evaluated by the following parameters:

1. Directly in the process of shotcrete — visually to accelerate the setting of cement dough, reduce the degree of rebound and reduce the gas-dust fraction.

2. In laboratory conditions — according to the acceleration and increase of strength gain in 28 days and the characteristics of cement stone.

Additional tests were carried out separately to determine and optimize the electric field strength depending on the strength characteristics and the degree of rebound.

Based on the visual evaluation and registration of the results, the following data on the initial setting of shotcrete were obtained (Table 3).

Table 3. Duration of initial setting of shotcrete B25 and B30

Concrete class	Initial setting, min	
	Standard	After electrostatic treatment (average time)
B25	240	56
B30	240	53

DETERMINATION OF SPECIFIC HEAT RELEASE AND REBOUND OF THE SHOTCRETE MIXTURE

Specific heat was determined using an adiabatic calorimeter according to GOST 24316–80 “Concrete. Method for determining heat release during hardening”. Control samples after electrostatics show that the formation of cement stone of the treated mixture occurs more rapidly, since hydration, which began in the nozzle, occurs faster, and the outline is better compacted. There is a uniform increase in heat generation, slowing down after about an hour (Fig. 3). Thus, electrostatic treatment cannot yet replace the use of setting accelerators, where this time is reduced to 20 min, but it accelerates the initial setting twice, which makes it possible for further scientific research.

Data on reducing the rebound of the mixture when applying shotcrete after applying electrostatics is shown in Fig. 4.

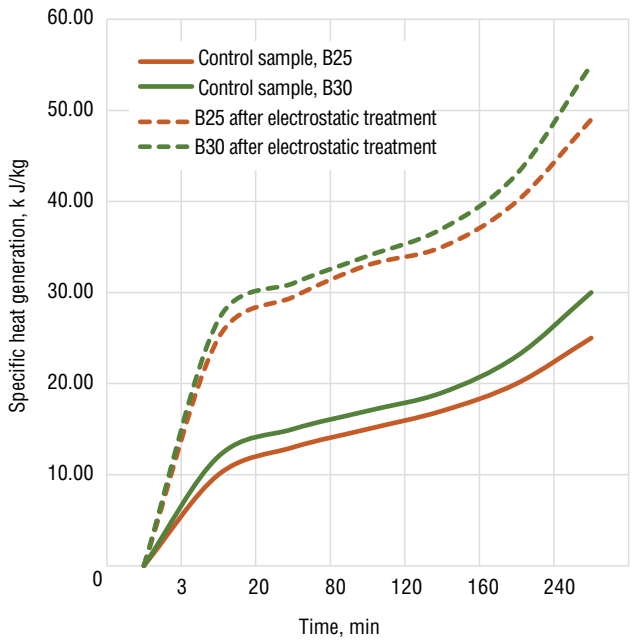

Fig. 3. Specific heat release of shotcrete samples B25 and B30 in the first 4 hours after application

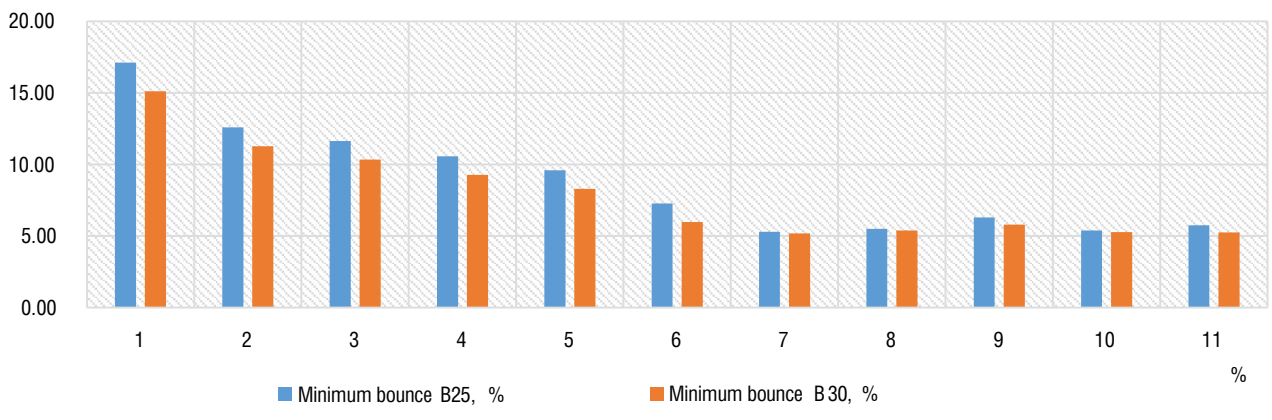

Fig. 4. Minimum rebound of shotcrete grades B25 and B30 after electrostatic treatment, %

INVESTIGATION OF THE EFFECT OF THE MIXTURE ELECTROSTATIC TREATMENT ON THE STRENGTH OF SAMPLES

The study of the effect of electrostatic treatment of the mixture on the strength of shotcrete samples was carried out on a universal testing machine Instron 1100 HDX. For this purpose, strength tests were carried out on 6 samples of each concrete with a size of 100×100×100 mm (Fig. 5) to determine strength characteristics according to GOST 10180–2012 (according to control samples) and flexural and compressive strength according to GOST 310.4–81[2, 3]. The samples were stored in a normal hardening chamber (at t = 20 °C) and tested at the age of 1, 2, 7, 14, 28 days. The results of the change in the tensile strength are shown in the graphs (Fig. 6–13).

Fig. 5. Instron 1100 HDX universal testing machine and shotcrete samples for strength testing

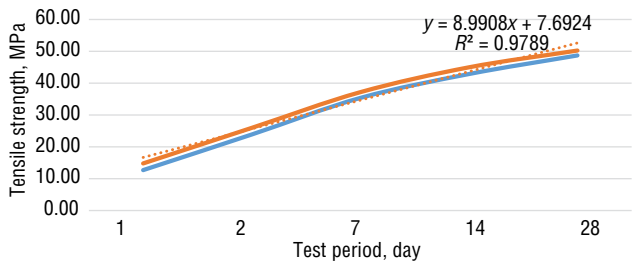

Fig. 6. Graph of changes in the compressive strength of shotcrete B25 before and after electrostatic treatment

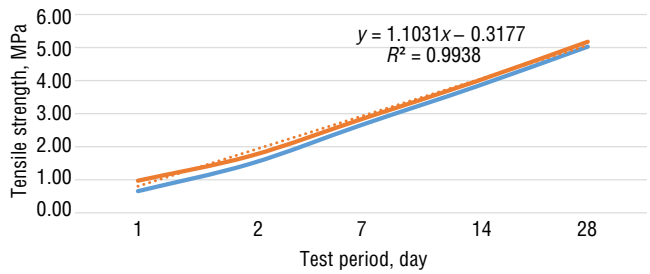

Fig. 7. Graph of changes in the bending strength limits of shotcrete B25 before and after electrostatic treatment

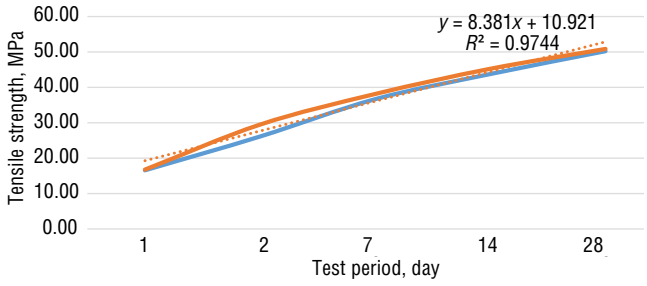

Fig. 8. Graphs of changes in the compressive strength limits of shotcrete B30 before and after electrostatic treatment

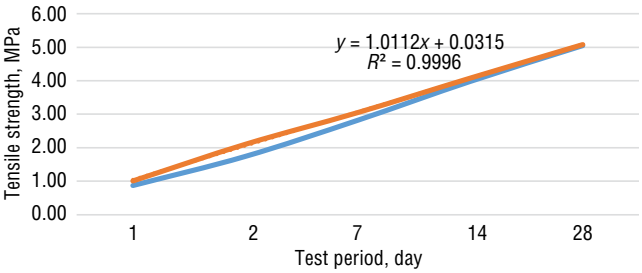

Fig. 9. Graphs of changes in the bending strength limits of shotcrete B30 before and after electrostatic treatment

2 GOST 10180–2012. Concrete. Methods for determining the strength of control samples. URL: https://files.stroyinf.ru/Data2/1/4293782/4293782275.pdf

3 GOST 310.4–81. Cements. Methods for determining the ultimate strength in bending and compression. URL: https://files.stroyinf.ru/Data2/1/4294853/4294853167.pdf

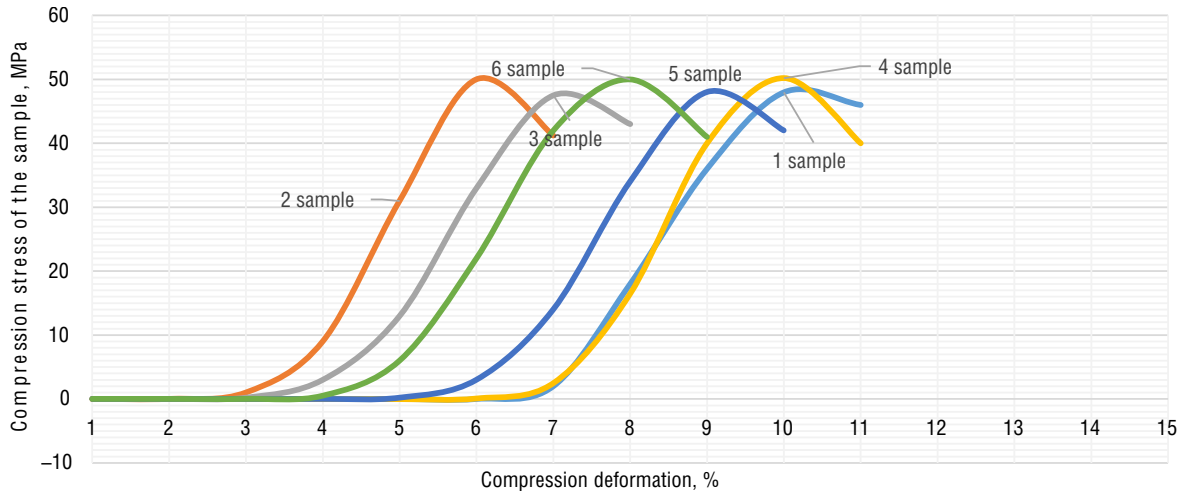

Fig. 10. Compression test of shotcrete samples B25 before electrostatic treatment (28 days)

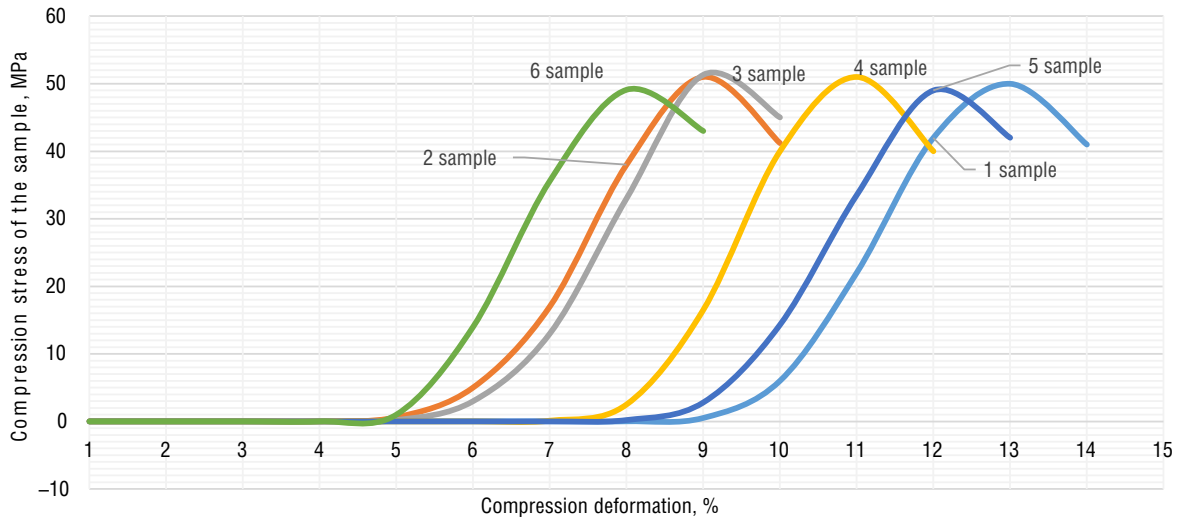

Fig. 11. Compression test of shotcrete samples B25 after electrostatic treatment (28 days)

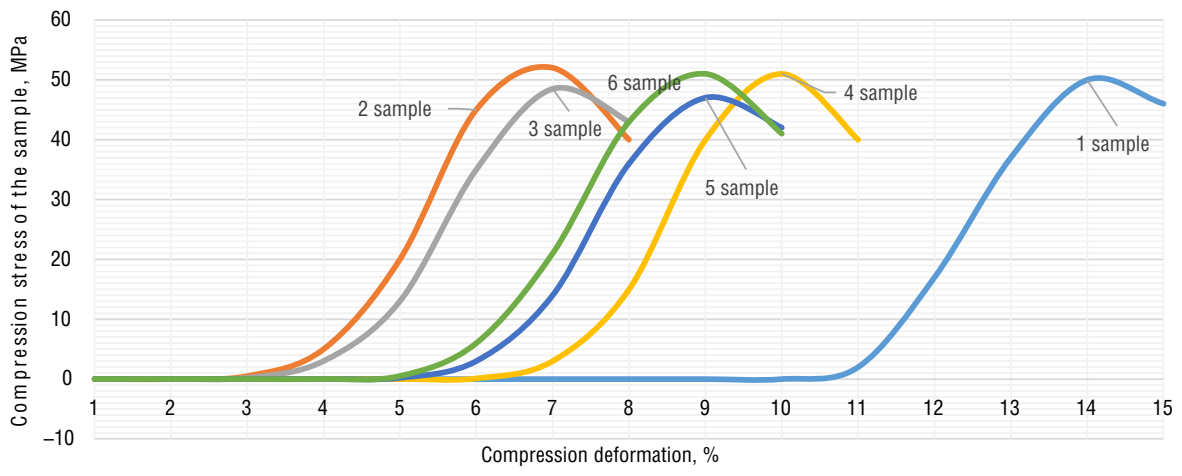

Fig. 12. Compression test of shotcrete samples B30 before electrostatic treatment (28 days)

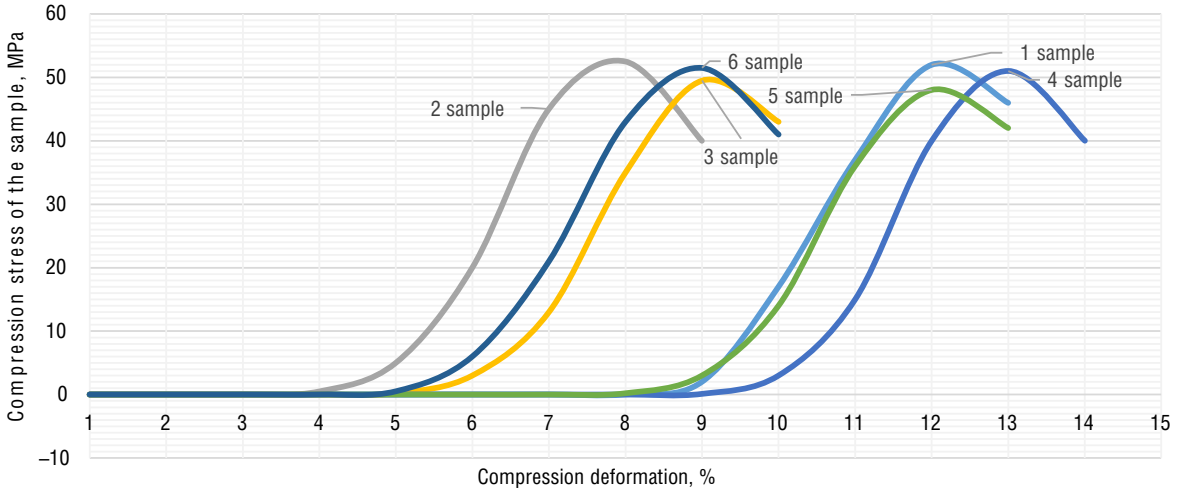

Fig. 13. Compression test of shotcrete samples B30 after electrostatic treatment (28 days)

CONCLUSION

We conclude that the electrostatic treatment allows to speed up the time of the initial setting of the cement dough. From the point of view of strength gain, the mixture of concrete B25 reacted more strongly to electrostatic charging, and in concrete B30, the acceleration of strength gain was noted at the early stages of hardening, then it approaches standard indicators.

It was revealed that the acceleration of setting and the increase in the strength of shotcrete occurs due to faster hydration of the mixture.

In addition, the use of electrostatics during shotcrete makes it possible to reduce dust formation in the working room due to the attraction of particles along force lines to the working surfaces.

Experimental data showed that the effect of electrostatic treatment on rebound is almost the same: the indicator decreased from 20–25 % to 5–6 %, but for stronger concretes, the volume of the mixture lost during application is less by 0.5–1 %.

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Влияние трехступенчатой ионизации на структурообразование бетонной смеси при торкретировании

В статье рассматривается проблема снижения отскока и пылеобразования, а также повышения прочности торкрет-бетона. Известно, что при «сухом» торкретировании отскок особенно значителен, поскольку смесь при смешивании различных фаз не успевает приобрести достаточные адгезионные свойства. В результате происходит невосполнимая потеря значительной части наносимого материала. Образование кристаллических центров, обеспечивающих набор прочности бетона, также происходит медленнее, чем при «мокром» торкретировании, поскольку контакт вяжущего с водой в сопле торкрет-машины слишком кратковременный. Это приводит к снижению прочностных характеристик, замедлению схватывания торкрет-бетона. В качестве решения данной задачи был разработан метод нанесения бетонной смеси

на ограждающие конструкции с применением ранее запатентованной экспериментальной форсунки и электростатической обработки. Данный способ давно и успешно применяется при окрашивании различных поверхностей, а его модернизация позволит внедрять электростатику в торкретирование. Предлагается поэтапная ионизация вяжущего, а затем и готовой смеси, в результате чего торкрет-бетон будет притягиваться к торкретируемой конструкции по силовым линиям. Для получения эмпирических данных и подтверждения теоретических расчетов проводились лабораторные испытания, в ходе которых формировались образцы как исходного торкрет-бетона, так и подвергавшегося воздействию электростатики. Во время нанесения смеси фиксировалась величина отскока на различных расстояниях сопла с закрепленной на нем форсункой от торкретируемой поверхности. Образцы полученного бетона исследовались на универсальных испытательных машинах с целью определения удельного тепловыделения, а также предела прочности на сжатие и изгиб. Проведенные опыты показали, что электростатическая обработка позволяет ускорить время первичного схватывания цементного теста за счет более быстрой гидратации смеси. Зафиксировано улучшение показателей по набору прочности торкретбетона и значительное уменьшение отскока.

Ключевые слова: *торкретирование, электростатика, ионизирование, коронирующий электрод, отскок материала, зарядка частиц, плотность торкрет-бетона, прочность торкрет-бетона*

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Об авторах: **Мищенко Валерий Яковлевич** — доктор технических наук, профессор, Заведующий кафедрой технологии, организации строительства, экспертизы и управления недвижимостью; **Воронежский государственный технический университет (ВГТУ)**; 394006, г. Воронеж, ул. 20-летия Октября, д. 84; РИНЦ ID: 386458, Scopus: 57195990417, ResearcherID: AAB-9505-2019, ORCID: 0000-0003-2385-5426; oseun@yandex.ru;

Семенов Алексей Львович — кандидат технических наук, доцент, доцент кафедры технологии, организации строительства, экспертизы и управления недвижимостью; **Воронежский государственный технический университет (ВГТУ)**; 394006, г. Воронеж, ул. 20-летия Октября, д. 84; SPIN-код: 5933-2800, ORCID: 0000-0001-9454-4823; ala_sem@mail.ru;

Титова Лариса Николаевна — кандидат технических наук, доцент, доцент кафедры электромеханических систем и электроснабжения; **Воронежский государственный технический университет (ВГТУ)**; 394006, г. Воронеж, ул. 20-летия Октября, д. 84; РИНЦ ID: 451324, Scopus: 56626385200, ResearcherID: AFE-9498-2022, ORCID: 0000-0001-8461-0591; tln64@mail.ru;

Лобода Дмитрий Владимирович — ведущий инженер инжинирингового центра «ПроектСтройИнжиниринг»; **Юго-Западный государственный университет (ЮЗГУ)**; 394006, г. Воронеж, ул. 20-летия Октября, д. 84; loboda.dv@novomor.org.

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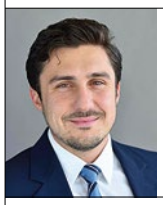
Aiman El-Hashem
Fedulova N.S.
Beliakov S.I.

"Timeback" concept — the future of the comfortable urban environment

In modern urban life, especially in large cities and megapolises, the principle of time-saving for residents is becoming increasingly important. Residents should be able to get to work, studies, shops and other places where they spend their time quickly and conveniently. In current Russian practice, this principle is most widely applied in the updated concept of urban space development implemented by the Samolet Group — the company's innovative approach is implemented in the "timeback" concept, which provides methodological connection of all elements and directions of development within the target vector of sustainable territorial development. The analysis of competitiveness factors in the context of introducing the "timeback" concept into development practice leads to the conclusion that the introduction of the concept can improve the quality of housing and the level of service, as well as more efficient use of investment potential of the territory and solve the marketing tasks and product promotion. In the medium and long-term aspects, a comprehensive introduction of the "timeback" concept within the company's project portfolio can contribute to the formation of a positive reputation of the developer, its long-term competitiveness, and positively influence the regional market as a whole, contributing to improvement of the product quality and competition.
Keywords: *spatial and territorial development of territories, complex residential development, development, time-saving, "timeback", competitiveness, comfortable environment*



Aiman El-Hashem,
Managing Director; Samolet Group; 19 Yartsevskaya st., Moscow, 121552, Russian Federation; elhashem@samolet.ru

Fedulova Nina Sergeevna,
Project Director; Samolet Group; 19 Yartsevskaya st., Moscow, 121552, Russian Federation; N.fedulova@samolet.ru

Beliakov Sergey Igorevich,
Candidate of Economic Sciences, Senior Lecturer, Associate Professor, Associate Professor of Construction Organization and Real Estate Management Department; Moscow State University of Civil Engineering (National Research University) (MGSU); 26 Yaroslavskoe Highway, Moscow, 129337, Russian Federation; ID RSCI: 587836, Scopus: 39763951700; osun_kaf@mgsu.ru

Developing a strategy for the spatial and territorial development of residential real estate is a solution to a wide range of tasks. Under modern conditions, these tasks cover all spheres of life and require consideration of many factors, many of which directly or indirectly come into conflict and thus form the areas of optimal decision-making in the presence of alternative scenarios and development concepts [1, 2].

The formation of comfortable residential urban development includes a number of principles that should be considered in the design and construction of urban housing estate [3–6]:

- functionality and convenience: urban development should be convenient and functional, i.e. provide residents with access to necessary services and amenities. This can include shops, pharmacies, schools, kindergartens, sports grounds and other infrastructure facilities;
- environmental friendliness: it is important to ensure that urban development is environmentally friendly. This requires the provision of green spaces, parks, squares, as well as the use of environmentally friendly materials in construction;
- safety: it is important to ensure the safety of residents in urban development. This could be done by installing security cameras, lighting the territory, landscaping entrances and roads;
- ergonomics: urban development must be ergonomic, i.e. take into account the needs of residents for comfortable and functional living spaces. This can be achieved through the development of projects for residential complexes taking into account the peculiarities of the life style of various population groups;
- accessibility: it is important to ensure that residential buildings are accessible to all groups of population, including people with disabilities. This requires the provision of special infrastructure facilities, such as ramps, elevators, as well as provide unhindered access to infrastructure facilities;
- social adaptation: it is important to ensure the social adaptation of residents in urban development. This can be achieved through the development of social support programs, holding social and cultural events, creating conditions for active communication and interaction of residents.

In modern conditions of urban life, especially in large cities and megapolises, the principle of time-saving for residents is becoming increasingly important. Residents should be able to get to work, studies, shops and other places where they spend their time quickly and conveniently.

In current Russian practice, this principle is most widely applied in the updated concept of urban space development implemented by the Samolet Group — the concept of "timeback".

Samolet Group is the fastest growing public company in Russia by 2021 and one of the largest federal corporations in the field of proptech and development. The following business areas are developing within the perimeter of the group: an online real estate services platform "Samolet+", a management company, commercial and rental real estate funds, development projects in all segments across Russia, residential housing, resort real estate and others.

At the end of 2021, the external valuation of assets reached 532.9 billion rubles, including a land bank of 29.0 million square meters of marketable area and a brand worth 34.3 billion rubles. The Group is one of the backbone organizations of the Russian economy and ranks the 1st place in the Moscow region in terms of current construction

and the 2nd place in Russia. It has representative offices in more than 100 cities of Russia and the CIS countries and a staff of about 5,000 employees. The declared mission of the company is to create a new quality of life in modern urban area and save people the most valuable resource — time[1, 2, 3].

One of the key factors in the dynamic development of the brand of Samolet Group is social responsibility and focus on the introduction and development of the most modern approaches to creating a comfortable living environment in a complex urban development.

The company's innovative approach is now systematically presented in the "timeback" concept, which provides a methodological connection of all elements and directions of development within the target vector of sustainable territorial development.

The implementation of the concept is based on the traditional pyramid of basic needs (Fig. 1).

Recently, the concept of "cashback" has become part of everyday life. However, time is presented as a much more valuable resource than money. The "timeback" concept is designed to give days and whole months back to people by creating convenient services and advanced infrastructure. Thanks to the thoughtful characteristics of the product, residents are given extra time for their daily chores and leisure activities. These advantages can be roughly divided into capital/basic "hard" and local, less resource-intensive "soft".

The most significant time-saving aspects are achieved due to:

- apartments with finishes and furnishings that save time in finding the optimal environment and installation;
- apartments with smart home technologies that save time on routine tasks;
- apartments in an eco-friendly location that save time on recuperation;
- full-fledged city blocks that save time on tedious commuting to the right places;
- apartments with a "smart" management company that save time on household chores;
- local operators of quality education and medicine.

According to the calculations of Samolet Group specialists, the approximate amount of time for each product parameter, which residents save due to the available set of characteristics is

Estimated time economy

Category/characteristic	Timeback		
Hard	Minutes per week	Hours per month	Days per year
Parking lots	30	2.25	0.9
School	300	22.5	9
Kindergartens	300	22.5	9
Neighborhood Center	60	4.5	1.8
Jobs	600	45	18
Sports infrastructure	60	4.5	1.8
Commercial infrastructure	60	4.5	1.8
Social infrastructure	10	0.75	0.3
Recreational areas (parks, embankments)	10	0.75	0.3
Master plan	20	1.5	0.6
Balconies	30	2.25	0.9
Functional layouts	5	0.375	0.15
Extra-apartment storerooms	60	4.5	1.8
Soft			
Smart Home	53	3.975	1.59
Apartment decoration	990	74.25	29.7
Furniture	120	9	3.6
Wheelchairs in public areas	35	2.625	1.05
Through passage in public areas	35	2.625	1.05
Modern elevators	28	2.1	0.84
Facades	0	0	0
Yard improvement	60	4.5	1.8
Playhub	60	4.5	1.8
Amount	2,926	219.45	87.78

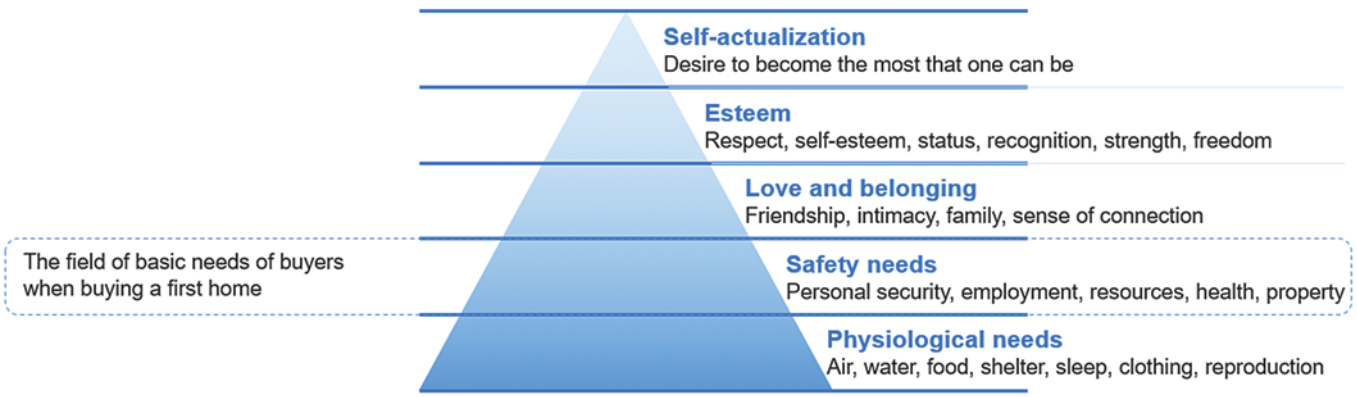


Fig. 1. Pyramid of basic needs of residents

1 The Samolet Group entered the rating of sustainable development of Russian business. Date Views October 10, 2022. URL: https://samolet.ru/investors/press/gruppa-samolet-voshla-v-rejting-ustojchivogo-razvi/ (rus.).

2 The value of the assets of the Samolet Group increased by 38 % to rub 532.9 billion, according to Cushman & Wakefield. Date Views October 11, 2022. URL: toimost-aktivov-gruppy-samolet-vyrosla-na-38-do-5/ (rus.).

3 Samolet Group and a group of private investors invested in the express delivery service "Darkstore at home". Date views October 11, 2022. URL: amolet-i-gruppa-chastnyh-investorov-vlozhilis-v-s (rus.).

determined (Table). The calculation shows how many minutes per week, hours per month and days per year are saved on average.

Thus, the total indicator shows that the value of the total "timeback" at the time of purchase can reach ~ 88 days. Annually, residents receive up to 55 days of extra time for their business and leisure activities due to the thoughtful product characteristics.

Based on the variation modelling of the qualitative and quantitative composition of the integrated development in accordance with the "timeback" concept, the developer can create long-term plans for the phased formation of the residential environment. Fig. 2 shows an example of such a development plan based on the "Mytishchi Park" residential complex project being implemented in Mytishchi, Moscow region.

It is obvious that the introduction of a number of these innovative solutions should be considered in the complex of tasks to ensure the long-term competitiveness of the projects under consideration and the development company as a whole [1, 2, 7, 8].

The main factors determining the competitiveness of investment projects of complex residential development are (in descending order of importance) [9–12]:

1. Quality of housing and level of service: the developer should strive to create high-quality housing that meets the requirements and expectations of buyers. In addition, it is important that the developer provides a high level of service, such as after-sale support, quick resolution of problems, etc.

2021–2023

- Different heights
- Quarterly development
- Yard without cars / privacy
- Ground level entrance
- Play-hub
- Sport-hub
- Pet friendly
- Through entrances
- Increased glazing of common areas
- Wheelchair / Bicycle
- Functional planning solutions
- Variety of facade, landscaping, design of common areas
- Saving balconies
- Increased proportion of balconies/terraces
- Ground parking
- Underground parking
- Developed commercial infrastructure

2023–2025

- Garbage separation
- Art objects
- Flexible planning solutions
- Neighborhood centers
- Mix of housing formats
- Sharing of transport in the districts
- Development of external transport
- Ecopark, smart gardens
- Individual rates

2025–2030

- Flexible housing
- Closed-end mutual fund of commercial real estate of your house
- Educational and educational complexes
- Transformer apartments
- Virtual concierge

Fig. 2. Long-term plan for the formation and development of a comfortable environment (on the example of the residential complex "Mytishchi Park")

2. Price: price is a key factor affecting the competitiveness of the developer. The price must be competitive and compliant with market conditions.

3. Location: location is the determining factor determining the potential of the area and the demand for the product.

4. Developer's reputation: a developer's reputation in the housing market plays an important role. A developer with a solid, positive reputation can attract more buyers and, in some cases, set higher prices.

5. Innovation: developers who incorporate new technologies and innovations into their projects, such as the use of eco-friendly materials, automation of home systems, and other amenities, can attract more buyers.

6. Financial sustainability: the competitiveness of a project also depends on its financial sustainability. The developer must have sufficient financial resources to complete projects on time, as well as have sufficient financial reserves for new projects.

The analysis of the above factors in the context of introducing the "timeback" concept into development practice leads us to the following expert conclusions:

1. In the short term: the introduction of the "timeback" concept can improve the characteristics of the quality of housing and the level of service, as well as more efficient use of the investment potential of the territory and solve the tasks of marketing and product promotion.

2. In the medium and long-term aspects: the integrated implementation of the "timeback" concept within the company's project portfolio can contribute to the formation of a positive reputation of the developer, its long-term competitiveness, as well as positively influence the regional market as a whole, contributing to improving the quality of the product and competition.

Thus, saving time for residents is an important factor in the formation of comfortable residential urban development and should be taken into account when designing and building new residential complexes and infrastructure. The implementation of the "timeback" concept can effectively contribute to solving a set of tasks of urban development of territories and improving the effectiveness of the development company.

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Концепция «таймбэк» — будущее удобной городской среды

В современных условиях городской жизни, в особенности в крупных городах и мегаполисах, все большее значение приобретает принцип обеспечения экономии времени для жителей. Жители должны иметь возможность быстро и удобно добираться до мест работы, учебы, магазинов и других мест, где они проводят свое время. В актуальной российской практике данный принцип получает наиболее широкое применение в обновленной концепции развития городского пространства, реализуемой ГК «Самолет», — инновационный подход компании реализуется в концепции «Таймбэк», обеспечивающей методологическую связь всех элементов и направлений девелопмента в рамках целевого вектора устойчивого территориального развития. Анализ факторов конкурентоспособности в контексте внедрения в практику девелопмента концепции «Таймбэк» позволяет сделать выводы о том, что внедрение концепции может способствовать улучшению характеристик качества жилья и уровня сервиса, а также более эффективному использованию инвестиционного потенциала территории и решению задач маркетинга и продвижения продукта в среднесрочном и долгосрочном аспектах, комплексное внедрение концепции «Таймбэк» в рамках портфеля проектов компании может способствовать формированию положительной репутации девелопера, его долгосрочной конкурентоспособности, а также позитивно влиять на региональный рынок в целом, способствуя повышению качества продукта и конкуренции.

Ключевые слова: *пространственно-территориальное развитие территорий, комплексная жилая застройка, девелопмент, экономия времени, таймбэк, конкурентоспособность, комфортная среда*

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Об авторах: **Эль-Хашем Айман** — управляющий директор; **ГК «Самолет»**; 121552, г. Москва, Ярцевская ул., д. 19; elhashem@samolet.ru;

Федулова Нина Сергеевна — директор проектов; **ГК «Самолет»**; 121552, г. Москва, Ярцевская ул., д. 19; N.fedulova@samolet.ru;

Беляков Сергей Игоревич — кандидат экономических наук, доцент, доцент кафедры организации строительства и управления недвижимостью; **Национальный исследовательский Московский государственный строительный университет (НИУ МГСУ)**; 129337, г. Москва, Ярославское шоссе, д. 26; РИНЦ ID: 587836, Scopus: 39763951700; osun_kaf@mgsu.ru.

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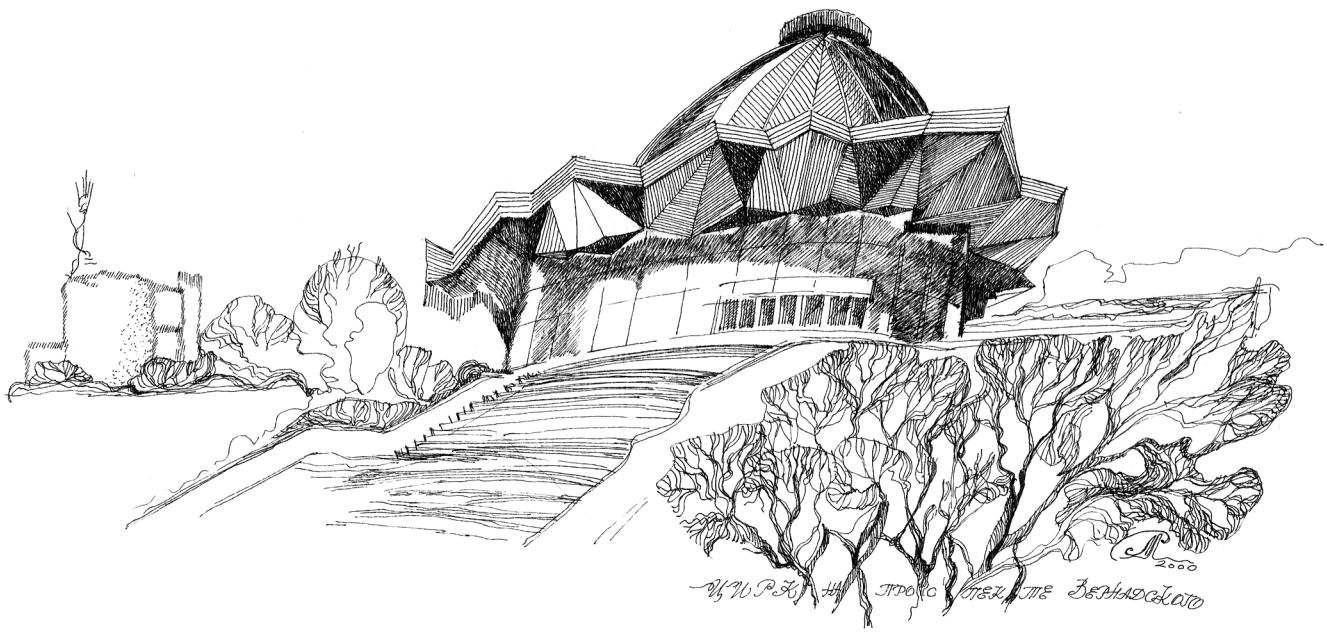

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Butyrin A.Yu.
Stativa E.B.

Construction and real estate: innovations of the legal regulation system

The article presents an overview of the main changes in the legal regulation of public relations in the field of real estate management and housing and communal complex, state registration of real estate, state cadastral valuation, regulation of land relations, construction and urban planning from January 1, 2023 to March 31, 2023.
Changes include: the entry into force of amendments to the Law on State Registration of Real Estate; the introduction of regulations on the state cadastral assessment of buildings, premises, structures, construction in progress, parking spaces in 2023; the introduction of regulations aimed at extending the features of regulation of land relations; the introduction of methods for determining the estimated cost of construction using federal unit rates and their individual components; establishment of the procedure for the formation and maintenance of the information resource of the federal targeted investment program; determination of the procedure for the implementation of federal state control (supervision) in the field of safe use and maintenance of hazardous technical devices of buildings and structures; exclusion from the list of acts that are not covered by the mechanism of the "regulatory guillotine" of a number of regulatory legal acts; determination of the procedure for conducting electronic auctions for sale of a land plot in state or municipal ownership; introduction of the Methodology for determining the amount of payment for the creation of an artificial land plot; change in the conditions for providing personal data of real estate owners to third parties; regulation of certain issues in the field of urban development; change in the procedure for organizing and conducting non-governmental expertise of project documentation and engineering survey results; introduction of Rules for connecting (technological connection) of capital construction facilities to telecommunication networks; changing the Rules for establishing and determining the standards for the consumption of utilities and the standards for the consumption of communal resources consumed during the use and maintenance of common property in an apartment building; clarifying certain provisions concerning the overhaul of common property in an apartment building; innovations in the calculation of tariffs in the field of water supply and sanitation; the introduction of a new federal assessment standard "Assessment of intellectual property and intangible assets (FAS XI)".

Keywords: *amendments, additions, legislation, construction supervision, forensic construction and technical expertise, forensic land management expertise, state registration of real estate, participants in shared construction, estimated cost of construction, apartment building, market value, utilities, preferential mortgage, "garage amnesty", urban planning*

Note. *Official website of the State Duma of the Federal Assembly of the Russian Federation[1]; Official Internet Portal of Legal Information[2]; Rossiyskaya Gazeta Internet portal[3]; ConsultantPlus legal reference system[4]; Legal Information portal "Garant.ru"[5]; Information portal "RBC Real Estate"[6]; Official website of the Government of Russia[7]; Official website of the Ministry of Construction and Housing and Communal Services of the Russian Federation[8]; Official website of the Ministry of Energy of Russia[9]; Official website of the Federal State Budgetary Institution "Rosreestr"[10].*

Butyrin Andrei Yur'evich,
Doctor of Law, Professor of the Department of Construction Organization and Real Estate Management; Moscow State University of Civil Engineering (National Research University) (MGSU); 26 Yaroslavskoe shosse, Moscow, 129337, Russian Federation; Head of the Laboratory of Forensic Construction and Technical Expertise; Russian Federal Centre of Forensic Science of the Ministry of Justice of the Russian Federation (RFCFS); 4 Bolshoy Spasoglinishchevsky Lane, Moscow, 101000, Russian Federation; ID RISC: 283267, Scopus: 57193087645, ORCID: 0000-0002-4774-3296; stroisud@mail.ru

Stativa Ekaterina Borisovna,
Candidate of Legal Sciences, Associate Professor of the Department of Construction Organization and Real Estate Management; Moscow State University of Civil Engineering (National Research University) (MGSU); 26 Yaroslavskoe shosse, Moscow, 129337, Russian Federation; Leading State Forensic Expert of the Laboratory of Forensic Construction and Technical Expertise; Russian Federal Centre of Forensic Science of the Ministry of Justice of the Russian Federation (RFCFS); 4 Bolshoy Spasoglinishchevsky Lane, Moscow, 101000, Russian Federation; ID RISC: 1003014, Scopus: 57193085375, ORCID: 0000-0002-8310-2349; stroisud@mail.ru

Federal Law of April 30, 2021 No. 120-FZ [1]; Resolutions of the Government of the Russian Federation of December 9, 2021 No. 2241 [2] and of August 1, 2022 No. 1362 [3]; Orders of the Federal Register of June 1, 2021 No. P/0241 [4], of August 2, 2021 No. P/0328 [5], of September 28, 2021 No. P/0437 [6] and No. P/0439 [7], of October 8, 2021 No. P/0458 [8], of November 8, 2021 No. P/0501 [9] and of December 3, 2021 No. P/0568 [10]; Letter of Rosreestr of July 20, 2021 No. 18-02191/21 [11], Letter of the Federal Tax Service of Russia of September 14, 2022 No. BS-4-21/12179@ [12]

Since January 1, 2023, amendments to the Law on State Registration of Real Estate have come into force.

In particular, it is established that applications can be submitted through the personal account without signing with an enhanced qualified electronic signature:

- on the impossibility of registering the transfer, termination, restriction of the right and encumbrance of the real estate object without the personal participation of the rightholder (his legal representative);
- about entering into the EGRN information about the e-mail address or postal address at which you can contact the person whose right to the real estate object is registered, as well as the person in whose favor the restriction of the right and encumbrance of the object is registered.

1 State Duma of the Federal Assembly of the Russian Federation. URL: http://duma.gov.ru/
2 The official Internet portal of legal information. URL: http://www.pravo.gov.ru
3 Rossiyskaya Gazeta. URL: https://rg.ru/
4 ConsultantPlus. URL: https://www.consultant.ru/
5 NPP "GARANT-SERVICE". URL: https://www.garant.ru/
6 РБК Недвижимость. URL: https://realty.rbc.ru/
7 Government of Russia. URL: http://government.ru/news/
8 Ministry of Construction and Housing and Communal Services of the Russian Federation. URL: https://www.minstroyrf.gov.ru/
9 Ministry of Energy of Russia. URL: https://minenergo.gov.ru/
10 Rosreestr. URL: https://kadastr.ru/about/

The list of building assignments has been adjusted (the designation "residential building" has been added, "residential" and "residential structure" have been excluded).

The EGRN will include lists of coordinates of geodetic base points in local coordinate systems established in relation to cadastral districts.

A number of additional information about the real estate object will be entered into the real estate cadastre (for example, about the decision to withdraw a land plot and (or) a real estate object located on it for state or municipal needs).

The register of boundaries will include a list of types of permitted use of capital construction facilities, the maximum size of land plots and the maximum parameters of permitted construction, reconstruction of capital construction facilities. Also, information on the reservation of land for state use will be entered in the register of borders.

It was clarified that it is possible to submit an application for state cadastral registration and state registration of rights, among other things, through regional portals of public services (on the basis of agreements concluded by the state authority of the subject of the Russian Federation and Rosreestr) or a personal account on the official website of Rosreestr.

State authorities and local self-government bodies will be obliged to send documents to the registration authority for entering information into the EGRN in case they make decisions on the seizure of a land plot, immovable property objects located on it for state registration and on the reservation of land for state registration (on the cancellation of such a decision).

Federal Law No. 269-FZ of July 31, 2020 [13]; Rosreestr Order No. P/0240 of June 22, 2022 [14]; Rosreestr information

In 2023, in all subjects of the Russian Federation, a state cadastral assessment of buildings, premises, structures, objects of unfinished construction, parking spaces should be carried out without taking into account restrictions on the frequency of state cadastral assessment.

In the future, the next state cadastral assessment of buildings, premises, structures, objects of unfinished construction, parking spaces will be carried out in 4 years from the year of the last state cadastral assessment, and in cities of federal significance, if the supreme executive body of the state authority of the subject of the Russian Federation makes a corresponding decision in 2 years.

Decree of the Government of the Russian Federation No. 2536 of December 30, 2022 [15]

Until the end of 2023, the validity of the peculiarities of land relations regulation has been extended. It is allowed to conclude a contract of exchange of a land plot in state or municipal ownership for a land plot in private ownership, if such a land plot in private ownership is necessary for the placement of social infrastructure facilities; as well as the sale without bidding of a land plot that is in state or municipal ownership, and a land plot, state ownership of which is not delimited, intended for recreation (recreation), production activities, industrial needs.

Order of the Ministry of Construction of Russia of August 8, 2022 No. 648/pr [16]

From January 1, 2023, the methodology for determining the estimated cost of construction using federal unit prices and their individual components will be put into effect.

The methodology establishes the procedure for determining the estimated cost of construction, reconstruction, capital repairs, demolition of capital construction facilities, works on the preservation of cultural heritage objects (historical and cultural monuments) of the peoples of the Russian Federation using federal unit rates and their individual components by the basic index method.

Order of the Ministry of Construction of Russia of October 18, 2022 No. 865/pr [17]

Since January 22, 2023, the procedure for the formation and maintenance of the information resource of the federal targeted investment program has been established.

The formation and maintenance of an information resource is carried out on the basis of information about capital construction objects, events (enlarged investment projects), real estate objects.

In addition, the form of the passport of the investment project is given, as well as the forms of submission of information to the Ministry of Construction of Russia by the main managers of federal budget funds and the board of the Military-Industrial Commission of the Russian Federation.

Federal Law No. 548-FZ of December 19, 2022 [18]

On March 1, 2023, the procedure for the implementation of federal state control (supervision) in the field of safe use and maintenance of hazardous technical devices of buildings and structures was determined.

Until the date of entry into force of the federal law establishing legal regulation in the field of safe use and maintenance of elevators, lifting platforms for the disabled, passenger conveyors (moving pedestrian paths), escalators, with the exception of escalators in subways, federal state control (supervision) in the field of their safe use and maintenance is carried out by the federal executive authority authorized by the Government of the Russian Federation; at facilities (organizations) subordinate to federal executive authorities in the field of defense, security, state protection, foreign intelligence, mobilization training and mobilization, execution of punishments — by units of these federal executive authorities. The subject of control (supervision) has been determined.

Decree of the Government of the Russian Federation of December 31, 2020 No. 2467 [19]

From March 1, 2023, a number of acts are excluded from the list of acts that are not covered by the mechanism of the "regulatory guillotine".

We are talking about the acts listed in paragraph 11 (1) of the Decree of the Government of the Russian Federation dated December 31, 2020 No. 2467.

Federal Law No. 385-FZ of October 7, 2022 [20]; Information of the Federal Register

Since March 1, 2023, the procedure for conducting electronic auctions for the sale of a land plot owned by the state or municipal property and auctions for the right to conclude a lease agreement for such a land plot has been determined.

An electronic auction is held on an electronic platform by its operator from among the operators of electronic platforms operating in accordance with the legislation on the contract system in the field of procurement.

According to the results of the electronic auction, the land purchase and sale agreement or the land lease agreement is

concluded in electronic form and signed with an enhanced qualified electronic signature of the parties to such an agreement. Auctions, the decisions on which were made before March 1, 2023, are held according to the old rules.

Order of the Ministry of Natural Resources of Russia of November 28, 2022 No. 824 [21]

Since March 1, 2023, the Methodology for determining the amount of payment for the creation of an artificial land plot has been put into effect.

The amount of payment for the creation of an artificial land plot on a water body that is in federal ownership, or part thereof, is determined on the basis of information from the EGRN on the cadastral value and area of existing land plots that are part of the municipality (municipalities) applied as of January 1 of the year in which the agreement on the creation of an artificial land plot is concluded), within the boundaries of which an artificial land plot will be created.

Federal Law No. 266-FZ of July 14, 2022 [22]; Order of the Federal Register of November 7, 2022 No. P/0427 [23]

From March 1, 2023, personal data of real estate owners will be provided to third parties only with the consent of a citizen.

On the basis of a citizen's application, a corresponding entry will be made in the EGRN. The procedure for making such an entry in the EGRN has been established.

In addition, access to the personal data of the rightholder of the real estate object or the person in whose favor the restriction of the right or encumbrance of the real estate object contained in the EGRN is registered is restricted. Such data may be provided at the request of these persons, at the request of a notary and in other cases expressly established.

Federal Law No. 612-FZ of December 29, 2022 [24]

Since March 1, 2023, certain issues in the field of urban development have been settled.

It is established that the map of urban zoning displays territories within the boundaries of which the requirements for the architectural and urban appearance of capital construction objects are provided. The borders of such territories may not coincide with the borders of territorial zones and may be displayed on a separate map.

The town-planning regulations with respect to land plots and capital construction objects located within the relevant territorial zone will specify the requirements for the architectural and urban appearance of capital construction objects, including requirements for spatial, architectural, stylistic and other characteristics of the capital construction object, which are established by the Government of the Russian Federation, unless otherwise provided.

The architectural and town-planning appearance of the capital construction object is subject to approval by the authorized local government body. Fixed cases that do not require appropriate coordination.

The deadline for the approval of the architectural and town-planning appearance of the capital construction object may not exceed 10 working days.

The deadlines for approving documentation on the planning of the territory, the deadlines for approving the draft master plan, the deadlines for public discussions, public hearings on the draft rules of land use and development, draft master plans of settlements, urban districts are being reduced.

Decree of the Government of the Russian Federation dated October 21, 2022 No. 1884 [25]

Since March 1, 2023, the procedure for organizing and conducting non-governmental expertise of project documentation and engineering survey results has changed.

It is established that the Regulation is valid until March 1, 2029.

The contract between the applicant and the expert organization, concluded in accordance with civil law, must specify the timing of the non-state examination and the amount of the fee for its conduct.

Decree of the Government of the Russian Federation dated July 01, 2022 No. 1196 [26]

Since March 1, 2023, the Rules for Connecting (technological connection) of capital construction facilities to telecommunication networks have been put into effect.

The rules define the procedure for connecting (technological connection) to telecommunication networks of capital construction objects designed, under construction, reconstructed or constructed, reconstructed, but not connected to telecommunication networks.

Decree of the Government of the Russian Federation of September 13, 2022 No. 1598 [27]

The Rules for establishing and determining standards for the consumption of utilities and standards for the consumption of communal resources consumed during the use and maintenance of common property in an apartment building are being changed.

The list of communal resources consumed during the use and maintenance of common property in an apartment building is fixed — cold water, hot water, electricity consumed during the use and maintenance of common property in an apartment building, wastewater disposal for the maintenance of common property in an apartment building.

The concept of “the standard of thermal energy consumption for water heating” is introduced. The procedure for calculating the standards of thermal energy consumption for water heating has been established.

The conditions for the establishment of standards for the consumption of communal resources consumed during the use and maintenance of common property in an apartment building are determined.

The change in the standards for the consumption of utilities and the standards for the consumption of communal resources consumed during the use and maintenance of common property in an apartment building will be carried out, including in the event of the entry into force of a court decision, which established that the standards for the consumption of utilities and the standards for the consumption of communal resources consumed during the use and maintenance of common property in an apartment building, were installed with a violation.

Federal Laws No. 100-FZ of April 16, 2022 [28] and No. 378-FZ of October 7, 2022 [29]

Since March 1, 2023, certain provisions concerning the overhaul of common property in an apartment building have been clarified.

It is established that the act of acceptance of services rendered and work performed on the overhaul of common property in an apartment building must be signed, including by a local

government body and a person who is authorized to act on behalf of the owners of premises in an apartment building (if the overhaul is carried out on the basis of a decision of the owners of premises in this apartment building).

Federal Law No. 5-FZ of January 28, 2022 [30]; Decree of the Government of the Russian Federation No. 988 of May 30, 2022 [31]

When calculating tariffs in the field of water supply and sanitation, the standards of losses of hot, potable, industrial water in centralized water supply systems during its production and transportation should be taken into account.

Accounting for losses of hot, potable, industrial water in centralized water supply systems during its production and transportation by organizations engaged in hot water supply, cold water supply, is carried out in accordance with the procedure in force until March 1, 2023, until the end date of the current long-term regulatory period established for these organizations, or until the end of the concession agreement, unless otherwise specified it is provided by an additional agreement to the concession agreement.

Order of the Ministry of Economic Development of Russia of November 30, 2022 No. 659 [32]

On March 23, 2023, a new federal valuation standard "Valuation of Intellectual Property and Intangible Assets (FAS XI)" will be put into effect.

The new standard supplemented and specified the requirements and procedures established by the general federal valuation standards for the valuation of intellectual property and intangible assets.

The objects covered by the standard are specified (individual objects that are the result of intellectual activity, including those related to intangible assets, rights of use in relation to such objects, a set of such objects, complex objects).

Also, the features of conducting an assessment when pledging an object of assessment are established.

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Строительство и недвижимость: новации в законодательстве

В статье представлен обзор основных изменений правового регулирования общественных отношений в сфере управления недвижимостью и жилищно-коммунальным комплексом, государственной регистрации недвижимости, государственной кадастровой оценки, регулирования земельных отношений, строительства и градостроительства с 1 января по 31 марта 2023 года.

К таким изменениям следует относить: вступление в силу изменений в Закон о государственной регистрации недвижимости; введение в действие норм о проведении государственной кадастровой оценки зданий, помещений, сооружений, объектов незавершенного строительства, машино-мест в 2023 году; введение в действие норм, направленных на продление действия особенностей регулирования земельных отношений; введение в действие методики определения сметной стоимости строительства с применением федеральных единичных расценок и их отдельных составляющих; установление порядка формирования и ведения информационного ресурса федеральной адресной инвестиционной программы; определение порядка осуществления федерального государственного контроля (надзора) в области безопасного использования и содержания опасных технических устройств зданий и сооружений; исключение из перечня актов, на которые не распространяется механизм «регуляторной гильотины» ряда нормативно-правовых актов; определение порядка проведения электронных аукционов по продаже земельного участка, находящегося в государственной или муниципальной собственности; введение в действие Методики определения размера платы за создание искусственного земельного участка; изменение условий предоставления персональных данных владельцев недвижимости третьим лицам; регулирование отдельных вопросов в сфере градостроительной деятельности; изменение порядка организации и проведении негосударственной экспертизы проектной документации и результатов инженерных изысканий; введение в действие Правил подключения (технологического присоединения) объектов капитального строительства к сетям электросвязи; изменение Правил установления и определения нормативов потребления коммунальных услуг и нормативов потребления коммунальных ресурсов, потребляемых при использовании и содержании общего имущества в многоквартирном доме; уточнение отдельных положений, касающихся проведения капремонта общего имущества в многоквартирном доме; нововведения при расчете тарифов в сфере водоснабжения и водоотведения; введение в действие нового федерального стандарта оценки «Оценка интеллектуальной собственности и нематериальных активов (ФСО XI)».

Ключевые слова: *изменения, дополнения, законодательство, государственная регистрация недвижимости, государственная кадастровая оценка, земельные отношения, сметная стоимость строительства, инвестиционная программа, государственный контроль (надзор), регуляторная гильотина, электронный аукцион, искусственный земельный участок, ЕГРН, градостроительство, негосударственная экспертиза проектной документации и результатов инженерных изысканий, технологическое присоединение, нормативы потребления коммунальных услуг и ресурсов, капитальный ремонт*

Примечание. *При составлении обзора использовалась информация следующих открытых источников: официальный сайт Государственной Думы ФС РФ[1]; официальный интернет-портал правовой информации[2]; Интернет-портал «Российской газеты»[3]; справочная правовая система КонсультантПлюс[4]; информационно-правовой портал «Гарант.ру»[5]; информационный портал «РБК Недвижимость»[6]; официальный сайт Правительства России[7]; официальный сайт Министерства строительства и жилищно-коммунального хозяйства Российской Федерации[8]; официальный сайт Минэнерго России[9]; официальный сайт ФГБУ «ФКП Росреестра»[10].*

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18. О внесении изменения в Федеральный закон «О внесении изменений в отдельные законодательные акты Российской Федерации в связи с принятием Федерального закона "О государственном контроле (надзоре) и муниципальном контроле в Российской Федерации"» : Федеральный закон от 19.12.2022 № 548-ФЗ.

19. Об утверждении перечня нормативных правовых актов и групп нормативных правовых актов Правительства Российской Федерации, нормативных правовых актов, отдельных положений нормативных правовых актов и групп нормативных правовых актов федеральных органов исполнительной власти, правовых актов, отдельных положений правовых актов, групп правовых актов исполнительных и распорядительных органов государственной власти РСФСР и Союза ССР, решений Государственной комиссии по радиочастотам, содержащих обязательные требования, в отношении которых не применяются положения частей 1, 2 и 3 статьи 15 Федерального закона «Об обязательных требованиях в Российской Федерации» : Постановление Правительства РФ от 31.12.2020 № 2467.

20. О внесении изменений в Земельный кодекс Российской Федерации и признании утратившей силу части 7 статьи 34 Федерального закона «О внесении изменений в Земельный кодекс Российской Федерации и отдельные законодательные акты Российской Федерации» : Федеральный закон от 07.10.2022 № 385-ФЗ.

21. Об утверждении Методики определения размера платы за создание искусственного земельного участка : Приказ Минприроды России от 28.11.2022 № 824.

22. О внесении изменений в Федеральный закон «О персональных данных», отдельные законодательные акты Российской Федерации и признании утратившей силу части четырнадцатой статьи 30 Федерального закона «О банках и банковской деятельности» : Федеральный закон от 14.07.2022 № 266-ФЗ.

23. О внесении изменений в некоторые приказы Федеральной службы государственной регистрации, кадастра и картографии по вопросам ведения Единого государственного реестра недвижимости и предоставления содержащихся в нем сведений в связи с принятием Федерального закона от 14 июля 2022 г. № 266-ФЗ «О внесении изменений в Федеральный закон "О персональных данных", отдельные законодательные акты Российской Федерации и признании утратившей силу части четырнадцатой статьи 30 Федерального закона "О банках и банковской деятельности"» : Приказ Росреестра от 07.11.2022 № П/0427.

24. О внесении изменений в Градостроительный кодекс Российской Федерации и отдельные законодательные акты Российской Федерации и о признании утратившим силу абзаца второго пункта 2 статьи 16 Федерального закона «О железнодорожном транспорте в Российской Федерации» : Федеральный закон от 29.12.2022 № 612-ФЗ.

25. О внесении изменений в постановление Правительства Российской Федерации от 31 марта 2012 г. № 272 : Постановление Правительства РФ от 21.10.2022 № 1884.

26. Об утверждении Правил подключения (технологического присоединения) объектов капитального строительства к сетям электросвязи : Постановление Правительства РФ от 01.07.2022 № 1196.

27. О внесении изменений в постановление Правительства Российской Федерации от 23 мая 2006 г. № 306 и признании утратившими силу отдельных положений некоторых актов Правительства Российской Федерации : Постановление Правительства РФ от 13.09.2022 № 1598.

28. О внесении изменения в статью 190 Жилищного кодекса Российской Федерации : Федеральный закон от 16.04.2022 № 100-ФЗ.

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30. О внесении изменений в Федеральный закон «О водоснабжении и водоотведении» : Федеральный закон от 28.01.2022 № 5-ФЗ.
31. О внесении изменений в некоторые акты Правительства Российской Федерации : Постановление Правительства РФ от 30.05.2022 № 988.
32. Об утверждении федерального стандарта оценки «Оценка интеллектуальной собственности и нематериальных активов (ФСО XI)» : Приказ Минэкономразвития России от 30.11.2022 № 659.

Об авторах: **Бутырин Андрей Юрьевич** — доктор юридических наук, профессор кафедры организации строительства и управления недвижимостью; **Национальный исследовательский Московский государственный строительный университет (НИУ МГСУ)**; 129337, г. Москва, Ярославское шоссе, д. 26; заведующий лабораторией судебной строительно-технической экспертизы; **Российский федеральный центр судебной экспертизы при Министерстве юстиции Российской Федерации (РФЦСЭ при Минюсте России)**; 101000, г. Москва, Большой Спасоглинищевский пер., д. 4; РИНЦ ID: 283267; Scopus: 57193087645, ORCID: 0000-0002-4774-3296; stroisud@mail.ru;

Статива Екатерина Борисовна — кандидат юридических наук, доцент кафедры организации строительства и управления недвижимостью; **Национальный исследовательский Московский государственный строительный университет (НИУ МГСУ)**; 129337, г. Москва, Ярославское шоссе, д. 26; ведущий государственный судебный эксперт лаборатории судебной строительно-технической экспертизы; **Российский федеральный центр судебной экспертизы при Министерстве юстиции Российской Федерации (РФЦСЭ при Минюсте России)**; 101000, г. Москва, Большой Спасоглинищевский пер., д. 4; РИНЦ ID: 1003014, Scopus: 57193085375, ORCID: 0000-0002-8310-2349; stroisud@mail.ru.

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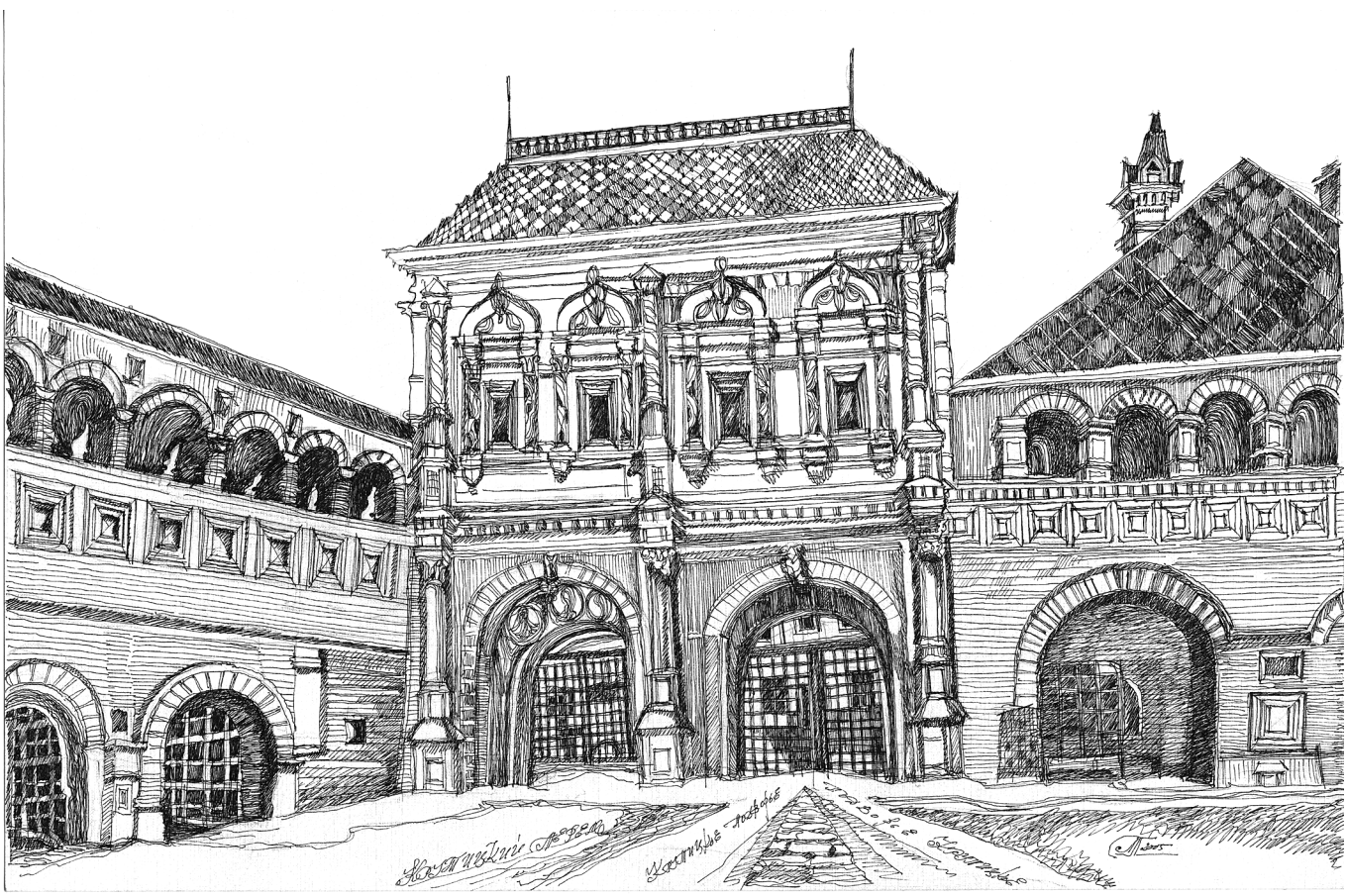

Л.И. Павлова. Москва. Крутицкий терем. Рисунок, тушь перо.