European Proceedings of
Multidisciplinary Sciences
EpMS

www.europeanproceedings.com
e-ISSN: 2421-826X

DOI: 10.15405/epms.2024.09.84

MTMSD 2022
I International Conference «Modern Trends in Governance and Sustainable Development of Socio-economic Systems: from Regional Development to Global Economic Growth»

MODELING THE STABILITY OF A COMPLEX RESIDENTIAL DEVELOPMENTS BASED ON GREEN ZOOM

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Abstract

The research focuses on modeling the stability of complex residential developments with an emphasis on Green ZOOM, aiming to enhance the sustainability and resilience of such projects. The study employs a comprehensive approach, integrating various methodologies and data sources to achieve a thorough analysis. The investigation delves into the application of Green ZOOM, a sustainable development framework, to assess its impact on the stability of complex residential developments. The research utilizes both quantitative and qualitative methods, drawing on data from case studies, surveys, and environmental assessments. In the pursuit of harmonizing urban spaces, a proactive and obligatory adoption of national green standards is imperative, enriched by insights gleaned from global experiences in environmentally-conscious construction. These standards function as the bedrock for instilling sustainability in urban planning, nurturing the development of meticulously designed, eco-friendly environments.A notable outcome of the study is the identification of key factors contributing to the stability of complex residential developments when integrating the Green ZOOM approach. The findings provide valuable insights for urban planners, developers, and policymakers, offering a foundation for informed decision-making and fostering sustainable practices in residential development projects.

Keywords: Energy efficient measures, Green Zoom, greenness indicators, integrated residential development, sustainable development, standards

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eISSN: 2421-826X

1. Introduction

The construction industry, as well as the Russian economy as a whole, is facing long-term systemic challenges that reflect both global trends and internal development barriers. One of the key challenges for the sustainable and innovative development of the construction industry is climate change and an increase in anthropogenic pressure on the environment, which dictate the need for the use of environmentally friendly energy, environmentally friendly building materials, technology, etc. in construction. Legal legislation is being developed in the field of adaptation of all participants in the investment construction activities to take into account the provisions of the green, circular and energy efficient economies, as well as stimulate the attraction of responsible investments in the environmental component of construction processes.

Environmentally oriented projects are understood as investment projects aimed at rational use and saving of natural and energy resources, reduction of environmental pollution, waste processing, production of environmentally friendly products, development of recreational activities (Alikhadzhieva, 2019).

As part of improving the greenness and energy efficiency of construction projects, environmental certification systems for buildings and territories have been approved and are in operation. Most Russian eco-standards are based on the requirements of international systems (Efremov & Efremova, 2021).

In addition to the environmental orientation of modern investment and construction projects, in accordance with the requirements of the concept of sustainable development of territories, attention is paid to the issues of integrated solutions. In urban planning legislation, this aspect is enshrined in Chapter 10 of the Town Planning Code of the Russian Federation. Integrated development of territories (CRT) is a set of activities carried out in accordance with the approved documentation for planning the territory and aimed at creating favorable living conditions for citizens, updating the living environment and common areas of settlements, urban districts (Town Planning Code of the Russian Federation No. 190-FZ, 2004).

The issues of ensuring complexity can be considered as a relevant tool for solving the unstable state of development of urban areas, such as: the active use of point fragmented principles of urban development, depreciation of the material and lack of capacity of the engineering and technical fund, the lack of solutions for the multifunctional use of the territory, etc.

The aim of the study is to develop an urban planning concept for the integrated development of an urban area and to model the sustainability of such development based on the use of national certification standards for the requirements of green and energy efficient construction.

The object of study is a set of residential, social, commercial and infrastructure real estate as part of integrated development projects for the Zarya residential area in the city of Penza, Penza Region (Gushchina et al., 2022).

2. Materials and Methods

The research focuses on the residential area "Novaya Zarya" in the northwestern peripheral region of Penza, Oktyabrsky administrative district, covering 345.2 hectares designated for integrated development. The undeveloped building site is surrounded by individual residential and mid-rise

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buildings, including industrial zones housing a repair and steelworking company. The area's advantageous features, such as a tranquil relief and proximity to the Mastinovsky Ponds cascade, highlight its potential for complex residential development (Gushchina et al., 2022).

Systemic and synergetic analysis methods were employed in urban planning research, incorporating social, humanitarian, and environmentally oriented approaches. Analytical and synthesizing methods, along with logical moderation, were applied to scrutinize theoretical and practical materials. The extensive analysis encompassed articles, abstracts, conference presentations, and other documents addressing sustainable development in urbanized areas. Relevant studies in sustainable and integrated city development, environmental considerations in planning, and the application of green standards for urban development were examined (Baronin & Porshakova, 2011; GOST R ISO 37120-2020, 2020; Pandit et al., 2017; Wu, 2014; Zhukovskaya & Geraskin, 2019). Drawing from these insights, the study proposes basic and optimized strategies for integrated urban development, aligning with green and energy-efficient standards.

3. Results and Discussion

3.1. Development of a draft urban planning concept for the integrated sustainable development of the Novaya Zarya residential area in Penza

The primary outcome of this study is the formulation of a preliminary urban planning concept tailored for the integrated and sustainable development of the Novaya Zarya residential area in Penza. The comprehensive analysis, incorporating systemic and synergetic approaches, along with attention to social, humanitarian, and environmental considerations, has culminated in a draft plan. This plan aims to optimize the use of the 345.2-hectare site, designated for integrated development, within the Oktyabrsky administrative district.

The proposed urban planning concept navigates the unexplored territory of the undeveloped building site and its surroundings, considering existing individual residential and mid-rise structures, as well as industrial zones hosting a repair and steelworking company. With a focus on sustainability, the plan incorporates features like a tranquil relief and harnesses the natural and ecological potential of the Mastinovsky Ponds cascade.

Informed by analytical and synthesizing methods, the plan aligns with green and energy-efficient standards, drawing inspiration from established studies in sustainable city development. This approach ensures that the Novaya Zarya residential area's growth adheres to principles of environmental responsibility, social welfare, and economic viability. The draft urban planning concept serves as a foundation for further refinement and implementation, contributing to the realization of an integrated and sustainable urban development in Penza.

The urban planning concept for the sustainable development of the Novaya Zarya residential area proposed the completion of the development of the planning zone with the creation of a comfortable and safe urban environment with the organization of residential and public areas with the inclusion of a natural and recreational component (see Figure 1).

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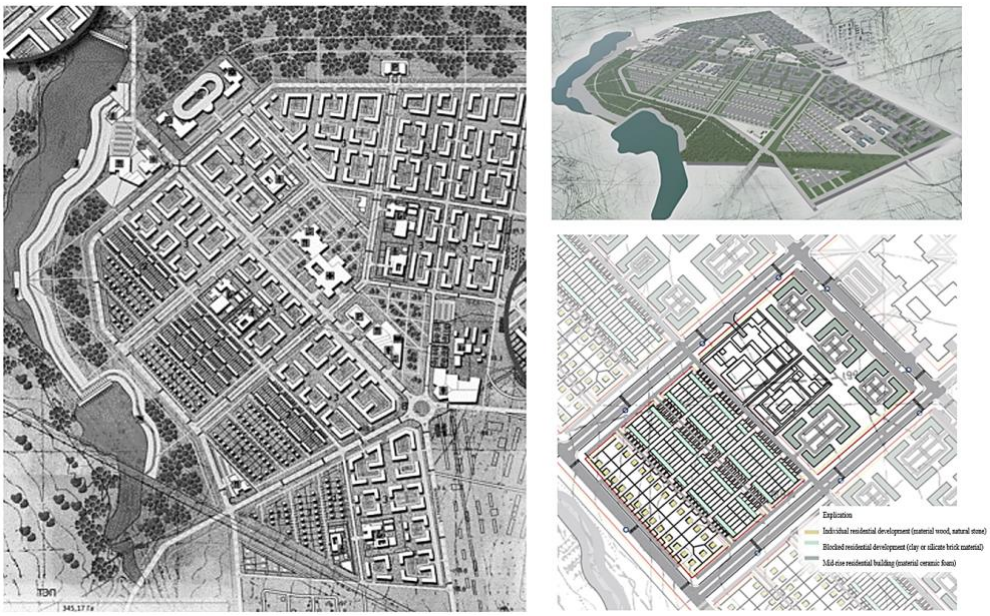
Residential development in the project of integrated development of the territory is represented by medium-rise houses and individual houses of the blocked and cottage type. Multi-apartment buildings are provided with underground parking spaces and multi-storey car parks located throughout the district with a standard capacity. In the project, the production zone for processing steel products is being developed while maintaining the sanitary protection zone. It is proposed to organize in the structure of production areas, an exhibition complex of citywide significance. These design solutions justify the need to increase the places of application of labor for the population of the region. The residential area is provided with objects of three levels of social services. Everyday use: schools, kindergartens, convenience stores, pharmacies, etc. Periodic use: polyclinics and medical centers, objects of additional education for children, etc. Occasional use: objects of urban importance - a park of culture and recreation along the cascade of Mastinovsky ponds, an indoor cycle track, a city florarium, etc.(Baronin et al., 2023).

The basis of the transport frame is the streets of city, district and local significance, which form a small-scale planning structure. Pedestrian and cycling traffic is organized in the fundamentally important compositional directions of the residential area, linking the responsible functional zones of the territory under consideration.



a) b)

Figure 1. a) Master plan of the residential area “Novaya Zarya” in Penza, b) Scheme of the microdistrict of the 3rd stage of construction (architects Agapova A.A., Gushchina E.S., Kheruvimova I.A.)

3.2. Modeling the planning structure of a complex residential development project based on the basic and optimization options for the project

An enlarged calculation according to the national GREEN ZOOM standard was made for the third stage of the construction of the Novaya Zarya residential area in the city of Penza. The microdistrict (total area 25 ha) is a residential area with the inclusion of the territory of a school and a kindergarten (see Figure 1b).

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According to the aggregated calculation according to the practical guideline of the GREEN ZOOM CITY standard (Green zoom city, 2018), out of 168 points, 67 points are given to the basic version of the project (see Table 1). It is worth noting that the minimum number of points required to obtain a bronze certificate is 85 points.

To improve the rating, an optimization version of the project was developed, which provided for the following main energy-efficient and environmentally oriented measures in accordance with the GREEN ZOOM "green building" standard: creation of a concept for improving energy efficiency, water efficiency and environmental friendliness (EWE) of the construction site, taking into account the level of investment costs; introduction of BIM - creation of information models at the design stage; reducing the consumption of drinking-quality water for irrigating green areas by at least 50% of the estimated amount of water required for irrigating green areas; use of water sources of natural origin existing in the area being certified (groundwater, lakes, rivers) to meet the total annual demand for water resources of all buildings in the area being certified; installation of an autonomous source of heat supply to ensure the total annual demand for thermal energy of all buildings of the certified territory in the amount of thermal power; a system of effective outdoor lighting was formed; measures were taken to control the speed of traffic: speed bumps, barrier poles, narrow one-way roads, road signs for motorists and other measures were placed (Green zoom city, 2018).

As a result of the above-mentioned main activities and the activities shown in Table 1, the optimization version of the project scored 94 points, which corresponds to a bronze certificate.

Table 1. Fragment of the questionnaire of the GREEN ZOOM certification table for the 3rd stage of the construction of the residential area "Novaya Zarya" in Penza (pp.1-14, 50-79)

№	№ PR	Max points	Requirement name	Base scores project	Points for optimization project
	1	9	Working group and holistic analysis of the project		
1-3	1.1-1.3	requirement	Creation of a working group; Evaluation of the object according to the GREEN ZOOM system; New construction,; Buildings in operation:; Land analysis	+	+
4	1.4	3	The concept of energy efficiency, water efficiency and environmental friendliness (EWE)	---	+1
5	1.5	1	Position estimation (relative to the sun, wind rose, etc.)	+1	---
6	1.6	1	Assessment of water consumption (irrigation of the territory, washing of hard surfaces, fountains and ponds)	+1	---
7	1.7	1	Development of the concept of on-site networks	+1	---
8	1.8	2	Implementation of BIM technology (not provided by the project)	---	+2
9	1.9	1	Conducting training events	---	+1
	2	12	Water efficiency		
10	2.1	requirement	Reducing the consumption of drinking-quality water for irrigating green areas	+	+
11	2.2	4	Additional reduction in the consumption of drinking-quality water for irrigating green areas	---	+1
12	2.3	2	Storm runoff reduction	---	---
13	2.4	3	Implementation of decentralized water supply	---	+1
14	2.5	3	Implementation of decentralized wastewater disposal	---	

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	3	38	Energy Efficiency, Resource Saving and Smart City		
50	5.14	1	Organization of opportunities for small business development / self-employment	+1	---
51	5.15	7	Organization of the street network	+4	---
52	5.16	3	Providing pedestrian access to public transport stops	+2	---
53	5.17	7	Organization of car parking	+5	---
54	5.18	1	Provide a decorative and protective translucent canopy over car parking areas		---
55	5.19	1	Provide a network of thoughtful walking, jogging and cycling paths	+1	---
56	5.20	4	Ensuring the use of cycling	+3	---
57	5.21	6	Landscaping, restoration and landscaping	+6	---
58	5.22	2	Organization of public space	+2	---
59	5.23	1	Reducing local overheating		---
60	5.24	2	Ensuring acoustic comfort	+1	---
61	5.25	1	Restoration of the contaminated area	+1	---
	6	10	Safe public space		
62-64	6.1-6.3	requirement	External input; pointers; Landscaping. Plants as a barrier to illegal entry	+	+
65	6.4	1	Preventing confusion when looking for a building entrance	+1	---
66	6.5	1	Main entrance control	+1	---
67	6.6	1	Inner zones	---	---
68	6.7	1	Pedestrian and bicycle paths	---	---
69	6.8	1	materials	---	+1
70	6.9	1	Motion control	---	+1
71	6.10	1	The absence of “bottlenecks”	+1	---
72	6.11	1	protection	---	---
73	6.12	1	natural overview	+1	---
74	6.13	1	Outdoor Lighting	---	+1
	7	6	Innovation		
75	7.1	2	Use in the innovation project	---	---
76	7.2	1	Collaboration with professional green building consultants	---	---
77	7.3	1	Creation of the Citizen's School	---	+1
78	7.4	1	Video about the object	+1	---
79	7.5	1	Workshop	---	---
Total:				67	67+27=94
Certification:			Bronze certificate - from 85 points; Silver certificate - from 100 points; Gold certificate - from 115 points; Platinum certification - 140 points.		

The introduction of the recommendations of the Green zoom standard system will make it possible to carry out a consistent and environmentally oriented development of the territories of complex development. It also forms an accessible living environment that programs the social and mental development of residents and has an educational impact. In economic terms, such certified projects allow increasing one-time costs for the construction and development of the territory, but subsequently reduce recurring costs in the operational period, taking into account the minimization of the level of negative impact on wildlife while maintaining human health.

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The use of foreign and domestic “green” standards in the design and construction allows achieving a triune effect of the development of the territory, which corresponds to the basic concept of sustainable development (Green zoom city, 2018): economic - the development of self-sufficiency of the territory, the provision of energy-efficient, water-efficient and environmentally friendly facilities of the territory, the introduction of resource-saving technologies and innovations and others; -environmental - landscaping and conservation of biological diversity, ecological restoration of territories, etc.; social - the presence of multifunctional zones, ensuring pedestrian accessibility of service facilities, cultural and sports facilities, etc.

The provisions of complexity, greenness and energy efficiency make it possible to ensure the stability of the urban area in the conditions of turbulence of ongoing socio-economic processes and form a comfortable, modern and safe urban space environment.

It is especially important to note that the author's research results were obtained as part of the diploma design by undergraduate students of the Penza State University of Architecture and Construction in 2022. This also confirms the presence of stable trends in the use of various modern global aspects of sustainable, integrated and green design in the educational process of higher education in the Russian Federation. This effective approach in education is consistent with the goals of sustainable development of the world community (United Nations, www.un.org) in terms of popularization and promotion of environmental issues, conservation, innovative, energy-efficient construction methods in the planning of the urban environment.

4. Conclusions

The study's conclusions emphasize the critical amalgamation of both global and local standards in green and energy-efficient construction methodologies. This integration emerges as a linchpin for ensuring the competitiveness of integrated development endeavors, positioning them as stalwarts of sustainable development capable of attracting diverse funding sources, encompassing both public and private investments.

In the pursuit of harmonizing urban spaces, a proactive and obligatory adoption of national green standards is imperative, enriched by insights gleaned from global experiences in environmentally-conscious construction. These standards function as the bedrock for instilling sustainability in urban planning, nurturing the development of meticulously designed, eco-friendly environments.

The scientific outcomes derived from the conceptual modeling of development zones and the certification of integrated residential projects, exemplified by the Novaya Zarya residential area in Penza, validate the robust demand for the principles of sustainable construction and design. This investigation underscores the imperative for continual exploration and enhancement in the realm of national green building standards, particularly concerning integrated residential development projects. The exploration of digital models and the implementation of Building Information Modeling (BIM) technologies throughout the entire life cycle of construction objects emerge as promising pathways for future research and practical application.

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Acknowledgments

The research was supported by the Russian Science Foundation grant No. 22-28-20511 (https://rscf.ru/project/22-28-20511/).

References

Alikhadzhieva, D. S. (2019). On the classification of investment environmentally oriented projects in environmental management. *Horizons of the economy*, *6*(52), 75-79. https://elibrary.ru/item.asp?id=41473362

Baronin, S. A., & Porshakova, A. N. (2011). Scientific aspects of determining and forecasting the economic reliability of complex residential development. *Izvestiya PGU im. V.G. Belinsky, 24*. https://cyberleninka.ru/article/n/nauchnye-aspekty-opredeleniya-i-prognozirovaniya-ekonomicheskoy-nadezhnosti-developmenta-kompleksnoy-zhiloy-zastroyki

Baronin, S. A., Gushchina, E. S., & Romanova, A. I. (2023). Integrated green construction as a prerequisite for sustainable urban development. *E3S Web of Conferences 403, 02013 (ESCP-2023).* https://doi.org/10.1051/e3sconf/202340302013

Efremov, N. A., & Efremova, M. P. (2021). World experience in the application of green technologies. *Economic Sciences, 1*, 21-30. https://oecomia-et-jus.ru/wp-content/uploads/2015/12/OEJ_2021_1_s.-21-30.pdf

GOST R ISO 37120-2020. (2020). *National Standard of the Russian Federation Sustainable Community Development. Indicators of urban services and quality of life* (Order of the Federal Agency for Technical Regulation and Metrology of August 25, 2020 N 523-st). https://docs.cntd.ru/document/1200174970

Green zoom city. (2018). Practical recommendations for the integrated and sustainable development of territories. *ANO NIIURS, 2018*. greenzoom.ru/books/6-prakticeskie-rekomendacii-po-kompleksnomu-i-ustojcivomu-razvitiu-territorij/

Gushchina, E. S., Budanov, I. V., & Baronin, S. A. (2022). Green Building Simulation as a Sustainable Integrated Residential Development. *International scientific and technical journal real estate: economics, management, 3.* https://n-eu.iasv.ru/index.php/neu/issue/download/20/27

Pandit, A., Minné, E. A., Li, F., Brown, H., Jeong, H., James, J.-A. C., Newell, J. P., Weissburg, M., Chang, M. E., Xu, M., Yang, P., Wang, R., Thomas, V. M., Yu, X., Lu, Z., & Crittenden, J. C. (2017). Infrastructure ecology: an evolving paradigm for sustainable urban development. *Journal of Cleaner Production, 163*, S19-S27. https://doi.org/10.1016/j.jclepro.2015.09.010

Town Planning Code of the Russian Federation No. 190-FZ. (2004). *Adopted by the State Duma of the Federal Assembly of the Russian Federation on December 22, 2004 with subsequent amendments*. https://cis-legislation.com/document.fwx?rgn=7632

Wu, J. (2014). Urban ecology and sustainability: The state-of-the-science and future directions. *Landscape and Urban Planning, 125*, 209-221. https://doi.org/10.1016/j.landurbplan.2014.01.018

Zhukovskaya, A. Y., & Geraskin, Y. M. (2019). Application of green standards in Russia: problems and prospects. *Bulletin of Eurasian Science, 2*, 11. https://esj.today/PDF/37SAVN219.pdf