The Principles of the Renovation of Residential Development on a Complex Terrain (on the Example of a Residential Environment in the Area of Komarov Hill in Vladivostok)

The Principles of the Renovation of Residential Development on a Complex Terrain (on the Example of a Residential Environment in the Area of Komarov Hill in Vladivostok)

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Abstract. The need for architectural and site planning development of the existing urban environment, including residential areas, is justified by the growth of living standards and the needs of the population, as well as the emergence of new trends in urban design. The purpose of this study is to formulate the principles of a comprehensive renovation and design methods for a comfortable living environment on the example of the existing residential development of Vladivostok, located on complex terrain. The study revealed: architectural and site planning shortcomings of mass typical development, features of its planning structure, the device of the road network, courtyards and public spaces, artistic inexpressiveness of the environment. It is established that the conditions of complex relief require an integrated approach to the renovation of the living environment. The main principles formulated in the study are: the creation of an affordable multifunctional infrastructure that meets the needs of various population groups; organization of safe and comfortable courtyards, pedestrian transit paths connecting different levels of the landscape; organization of cycling; creation of public spaces saturated with social activity; the organization of compact buildings with adjoining and public spaces free from car parking; increase in the total area of landscaping due to the exploited roofs, slopes and vertical landscaping of the walls; giving the building and landscaping a unique architectural appearance, taking into account modern trends in design; formation of a barrier-free environment in residential development on complex terrain and taking into account the needs of people with disabilities. Based on the developed principles, an experimental project proposal for the renovation of residential development, which takes into account the climate and topography of the city of Vladivostok, was completed.

1. Introduction

The need for architectural and site planning development of the existing urban environment, including residential areas, is justified by the growth of living standards and the needs of the population, as well as the emergence of new trends in urban design. A big number of residential and public complexes and residential districts in large Russian cities belong to the category with increased morale and physical

depreciation. Due to the rapidly changing socio-economic and urban planning conditions, housing reconstruction projects developed based on outdated methodological and regulatory indicators do not fully take into account the current situation. Changes associated with a comprehensive improvement in the quality of residential development and the comfort of the living environment require systematic approaches to the reconstruction of urban development. According to SR (Set of Regulations) 2.07.01-89* "Urban planning, planning, and development of urban and rural settlements", "the formation of a three-dimensional composition of building development is settled in the form of a concept of urban planning solution for the comprehensive reconstruction of a residential building (quarter, residential district, residential area) to determine the totality of prerequisites for maintaining and updating the existing development" (SR 2.07.01-89* [1]).

The purpose of this study is to formulate the principles of comprehensive renovation and design methods for a comfortable living environment on the example of the existing residential development of Vladivostok, located on a complex terrain.

The term "renovation" means the process of improvement, reconstruction, restoration without destroying the integrity of the structure. However, in Russia, the renovation process is primarily associated with the complete replacement of housing that has lost its consumer properties, with the subsequent consolidation of buildings and an increase in its number of stories (Prokhorova E [2]).

Renovation abroad is carried out on the principles of sustainable spatial planning in accordance with green standards. The modernization of real estate (building or residential group) and adjoining territories is carried out by partial replacement of structural elements (the appearance of superstructures, end and front extensions, the dismantling of sections, the appearance of terraces and loggias) using modern technologies (Shuntov A [3], Prokhorova E [4], Vavilova T [5]).

The authors have collected, summarized, and analyzed information from literary and online sources. The main information on theoretical studies was obtained from domestic and foreign scientific journals, including those presented on the Elsevier electronic library portal and the ScienceDirect interdisciplinary platform. A review of information sources revealed the state of scientific development of the problem.

At the stage of formulating the problem and determining its relationship with important scientific and social tasks related to the renovation of mass housing development on the slopes in the conditions of the city of Vladivostok, an analysis of theoretical studies on the following issues was carried out:

renovation of the urban environment, city planning, the search for directions of balanced urban areas communication zones, the consolidation of the development of the territory, the development of master plans (Moor V and Erysheva E [6], Solontsov S [7], Suptelo N [8], Canter M and Karpenko M [9], Daineko D [10], Grakhov V, Manokhin P and Vychujanin O [11]);

deep reconstruction of existing residential buildings with partial replacement of structural elements (Fotopoulou A and Semprini G & 5 more [12], Salvalai G, Sesana M M and Iannaccone G [13], Österbring M and Camarasa C & 3 more [14]);

renovation of residential buildings in accordance with green standards (Aparicio-Gonzalez E, Domingo-Irigoyen S and Sánchez-Ostiz A [15], Dipasquale Ch and Fedrizzi R & 4 more [16], Földváry V and Bekö G & more [17], Wehle B, Geyer Ch and Müller A [18]);

renovation of open public urban spaces and their elements (Martinelli L, Battisti A and Matzarakis A [19], Silva J.F. and Oliveira C. & 2 more [20]);

designing residential areas in complex terrain **(**Krogius V [21], Krogius V, Abbott D and Pollit K [22]);

renovation of the living environment of the Far Eastern coastal cities (Moor V, Erysheva E and Smotikovsky V [23], Babenko A and Erysheva E & 6 more [24], Babenko A., Gavrilov, A. and Erysheva E. & 5 more [25], Shuntov A, Kopeva A and Maslovskaia O [26], Palienko S [27]);

organization of the residential yards of urban housing on the slopes (Kopeva A [28], Kopeva A and Maslovskaia O & 3 more [29], Strikauskas L, Maslovskaia O and Kopeva A [30]);

organization of school territories and territories of kindergartens (Khrapko O and Baranov V & 15 more [31], Khrapko O and Golovan E & 2 more [32], Khrapko O, Kopeva A and Ivanova O [33, 34]);

the use of methods of geoplastic of the earth's surface in residential development on complex terrain (Ivanova O, Khrapko O & 12 more [35] pp 52-64, pp 296-314);

organization of a greening system in residential development (Khrapko O, Savin S and Kopeva A [36], Kopeva A, Ivanova O and Khrapko O [37], Khrapko O, Kopeva A and Ivanova O [38], Khrapko O and Koldaeva M & 2 more [39], Kopeva A and Ivanova O & 2 more [40], Kopeva A, Ivanova O and Maslovskaia & 5 more [41]);

the formation of a barrier-free environment in residential development on complex terrain and taking into account the needs of people with disabilities (Androsov A, Maslovskaia O and Kopeva A [42]. Kopeva A, Ivanova O and Zaitseva T [43], Kopeva A, Khrapko O and Ivanova O [44], Androsov A, Kopeva A and Maslovskaia O [45]).

2. Methods

At the stage of collecting and studying the source data, the following methods were used. At the stage of determining the degree of knowledge of the problem, a method was used to systematize theoretical sources: domestic and foreign scientific publications, including journals presented on the E-library portal and Elsevier's multidisciplinary ScienceDirect platform.

At the pre-project stage of the study, the analysis of urban planning and natural-climatic characteristic of the district environment was used. At the stage of assessing the condition of the жилой среды and determining the level of comfort of the residential yards, the following methods were used: observation and behavioral mapping, photo-fixation, description of functional and aesthetic characteristics. The condition of the territories was assessed based on the requirements of normative and technical documentation (SR (Set of Regulations) 2.07.01-89* [1]).

The pre-project analysis served as the basis for determining the principles of the renovation residential development on a complex terrain in the city of Vladivostok. These principles, in turn, served as the basis for applying the method of experimental design and creating the project of the renovation of the residential environment on a complex terrain in the area of Komarov Hill in the city of Vladivostok.

3. Results

The study revealed: architectural and site planning shortcomings of mass typical development, features of its planning structure, the device of the road network, courtyards and public spaces, artistic inexpressiveness of the environment. It is established that the conditions of complex relief require an integrated approach to the renovation of the living environment. The main principles formulated in the study are: the creation of an affordable multifunctional infrastructure that meets the needs of various population groups; organization of safe and comfortable courtyards, pedestrian transit paths connecting different levels of the landscape; organization of cycling; creation of public spaces saturated with social activity; the organization of compact buildings with adjoining and public spaces free from car parking; increase in the total area of landscaping due to the exploited roofs, slopes and vertical landscaping of the walls; giving the building and landscaping a unique architectural look, taking into account modern trends in design; formation of a barrier-free environment in residential development on complex terrain and taking into account the needs of people with disabilities. Based on the developed principles, an experimental project proposal for the renovation of residential development, which takes into account the climate and topography of Vladivostok, was completed.

4. Discussion

The structure and appearance of Vladivostok, like most other cities, is largely determined by the building of the Soviet period. The mass typical building development of the 70-80s was tasked with maximizing the increase in housing stock with minimal economic costs. Today it needs a

comprehensive reconstruction, the main task of which is the humanization of the living environment. When analyzing the state of the line block-sectional building development of the panel nine-story houses, not only physical but also moral obsolescence is noted. This is not only about buildings but also about the living environment formed by these houses. With an increase in the standard of living of the population, new needs appear in a more comfortable living environment, which should be provided by the renovation of an existing building.

Since renovation poses complex tasks, namely, the transformation of the living environment, it is more advisable to consider it in the context of such a structural city-forming unit as a residential area. As an example, we consider a residential development located in the city of Vladivostok, in its eastern part, between the Komarov Hill and the Strelkova Pad' (fold). It is formed by multistoried panel houses built in the 70-80s of the XX century.

Analysis of the existing urban situation. One of the drawbacks of the mass typical building development of a residential district is its artistic and compositional uniformity and monotony. In the panorama of the city, buildings are perceived as a single gray spot formed by typical buildings located on the hillside above each other. Placing a linear residential building on a complex terrain determines the need to erect high retaining walls and slopes, making it difficult for pedestrian communications between different relief levels. Significant gaps between buildings, dictated by fire requirements and insolation standards are not functionally filled. Landscaping of courtyards is represented by the device of driveways around the building and platforms stretched along the facades. A significant part of the residential district is filled with spontaneous car parking and garage cooperatives, which leads to the "degradation" of valuable landscapes. Together, these conditions create a poverty of visual scenarios of the living environment.

The principles of the renovation of a residential environment in complex terrain. The study identified seven principles for the formation of a comfortable living environment at multi-story buildings in the area of Komarov Hill:

organization of accessible pedestrian paths: horizontal and vertical connections in hilly terrain;

reorganization of residential yards due to the formation of car-free spaces by creating parking lots built into the relief, using roofs to create grounds for various purposes, filling the yard with small architectural forms and landscaping;

organization of public spaces: the creation of inner-quarter venues for recreation, sports, events, seasonal trade;

development of affordable multifunctional residential infrastructure: the creation of commercial and cultural facilities in the ground and basement floors of residential buildings and stylobates;

landscaping of residential buildings due to the greening of roofs of residential buildings, landscaping of slopes, vertical landscaping, greenhouses, winter gardens, and agricultural facilities;

updating the architectural and artistic appearance of the environment: the introduction of new building elements, the formation of a living environment for each house with unique and unique architecture and landscaping, the development of color and architectural solutions of buildings;

the formation of a barrier-free environment in residential buildings on complex terrain and taking into account the needs of people with disabilities.

Experimental project proposal for the renovation of the residential district. The project proposed increasing the development efficiency of the urban environment. Dismantling of some large linear extended elements (multi-sectional houses of the 83rd series), going along the horizontal lines of the relief, will allow rational use of the territory. In the vacant space, the medium-rise buildings with stylobates are projected, cascading down the terrain. Formed residential groups, together with the existing housing facilities, form closed and semi-closed courtyard spaces, with openings to the south and southeast. The roofs of stylobates are landscaped and used to accommodate walking areas, recreational areas, and sports. In the project proposal, the adjoining territories were expanded due to the exemption from parking lots. When designing local territories, zoning is observed for the main types of activities and the differentiation of functional zones following the nature of use and the specific conditions of the site. The project uses the existing planning structure of the residential district

and the existing transport links (roads of regional significance and intra-quarter driveways). The issue of providing parking spaces has been resolved: for the old housing stock, it is planned to place closed parking lots built into the relief; parking spaces have been designed for new residential groups in the stylobate part of buildings and free-standing open and closed car parks.

Design proposals for space-planning solutions for residential buildings include communication floors, allowing you to move between different levels of the landscape. Consumer services facilities can be located along one side of the communication floor, and stained-glass windows on the other hand provide a panoramic view of the city, which allows you to orient in space. On the territory of residential development, walking areas are provided that connect the adjacent territories with public spaces and other parts of the residential area. Part of the pedestrian route in this case is duplicated by a bicycle path having circular motion. The infrastructure of the residential district is represented by existing facilities (schools, kindergartens, colleges, shops, car service facilities) and is complemented by cultural facilities located in the basement and stylobates floors of new buildings, as well as a leisure center of regional significance.

5. Conclusions

As a result of the research, the shortcomings of the existing residential development and residential yards on a complex terrain in the area of Komarov Hill of the city of Vladivostok were identified. Those shortcomings became the basis for the formation of the principles of the renovation residential environment on complex terrain, as well as the main points that should be avoided when designing new territories. Seven principles have been developed of the renovation residential environment using the example of the renovation of residential development on a complex terrain in the area of Komarov Hill of the city of Vladivostok. The renovation based on these principles is designed to optimize residential development and residential yards, make them ‘points of attraction’ for citizens and visitors, increase the overall level of comfort and well-being of the neighborhood. The pilot project for the renovation of residential development on a complex terrain in the area of Komarov Hill of Vladivostok based on elaborated theoretical principles was developed. The study can be used in the educational process in the direction of Architecture. The project proposal, as well as materials collected about the developed territory, can be used in real practice of residential development renovation. Project proposals of the renovation residential development in hilly terrain in Vladivostok are the basis for further theoretical research and practical design developments to create residential development in hill terrain not only in Vladivostok but also in other Russian cities in similar conditions.

6. References

[1] SR (Set of Regulations) 2.07.01-89* «Site planning and development of urban and rural settlements»
[2] Prokhorova E 2019 On the implementation of the renovation program in the city of Moscow. *International Journal of Applied Sciences and Technologies «Integral»* **3** 4
[3] Shuntov A 2019 Volumetric and spatial techniques for renovating multi-story residential buildings *Resource-efficient technologies in the construction complex 7th Int. Sci.-Prac. Conf. Proc.* 148-52
[4] Prokhorova E 2019 Foreign experience in implementing residential renovation projects *International journal of applied sciences and technologies «Integral»* **3** 5
[5] Vavilova T 2019 Review of Modern Foreign Concepts of Environmentalization of the Living Environment *Urban Constr. Archit.* **9** 113-25
[6] Moor V and Erysheva E 2019 Basic Principles and Strategy of Integrated Approach to Urban Environment’ Renovation *IOP Conf. Ser. Earth Environ. Sci.* **272** 032243
[7] Solontsov S 2007 Modern state policy on urban development in the Russian Federation *Bulletin of the Chuvash University* **4** 467-75

[8] Suptelo N 2018 The main stages of the modern urban development of the city of Moscow *Bulletin of Moscow University named after S.Yu. Witte. Series 1: Economics and Management* **1 (24)** 7-14
[9] Canter M and Karpenko M 2013 Reconstruction of built-up areas the main priority in the development of cities *Internet journal Science* **3 (16)** 146
[10] Daineko D 2013 Institutional problems of urban planning and modern methods of reconstruction of Siberian cities *Bulletin of Irkutsk State Technical University* **8 (79)** 75-81
[11] Grakhov V, Manokhin P and Vychujanin O 2014 Analysis of reconstruction of built-up areas *Problems of economics and management* **12 (40)** 29-34
[12] Fotopoulou A, Semprini G, Cattani E, Schihin Y, Weyer Ju, Gulli R and Ferrante A 2018 Deep renovation in existing residential buildings through façade additions: A case study in a typical residential building of the 70s *Energy and Buildings* **166** 258-70
[13] Salvalai G, Sesana M M and Iannaccone G 2017 Deep renovation of multi-storey multi-owner existing residential buildings: A pilot case study in Italy *Energy and Buildings* **148** 23-36
[14] Österbring M, Camarasa C, Nägeli C, Thuvander L and Wallbaum H 2019 Prioritizing deep renovation for housing portfolios *Energy and Buildings* **202** 109361
[15] Aparicio-Gonzalez E, Domingo-Irigoyen S and Sánchez-Ostiz A 2020 Rooftop extension as a solution to reach nZEB in building renovation Application through typology classification at a neighborhood level *Sustainable Cities and Society* **57** 102109
[16] Dipasquale Ch, Fedrizzi R, Bellini A, Gustafsson M, Ochs F and Bales Ch 2019 Database of energy, environmental and economic indicators of renovation packages for European residential buildings *Energy and Buildings* **203** 109427
[17] Földváry V, Bekö G, Langer S, Arrhenius K and Petráš D 2017 Effect of energy renovation on indoor air quality in multifamily residential buildings in Slovakia *Building and Environment* **122** 363-72
[18] Wehle B, Geyer Ch and Müller A 2015 Energetic and Acoustic Renovation of Residential Buildings of the 1950s to the 1970s *Energy Procedia* **78** 895-900
[19] Martinelli L, Battisti A and Matzarakis A 2015 Multicriteria analysis model for urban open space renovation: An application for Rome *Sustainable Cities and Society* **14** e10-e20
[20] Silva J F, Oliveira C, Reis C and Torres Silva L 2019 Footpaths Design on Renovation of City Centres – A Model of Assessment *Procedia Structural Integrity* 22 137-43
[21] Krogius V 1981 *Residential Design Guidelines in Hill Terrain* (Moscow: Publishing House of Central Research and Design Institute of Urban Planning) p 61
[22] Krogius V, Abbott D and Pollit K 1988 *Urban planning on the slopes* (Moscow: Stroyizdat Publishing House) p 336
[23] Moor V, Erysheva E and Smotikovsky V 2017 Problems and prospects for the renovation of the living environment of the Far Eastern coastal cities of Russia *Bulletin of the Engineering School of the Far Eastern Federal University* **4 (33)** 85-101
[24] Babenko A, Erysheva E, Kopeva A, Melnik A, Moor V, Obertas O, Palienko S and Smotikovsky V 1994 *Reconstruction and intensification of mass residential development (Theory and methodology of regional design)* (Vladivostok: Publishing House of Far Eastern Polytechnic Institute) p 128
[25] Babenko A, Gavrilov A, Erysheva E, Ignatov G, Kopeva A, Maslovskaia O, Moor V and Palienko S 2004 *Reconstruction of the Existing Residential Environment of the Seaside City* (Vladivostok: Publishing House Far Eastern State Tech. Univ.) p 130
[26] Shuntov A, Kopeva A and Maslovskaia O 2020 Peculiarities of location of mass building on a complex relief in microdistricts of Vladivostok *The New Ideas of New Century 20th Int. Sci. Conf. Proc.* **1** 485-91
[27] Palienko S 1990 Principles of the formation of residential buildings on the northern slopes (on the example of the coastal zone of the Primorsky krai (Moscow Arch. Inst.) p 22

[28] Kopeva A 1989 Architectural Organization of the Residential Yards of Urban Housing on the Slopes (in the Conditions of Vladivostok) (Moscow Arch. Inst.) p 22
[29] Kopeva A, Maslovskaia O, Strikauskas L, Ivanova O, Khrapko O 2020 Humanization of the Urban Environment for Children (on Example of the Residential Yards in City of Vladivostok) *Lecture Notes in Civil Engineering*
[30] Strikauskas L, Maslovskaia O and Kopeva A 2018 Comfort Level of the Housing Courtyards of the City of Vladivostok *The New Ideas of New Century: 18th Int. Sci. Conf. Proc.* **2** 311-17
[31] Khrapko O, Baranov V, Berezovskaya O, Golovan E, Denisov N, Dudkin R, Zorina E, Kalinkina V, Koldaeva M and Kopeva A and etc. 2012 *Landscaping of schoolyard* (Vladivostok: Publishing House of Primorsky Regional Institute of Educational Development) p 180
[32] Khrapko O, Golovan E, Kopeva A and Ivanova O 2016 Basic principles of architectural and landscape organization of schoolyard *Modern technologies and development of polytechnic education Int. Sci. Conf. Proc.* 551-56
[33] Khrapko O, Kopeva A and Ivanova O 2017 Landscape Planning of Schoolyards *IOP Conf. Ser. Mater. Sci. Eng.* **262** 012145
[34] Khrapko O, Kopeva A and Ivanova O 2018 Landscape planning of preschool yards *IOP Conf. Ser. Mater. Sci. Eng.* **463** 022017
[35] Ivanova O, Khrapko O, Berezovskaya O, Gridneva N, Denisov N, Zorina E, Kalinkina V, Koldaeva M, Kopeva A, and Mironova M and etc. 2017 *Landscape Design* (Vladivostok: Publishing House of Vladivostok State Univ. Econ. Serv.) p 368
[36] Khrapko O, Savin S and Kopeva A 2006 Some aspects of optimizing the urban environment by means of landscape design *Modern Problems of Regional Development 1st Int. Sci. Conf. Proc.* 208-10
[37] Kopeva A, Ivanova O and Khrapko O 2018 Green infrastructure in high-rise residential development on steep slopes in city of Vladivostok *E3S Web Conf.* **33** 01004
[38] Khrapko O, Kopeva A and Ivanova O 2015 Natural emphasis in urban landscaping *Modern problems of science and education* **5 (61)** 689-95
[39] Khrapko O, Koldaeva M, Golovan E and Kopeva A 2013 Informal style in landscape architecture of Far-Eastern cities *The New Ideas of New Century 13th Int. Sci. Conf. Proc.* **3** 395-99
[40] Kopeva A, Ivanova O, Malyshenko T and Khrapko O 2015 *Environmental Design: Book 4, Part 1* (Vladivostok: Publishing House of Vladivostok State Univ. Econ. Serv.) p 330
[41] Kopeva A, Ivanova O, Maslovskaia O, Elkina A, Malyshenko T, Filonenko E and Khrapko O 2015 *Environmental Design: Book 4, Part 2* (Vladivostok: Publishing House of Vladivostok State Univ. Econ. Serv.) p 194
[42] Androsov A, Maslovskaia O and Kopeva A 2017 The concept of organizing a barrier-free environment in residential buildings on complex terrain *Architecture and Design: History, Theory, Innovation: 2nd Int. Sci. Conf. Proc.* **2** 177-80
[43] Kopeva A, Ivanova O and Zaitseva T 2018 Application of Universal Design principles for the adaptation of urban green recreational facilities for low-mobility groups (Vladivostok case-study) *IOP Conf. Ser. Mater. Sci. Eng.* **463** 022018
[44] Kopeva A, Khrapko O and Ivanova O 2020 Landscape Organization of a Sensory Garden for Children with Disabilities *IOP Conf. Ser. Mater. Sci. Eng.* **753** 022028
[45] Androsov A, Kopeva A and Maslovskaia O 2018 Bicycle infrastructure in cities with complex terrain *Architecture and Design: History, Theory, Innovation: 3rd Int. Sci. Conf. Proc.* **3** 223-26