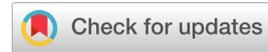




Research Article



## The Effectiveness of Contemporary Approaches to Housing Stock Reconstruction in Facilitating the Integration of Cutting-Edge Technologies

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**Abstract:** The article discusses innovative technologies in the reconstruction of housing stock, as well as what efficiency is achieved as a result. Innovative activity involves the development and implementation of an improved product or service, as a result of which the necessary social or economic benefits can be obtained. Innovative technologies used in the reconstruction of the housing stock make it possible to increase energy efficiency, reliability of load-bearing structures, as well as improve the appearance of the buildings themselves.

**Keywords:** reconstruction, housing stock, innovative technologies.



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### INTRODUCTION

According to experts, up to 50% of the housing stock of large cities consists of panel, block, brick houses built according to standard projects in the 50s and 70s. Technical standards and building materials of those years do not meet modern standards of energy efficiency, hydro-sound insulation. The layout and exterior decoration are outdated. Violation of the stipulated deadlines for major repairs further worsens the situation, increasing structural wear.<sup>1</sup> Heating expenses in five-storey Khrushchev buildings are 3-4 times more than those spent on heating in new generation residential buildings operated in countries with a more severe climate (Canada, Norway).

The inefficiency of heating and thermal insulation systems leads to several problems: irrational use of resources, high utility bills, and the inability to ensure a comfortable temperature regime in the cold season. Up to 70% of heat loss occurs directly in places of consumption-apartments, common areas (attics, basements, stairwells). Improving the energy efficiency of a building (up to 60%) is one of the main indicators of successful reconstruction of an apartment building.<sup>2</sup>

<sup>1</sup> Burak Gunay and others, 'An Investigation of Municipal Housing Permit Data for Representation of the Canadian Housing Stock in Building Codes Analysis', *Building and Environment*, 245 (2023), 110848 <<https://doi.org/10.1016/j.buildenv.2023.110848>>.

<sup>2</sup> Marija Bogataj, David Bogataj, and Samo Drobne, 'Planning and Managing Public Housing Stock in the Silver Economy', *International Journal of Production Economics*, 260 (2023), 108848 <<https://doi.org/10.1016/j.ijpe.2023.108848>>.

Factors for reducing heat loss: 25% insulation of facades, roofs; 20% modernization of engineering systems; 10% energy-saving double-glazed windows; 5% elimination of excessive ventilation.<sup>3</sup> The characteristic disadvantages of the main housing construction are: monotonous inexpressive architecture; low thermal protection characteristics and, as a result, high heat consumption during the heating season. In order to solve a number of the described problems and increase the operational reliability of building facades, it is necessary to implement a set of measures to renovate houses.

## METHOD

There are methods that reduce heat loss-active and passive. The active ones include the use of various devices for regulating the supply of heat to the room (manual and automatic), as well as the installation of heat meters. Passive ones include improving the thermal insulation of enclosing structures and main heating networks.<sup>4</sup> The passive method of reducing heat loss involves improving the thermal protection characteristics of enclosing structures. In this method, an increase in energy efficiency can be achieved through measures: replacement of windows; insulation of exterior walls; insulation of the roof.<sup>5</sup>

## RESULT AND DISCUSSION

The main works that are part of the reconstruction of the housing stock are: strengthening the foundation and compaction of soils; reconstruction of the aboveground part of the building; improvement of the exterior of the building.<sup>6</sup> The work on restoring the exterior of the building is one of the frequent directions within the framework of the reconstruction of the housing stock. The use of energy-saving methods, technologies and materials is one of the priorities.

The most effective measure to reduce heat energy losses is to improve the thermal protection characteristics of enclosing structures, improve ventilation systems, and utilize the heat of exhaust air to heat the supply air.<sup>7</sup> The high tightness of modern windows has made natural ventilation systems practically inoperable. The comfort of living in apartments has deteriorated: there is high humidity and poor air quality, and

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<sup>3</sup> Krzysztof Barnaś and others, 'Algorithm for the Comprehensive Thermal Retrofit of Housing Stock Aided by Renewable Energy Supply: A Sustainable Case for Krakow', *Energy*, 263 (2023), 125774 <<https://doi.org/10.1016/j.energy.2022.125774>>.

<sup>4</sup> S. Rasoul Asaee, V. Ismet Ugursal, and Ian Beausoleil-Morrison, 'Development and Analysis of Strategies to Facilitate the Conversion of Canadian Houses into Net Zero Energy Buildings', *Energy Policy*, 126 (2019), 118–30 <<https://doi.org/10.1016/j.enpol.2018.10.055>>.

<sup>5</sup> Ning Li and others, 'Comprehensive Renovation and Optimization Design of Balconies in Old Residential Buildings in Beijing: A Study', *Energy and Buildings*, 295 (2023), 113296 <<https://doi.org/10.1016/j.enbuild.2023.113296>>.

<sup>6</sup> Seyedehrabeeh Hosseinihaghighi and others, 'Discovering, Processing and Consolidating Housing Stock and Smart Thermostat Data in Support of Energy End-Use Mapping and Housing Retrofit Program Planning', *Sustainable Cities and Society*, 78 (2022), 103640 <<https://doi.org/10.1016/j.scs.2021.103640>>.

<sup>7</sup> A. Marini, C. Passoni, and A. Belleri, 'Life Cycle Perspective in RC Building Integrated Renovation', *Procedia Structural Integrity*, 11 (2018), 28–35 <<https://doi.org/10.1016/j.prostr.2018.11.005>>.

the likelihood of fungal lesions of structures increases. Therefore, for a comfortable stay indoors, several ways to increase energy efficiency are necessary at the same time.<sup>8</sup>

In buildings, a significant amount of heat is lost through windows. It is especially effective to replace windows in reconstructed buildings, the construction of which used windows with a wooden frame without the use of double-glazed windows. The main types of translucent structures used: 1) The use of glass. This glass is placed in the inner part of a double-glazed window, and it is coated with metal oxide, silver or zinc; 2) The use of double-glazed windows with inert gases. Increases the resistance to heat transfer; 3) The use of 3 or more double-glazed windows.<sup>9</sup>

One of the innovative ways to restore the facade appearance of buildings is the installation of facade systems. Advantages of this method: long service life (about 50 years); natural ventilation is carried out, which helps to remove excess moisture; installation can be carried out all year round; improves the sound insulation of the building; the hinged facade gives a beautiful appearance of the building and thus eliminates the need for finishing work. Disadvantages of this method: high cost; complexity of installation.<sup>10</sup> Today, when reconstructing the facade of buildings, software modeling of the shape of structural elements using the parametric method is also used. The program allows you to take into account the influence of both external and internal factors when modeling the outer shell of a building, which allows you to increase its wear resistance.<sup>11</sup>

Thus, the reconstruction of the housing stock acts as the main direction in the field of capital construction. Unlike the construction process, reconstruction has a number of features: cramped conditions for construction, installation; the need to adapt the building to new requirements without changing some of its elements; the specifics of the work that is absent during the "usual" repair or construction; the need to restore or preserve existing building structures; high labor intensity, the presence of additional requirements (for example, the organization of reconstruction at an existing production facility without stopping it).<sup>12</sup>

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<sup>8</sup> B. Ozarisoy and H. Altan, 'Bridging the Energy Performance Gap of Social Housing Stock in South-Eastern Mediterranean Europe: Climate Change and Mitigation', *Energy and Buildings*, 258 (2022), 111687 <<https://doi.org/10.1016/j.enbuild.2021.111687>>.

<sup>9</sup> Mohammed M. Qaid and others, 'Effect of Housing System and Housing Density on Performance, Viability, and Gastrointestinal Tract Growth of Broiler Chicks during the First 2 Wk of Age', *Poultry Science*, 102.7 (2023), 102752 <<https://doi.org/10.1016/j.psj.2023.102752>>.

<sup>10</sup> Filippo Marchesani, Francesca Masciarelli, and Andrea Bikfalvi, 'Smart City as a Hub for Talent and Innovative Companies: Exploring the (Dis) Advantages of Digital Technology Implementation in Cities', *Technological Forecasting and Social Change*, 193 (2023), 122636 <<https://doi.org/10.1016/j.techfore.2023.122636>>.

<sup>11</sup> Maria C. Cunha and others, 'A Multi-Criteria Assessment of the Implementation of Innovative Technologies to Achieve Different Levels of Microplastics and Macroplastics Reduction', *Marine Pollution Bulletin*, 191 (2023), 114906 <<https://doi.org/10.1016/j.marpolbul.2023.114906>>.

<sup>12</sup> Vivek Rawal and others, 'Inclusion of the Poor and Vulnerable: Learning from Post-Earthquake Housing Reconstruction in Nepal', *Progress in Disaster Science*, 10 (2021), 100162 <<https://doi.org/10.1016/j.pdisas.2021.100162>>.

## CONCLUSION

The implementing construction innovations, architectural planning and engineering solutions are improved during the reconstruction of the housing stock, technical reliability and economic efficiency are increased.

## DECLARATION OF CONFLICTING STATEMENTS

The author(s) stated that this work is original and has not been previously published in another journal or publication. The author(s) also declared that there is no conflict of interest in the publication of this article.

## References

- Asaee, S. Rasoul, V. Ismet Ugursal, and Ian Beausoleil-Morrison, 'Development and Analysis of Strategies to Facilitate the Conversion of Canadian Houses into Net Zero Energy Buildings', *Energy Policy*, 126 (2019), 118–30 <<https://doi.org/10.1016/j.enpol.2018.10.055>>
- Barnaś, Krzysztof, Tomasz Jeleński, Marzena Nowak-Octoń, Kinga Racoń-Leja, Elżbieta Radziszewska-Zielina, Bartłomiej Szewczyk, and others, 'Algorithm for the Comprehensive Thermal Retrofit of Housing Stock Aided by Renewable Energy Supply: A Sustainable Case for Krakow', *Energy*, 263 (2023), 125774 <<https://doi.org/10.1016/j.energy.2022.125774>>
- Bogataj, Marija, David Bogataj, and Samo Drobne, 'Planning and Managing Public Housing Stock in the Silver Economy', *International Journal of Production Economics*, 260 (2023), 108848 <<https://doi.org/10.1016/j.ijpe.2023.108848>>
- Cunha, Maria C., Kostas Tsiaras, João R. Marques, Yannis Hatzonikolakis, Luis C. Dias, and George Triantaphyllidis, 'A Multi-Criteria Assessment of the Implementation of Innovative Technologies to Achieve Different Levels of Microplastics and Macroplastics Reduction', *Marine Pollution Bulletin*, 191 (2023), 114906 <<https://doi.org/10.1016/j.marpolbul.2023.114906>>
- Gunay, Burak, Adam D. Wills, Heather Knudsen, and Iain Macdonald, 'An Investigation of Municipal Housing Permit Data for Representation of the Canadian Housing Stock in Building Codes Analysis', *Building and Environment*, 245 (2023), 110848 <<https://doi.org/10.1016/j.buildenv.2023.110848>>
- Hosseinihaghighi, Seyedehrabeeh, Karthik Panchabikesan, Sanam Dabirian, Jessica Webster, Mohamed Ouf, and Ursula Eicker, 'Discovering, Processing and Consolidating Housing Stock and Smart Thermostat Data in Support of Energy End-Use Mapping and Housing Retrofit Program Planning', *Sustainable Cities and Society*, 78 (2022), 103640 <<https://doi.org/10.1016/j.scs.2021.103640>>
- Li, Ning, Xufeng Miao, Wenying Geng, Ziwei Li, and Lin Li, 'Comprehensive Renovation and Optimization Design of Balconies in Old Residential Buildings in Beijing: A Study', *Energy and Buildings*, 295 (2023), 113296 <<https://doi.org/10.1016/j.enbuild.2023.113296>>

- Marchesani, Filippo, Francesca Masciarelli, and Andrea Bikfalvi, 'Smart City as a Hub for Talent and Innovative Companies: Exploring the (Dis) Advantages of Digital Technology Implementation in Cities', *Technological Forecasting and Social Change*, 193 (2023), 122636 <<https://doi.org/10.1016/j.techfore.2023.122636>>
- Marini, A., C. Passoni, and A. Belleri, 'Life Cycle Perspective in RC Building Integrated Renovation', *Procedia Structural Integrity*, 11 (2018), 28–35 <<https://doi.org/10.1016/j.prostr.2018.11.005>>
- Ozarisoy, B., and H. Altan, 'Bridging the Energy Performance Gap of Social Housing Stock in South-Eastern Mediterranean Europe: Climate Change and Mitigation', *Energy and Buildings*, 258 (2022), 111687 <<https://doi.org/10.1016/j.enbuild.2021.111687>>
- Qaid, Mohammed M., Hamad A. Albatshan, Elsayed O.S. Hussein, and Maged A. Al-Garadi, 'Effect of Housing System and Housing Density on Performance, Viability, and Gastrointestinal Tract Growth of Broiler Chicks during the First 2 Wk of Age', *Poultry Science*, 102.7 (2023), 102752 <<https://doi.org/10.1016/j.psj.2023.102752>>
- Rawal, Vivek, Jitendra Bothara, Pragya Pradhan, Ramraj Narasimhan, and Vijaya Singh, 'Inclusion of the Poor and Vulnerable: Learning from Post-Earthquake Housing Reconstruction in Nepal', *Progress in Disaster Science*, 10 (2021), 100162 <<https://doi.org/10.1016/j.pdisas.2021.100162>>