UDC 624.01

RESOURCE EFFICIENT TECHNOLOGY FOR ENVIRONMENT-FRIENDLY SOCIAL HOUSING CONSTRUCTION IN UKRAINE

Savytskyi Mykola, Dr. Sc. (Tech.), Prof.; **Kolokhov Viktor**, Ph.D. (Sc.Tech.), Assoc. Prof.;
Degtyariova Yuliya, Ph.D. (Pedagogy), **Gavrilyuk Sergii,** Postgrad. Stud.
State Higher Education Institution
"Prydniprovska State Academy of Civil Engineering and Architecture"

Problem statement. The global population is estimated to reach 9.7 billion in 2050 [1]. The urbanization of the population has its own positive impact on economic growth [1]. Nevertheless, it also demands careful thought about the provision of adequate housing and urban planning strategies. The global residential buildings in particular account for 38% of the global construction volume [2]. Residential buildings also occupy much more floor space compared to non-residential buildings [3]. Such demand has so far been supplied by the construction industry that consumes an estimated 3 billion tones of raw materials and other resources [2]. Still, this supply of housing has also not been able to meet the demand resulting in more substandard housing [1].These trends endanger the planetary boundaries that are defined to be a safe operating space for humanity. Reasons for inefficient construction resource utilization include the fragmented, project-based approach [4] and the "linear" economy approach in which construction materials are sourced, used, and disposed of with little re-use or recycling [5]. Hence studying this particular segment of the infrastructure demand and supply is vital.

In Ukraine, according to the 'Sustainable Development Goals and the Agenda 2030: Ukraine' national report, the need of large numbers of the population for quality housing has not been met. A large proportion of households are forced to reside in inadequate flats in obsolete, hazardous or unsuitable buildings. There is no social and/or temporary housing, and the rental market is underdeveloped and poorly regulated. The unfavourable living conditions in cities are aggravated by the lack of a systematic approach to urban development, which results from both a lack of modern general development plans and uneven funding. As a result, the development of municipal, social, transport, trade and consumer infrastructure is lagging far behind the ever-increasing public needs.

Resource- and energy-intensive industries account for a large part of Ukrainian GDP. Thus, the priorities of state policy in this context are to optimize the use of natural resources and reduce energy intensity, and to minimize the environmental impact by moving to a 'green economy' model. This involves the gradual removal of hazardous chemicals from manufacturing processes and product life cycles. Therefore, the use of recycled materials and industrial by-products is an urgent task, because such a system will serve as a tool for introducing more rational approaches to the use of natural resources and chemicals. As only a small proportion of waste, including household waste, is recycled, reused or salvaged, Ukraine has accumulated over 30 billion tonnes of waste, and this volume is growing every year. The issue is a nationwide challenge. The dominant waste management practice in Ukraine does not meet modern requirements, as it fails to either reduce waste generation or treat, reuse or recycle large quantities of accumulated waste. The promotion of investment projects to launch modern technologies for solid waste treatment, including with foreign investments on the basis of public–private partnerships, is an important tool to solve the problem of waste management. To achieve this goal, it is necessary to create legal and institutional preconditions for the establishment of a green economy in Ukraine, which will significantly reduce the dependence of economic growth on the use of natural resources and

energy. The concept of a circular economy can be served as a basis for rethinking the role of waste as a resource.

Purpose of the study. Over the past several decades, increased global demand for affordable housing has led to claims of a social housing crisis. The issues of access to land and construction costs have been unabated drivers of housing unaffordability. Furthermore, housing plays an important role in global sustainability, including a holistic view that balances societal justice, economic development, and environmental services. In its 2013 resolution, Social housing in the EU, the European Parliament called on the EuroFound to examine the cost of inaction on inadequate housing. According to its findings, housing inadequacies, such as the inability to keep homes adequately warm or lack of adequate indoor sanitary facilities, have negative impacts that include ill-health or accidents, resulting in substantial healthcare costs. These challenges require improved planning and construction of housing.

To balance sustainability requirements and the demand for affordable housing, one potential strategy is resource and energy efficiency, which implies the increased adoption of IHC including novel construction methods and products. Although concrete has been the most popular building material for decades, it takes its toll on the environment in a few different ways: 1) involving a certain percentage of greenhouse gas emissions, 2) requiring a large amount of energy use for its production 3) mining natural resources. Fly ash slag, crushed concrete, brick, glass and other recycled materials and industrial by-products can provide excellent binding properties to concrete and serve as serve as concrete aggregates. Additionally, the reuse of these materials helps in reducing the consumption of cement and serves as an efficient method for their safe disposal.

IHC extends beyond prefabrication of elements. IHC refers to a holistic strategy that includes well-defined technical systems, use of information communication technology (ICT), planning and control of processes, and a stronger relationship with stakeholders. The term pre-manufacturing is defined as all activities that occur away from the final site where buildings are permanently placed. Additionally, IHC can include on-site improvements such as integrating lean processes, and/or on-site fabrication of individual components of a building.

Hence the main objectives of the proposed paper include 1) the development of a comprehensive methodology for architectural, constructive and technological IHC system of energy- and resource-efficient eco-friendly affordable dwellings which will provide a safe, healthy and hazard-free environment; 2) research into physical, mechanical and structural properties of concrete with recycled aggregates with a view to further provision of scientific foundations for on-site IHC technology.

References

1. United Nations, Department of Economic and Social Affairs, Population Division. World Urbanization. Prospects: The 2018 Revision (ST/ESA/SER.A/420), 2019, 126 p.

2. WEF, Shaping the Future of Construction. A Breakthrough in Mindset and Technology. World Economic Forum, 2016, 64 p.

3. Huang B., Zhao F., Fishman T., Chen W.Q., Heeren N. and Hertwich E.G. Building material use and associated environmental impacts in China 2000−2015. Environ. Sci. Technol. Vol. 52, 2018, pp. 14006−14014.

4. Hall D.M., Whyte J.K., Lessing J., Hall D.M. and Whyte J.K. Mirror-breaking strategies to enable digital manufacturing in Silicon Valley construction firms : a comparative case study. Construct. Manag. Econ. 2019, pp. 1−18.

5. Zimmann R., O'Brien H., Hargrave J. and Morrell M. The circular economy in the built environment. 2016, pp. 1−93. URL: https://doi.org/10.1016/j.ecoser.2013.04.008