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SIMULATION MODELING OF THE LIFE CYCLE OF ENERGY-EFFICIENT BUILDINGS

The issue of reducing the energy intensity of buildings is currently one of the acute problems of the construction industry of the Republic of Kazakhstan, the fundamental document in the sphere of which is the Law of the RK «On energy saving and energy efficiency» [1].

The article is based on the research of kazakh scientists such as Tleppaev A.M., Zeinolla S.Zh. as well as russian scientists Aloyan R.M., Fedosov S.V., Oparina L.A., Likhachev V.L. L., who identify the problems hindering the active emergence of energy-efficient buildings and propose the author's approach to solve them. The issues of cost-effective methods of reconstruction of existing buildings, using modern technology, performed by foreign researchers Pacheco-Torgal F., Granquist K., Jel B., Vanoli J., Bianco N., Kurnitsky Ya.

In 2015, Kazakh research and design institute of construction and architecture proposed a transition to an innovative for Kazakhstan life cycle management system for all its stages through the introduction of construction industry information modelling technologies (CIIMT).

The importance of applying CIIMT in the field of energy reduction stems from the need to perceive the building as an integral energy system, which is in continuous dynamics and interaction with the external environment. The active use of simulation modelling in the work of construction and energy audit companies and firms is currently relevant for the following reasons:

- there is no single, universally recognised level of energy efficiency throughout the life cycle of such buildings, so the indicators formed in the design may not be respected during the construction and operation phases, due to a lack of effective reasoning and control mechanisms;
- is an easier way of solving the problem, although there are analytical methods for designing energy-efficient buildings, but the mathematical calculations are very complex and time-consuming;;
- has the possibility of taking into account the alternative and probabilistic nature of the construction process, as such experiments would be difficult to carry out under realistic conditions [2].

From the above, it follows that simulation modelling is one of the tools for implementing a life cycle management methodology for energy-efficient buildings.

The purpose of an energy simulation is to investigate and select the least energy-intensive life cycle option for a building. For this reason, all energy consumption factors of the building over its entire life cycle, which are variables in the simulation model, are identified and then an algorithm is developed to determine them.

A life cycle process simulation model is worth considering from the perspective of aggregate systems, because it is important to understand that the energy efficiency of a building is a complex characteristic that depends on many factors with a probabilistic nature, and is a complex energy system.

By taking into account all building components, architectural and construction solutions, engineering equipment parameters, heat dissipation from people, household appliances, and combining the energy consumption components into generalised units, the integral effects of their interaction within the building as a unified energy system can be taken into account, and system performance in dynamics can be traced using simulation modelling.

«Energy use units are factors in the energy consumption of a building as an energy system, integrating energy resource expenditure by energy resource type and by stage of the building's life cycle» [3].

Consequently, creating an energy simulation model with CIIMT allows the combination of derived expert data and the formal apparatus of random aggregate systems. However, despite the clear advantages of simulation modelling, this approach is currently not widespread, due to the fact that the development of such energy models is time-consuming and costly. It is necessary to create a conceptual simulation model of the energy intensity of the life cycle of an object, which would define the composition and structure of the system, the properties of the elements and cause-effect relationships, and of course - energy savings. In this regard, the choice of random value distribution laws and function approximation is of particular importance in forming the input data. This method will provide additional energy savings and energy efficiency gains over the lifetime of the building of more than 30%.

List of sources used

1. Law of the Republic of Kazakhstan dated January 13, 2012 № 541-IV «On energy saving and energy efficiency». Astana, 2012.

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3. Oparina, L.A. Simulation modeling of energy consumption by buildings / L.A. Oparina // Energy Saving. - 2012. - № 7. - P. 68-70.