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Research Article

IMPROVING THE ENERGY EFFICIENCY OF DESIGN SOLUTIONS ENCLOSING STRUCTURES

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ABSTRACT

This research paper provides a scientific study of design solutions to reduce energy costs during the reconstruction of residential buildings. Also, the efficiency of using structures with ventilated facades consisting of an air gap in the technology of reducing energy costs has been confirmed. The results of the analysis of thermal engineering calculations of ventilated facade structures reflect the positive tendencies of an increase in heat-insulating indicators in the process of changing the thickness of the air gap in the structures when insulating the covering.

KEYWORDS

Energy efficiency of a residential building, energy consumption, enclosing structures, constructive solutions, reconstruction.

INTRODUCTION

Nowadays, taking into account the growth of the population and the acceleration of urbanization, the demand for energy resources in the buildings sector has increased several times in recent years. According

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to UNDP reports [1], the specific energy consumption in buildings in Uzbekistan is 2-2.5 times higher than the corresponding indicators of developed countries. In this regard, the actual problem is to reduce the use of energy resources, taking into account economic and environmental aspects. Significant amounts of energy resources can be saved if an effective energy saving mechanism is created and implemented in all areas of energy consumers. One of these industries is the process of reconstruction of residential buildings.

The aim of the work is to study design solutions to reduce energy costs in the reconstruction of residential buildings.

METHODS OF RESEARCH

Currently, the total number of residential buildings built in the last century according to design solutions are in need of reconstruction. For example, buildings with brick walls and 5% - houses built using prefabricated large-block elements. The problematic issues of their further operation over the years are exacerbated both because of the loss of operational reliability of individual load-bearing elements of buildings, and because of the high rates of operational energy costs.

A promising direction in the design of engineering and technical measures to improve the energy efficiency of residential facilities is their use to reduce the energy costs of heat-efficient building materials obtained on the basis of resource-saving technologies. Efficient and affordable building materials with high performance are cellular concrete made from industrial waste.

The main indicator of the energy efficiency of a residential building is the consumption of energy carriers to ensure normalized indoor microclimate parameters. Periodic changes in the normalized indicators of energy efficiency of building elements, introduced at the time required in the construction legislation, led to an increase in the normalized values of the thermal resistance coefficient for external walls up to 2.9 m2 °C/W.

Non-compliance with modern requirements of the thermal parameters of objects of obsolete buildings, for which the thermal resistance of the outer walls barely reaches 1.2 m2 °C / W, requires the introduction of organizational and technical measures to reduce the energy costs of residential buildings. For such facilities, heat costs due to building envelopes account for up to 65% of all total energy supply costs.

RESULTS

Studying the structure of the operational elements of buildings, it is quite obvious that reducing the energy consumption of the external building envelope will provide significant savings in energy resources while improving the microclimate parameters inside the premises [3-5]. External thermal insulation of enclosing structures significantly reduces the transfer of heat from the premises to the outside. Temperature flows from inside the room penetrate into the building envelope and are partially absorbed in the layer. The residual heat of the stone wall structures also prevents the occurrence of negative processes associated with the freezing of liquids in the engineering systems of internal heating and plumbing, which, as a rule, are located along external load-bearing walls.

The most common technologies are wet and ventilated facades. The methodology for designing engineering and technical solutions for exterior finishes involves the substantiation of the thermal parameters of enclosing structures by selecting a material according to its heat-insulating properties [6]. At the same time, it is taken into account that the main load of the effective material performs the function of resistance to heat transfer taken over by the inner layer of the enclosing structure. It should be taken into account that a potential problem that may arise during the operation of the building is associated with significant indicators of the vapor-permeable massiveness of the wall, while the thermal conductivity of the wall increases, with condensed moisture in the pores, the finishing layer may be destroyed.

One of the best ways to design a heat-shielding coating for the outer walls of a building is the installation of a ventilated facade.

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The study of the influence of air spaces in the composition of the wall structure was carried out for different thicknesses of the air gap. Thus, the thickness of the layer between the wall surface and the inner surface of the insulation varied from 20 mm to 100 mm in increments of 15 mm. The accepted limits of the interlayer are due to the possible ways of constructive implementation of the finishing and insulating coating and the conditions for ensuring the operational reliability of the structure. The calculation of the thermal parameters of the enclosing structure was carried out according to the methodology in accordance with the regulatory requirements of KMK RUz 2.01.04-18 "Construction Heat Engineering" [2], the calculation results are shown in Table 1.

Table 1. The results of the calculation of the thermal properties of the options for the external enclosing structure of the load-bearing wall

Air layer thickness, mm	Thermal resistance index, $m^2 \cdot K/W$	Heat loss reduction rate, %
20	4.780	9.7
40	5.291	17.8
60	5.672	23.9
80	5.899	34.1
100	6.102	38.7

CONCLUSION

Analyzing the results of computational studies, it can be argued that the installation of an air gap in the heat-insulating coating of the outer wall structure will reduce the heat loss of the building. The presence of an air gap will contribute to the accumulation of thermal energy in the structure of the enclosing structure, which in turn will ensure compliance with the normalized microclimate parameters in the premises of the building without unnecessary heat loss due to the enclosing structures.

As a result of the studies performed, the efficiency of using structures with ventilated facades consisting of an air gap in the technology to reduce energy costs has been confirmed. The results of the analysis of thermal engineering calculations of ventilated facade structures reflect positive trends in increasing heat-insulating performance in the process of changing the thickness of the air gap in structures during coating insulation.

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