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Research Article

OPPORTUNITIES AND PROBLEMS IN INCREASING ENERGY EFFICIENCY OF BUILDINGS IN THE CONDITIONS OF THE CLIMATE OF UZBEKISTAN

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ABSTRACT

This article, based on the newly implemented building norms and regulations and experimental work on the example of constructed and renovated buildings, examines the impact of roof structures on the energy efficiency of low-rise residential buildings and the energy efficiency of buildings in developed countries. and was devoted to the analysis of the work being carried out in Uzbekistan. In the work, issues of heat loss from the roof structures of a low-rise residential building, factors affecting the energy efficiency of barrier structures, as well as issues of changes in energy efficiency indicators with the design of selected insulation materials for the roof structure were studied. Scientific hypotheses and forecasts regarding the effectiveness achieved by designing them were given.

KEYWORDS

Low-rise residential buildings, construction energy efficiency, energy-efficient building, insulation materials.

INTRODUCTION

Climatic zones must be taken into account when designing buildings. The internal climate of buildings is formed under the influence of climate parameters. The indoor climate is considered to be a set of all parameters that affect human perception of heat. The main parameters of indoor climate are air and indoor surface temperature, humidity and air movement. Despite the wide biological adaptation of man to the external environment, his thermal management capabilities are limited to a relatively small meteorological range. Internal climate discomfort can cause various diseases. In order for a person to have a comfortable environment, the body's thermal management system should be in the state of the smallest stress [1,2,3].

Today, there are several directions and methods of improving the energy efficiency of buildings. There are the following resources for improving the energy efficiency of buildings:

- Thermal insulation of barrier structures;
- Air ventilation heating;
- Water heating from a hot water system;
- Coordination of the heat distribution system;
- Lighting system;
- Local automation, etc.

It is necessary to rely on the rich experience of using different buildings for the development of energy-efficient building construction. The energy efficiency of buildings is determined by a combination of many factors. Studies show that when traditional residential buildings are used, up to 30% of heat is lost through walls and cracks, 18-30% through windows, 5-10% through the basement, 10-18% through the roof, and ventilation. 18% of heat is lost [4,5]. In order to reduce heat loss, an integrated approach to energy saving is necessary.

In this field, foreign, Russian and Uzbek scientists are interested in increasing energy efficiency, and their observations are not enough. They put forward the idea of conducting theoretical and practical research based on normative rules to study the problem of energy efficiency in accordance with the requirements of the time. Currently, they say that the existing regulatory framework is outdated in the social economy, and the new one has not yet been developed. The goal of the redevelopment of the regulatory provisions is to increase energy efficiency, to achieve efficiency in energy production as a result of saving available resources.

The first energy-efficient building project was developed by architects Andrew Isaac and Nicholas Isaac in Manchester, New Hampshire, USA in 1972 [6,7,8]. Although the energy crisis has not yet been announced, the era of cheap energy has begun to be felt. The energy consumption of buildings was not so important, but now it was one of the main factors in the design.

The second energy-efficient building was built in Otaniemi, Finland, and EKONO-house was built as an experimental building to evaluate architectural, technological and engineering measures for energy efficiency. Both buildings

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will use solar radiation and use a computer to control engineering devices.

Later, the first direction developed on a large scale, despite the fact that it was the Nordic countries. Experimental residential districts using solar energy have been built in Finland [9,10].

The second direction, that is, the scale of application of computer-controlled systems, has reached such a level that the construction of "Smart Buildings" is currently in full swing.

LITERATURE REVIEW

There are noteworthy developments of the following foreign scientists and engineers in designing energy-efficient buildings, discovering them as a new, unique architectural-artistic and technical-economic innovation, and creating energy-efficient building projects.

These are Finnish engineer and scientist Juhe Gabrielson, Danish Prof. Peter Petersen, Japanese Prof. Toru Mashida, German engineer Peter Mushelknausa Frankfurt-am-Main, US engineer Reeth and Jim Walton, Danish Ul Fanger, US Sam Taylor, Finnish Esko Takht, scientists from the Russian Federation Yu.A. Tabunshikov, M.M. Brodach, N.V. Shipkin, A.N. Dmitriyev, Monastmrev P.V., Sborshikov S.B. and others [11-17].

Among foreign scientists, the following scientists worked on the development of the problem and energy efficiency in research in this field: V.A. Putyatinsky, V.N. Panasyuk, A.I. Tyutyunnikov, F.B. Yurevich, I.M. Brodach, A. Barinov, O.V. Barmbina, I.V. Belavkin, I.I. Borisov, V. Borovkov, V. Bushev, S. Voronina, N.P. Gavrilin, Y.G. Gasho, L.D. Gitelman, L.A. Golovanova, N. Danilov, V. Kirillkin, M.A. Kovalenko, K.G. Kozhevnikov, I.R. Kostyuk, V.N. Kuryatov, L. Koshkin, V.A. Lezhnikov, V.V. Litvak, L.V. Olekhnovich, V.I. Polivanov, I.V. Mojina, S.P. Tkachev, V.N. Inyakin, L.I. Prishepa, A.V. Sapenko, D. Box, A. Briden, K.D. Lewis, D.N. Nurmakhmatov and others [18-23].

METHODOLOGY

The fact that the energy consumption of buildings under construction in European countries is 5-10 times less compared to our buildings shows that the scope of work in this direction is much wider in our republic. So we have huge opportunities to improve the energy efficiency of buildings (Figure 1).

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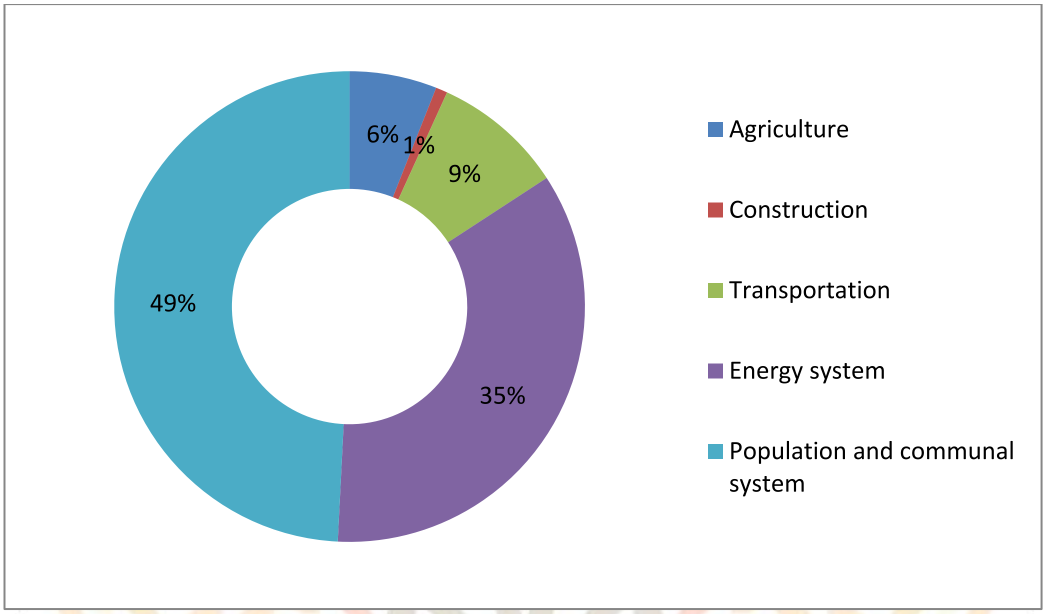

Figure 1. Diagram of total energy consumption in Uzbekistan

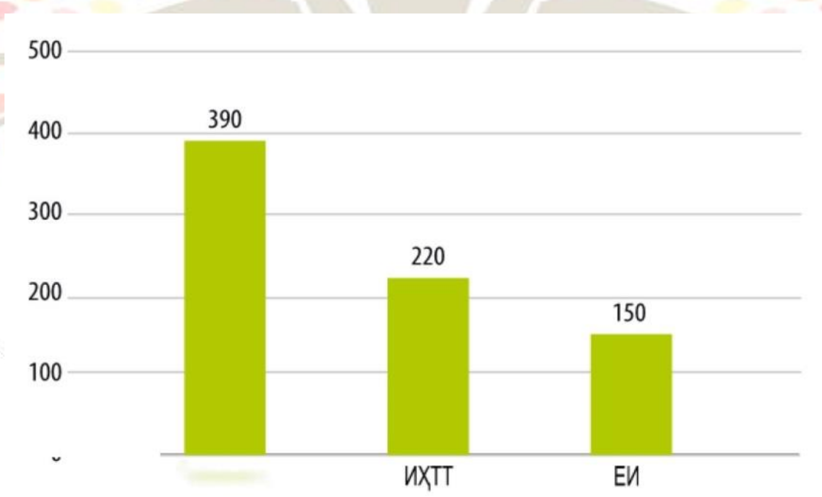

Figure 2. Energy consumption comparison chart (kWh/m2 per year).

In Uzbekistan 66% of low-rise houses have wooden frames and 91.7% of houses have no roof insulation (Figure 3).

Energy consumption of buildings in Uzbekistan is 2-2.5 times higher than in developed countries (Figure 2).

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Today, buildings account for almost half of the total energy consumption in our republic (24.1 million t. per year), (1 picture) [24,25].

Excessive loss of energy is usually explained by:

- outdated engineering communications and a high percentage of previously built buildings whose energy efficiency does not meet modern requirements in terms of their technical parameters;
- due to the use of old equipment with the high energy consumption during the renovation and construction of buildings;
- low efficiency of heating and air conditioning systems;
- low heat-protective properties of the materials used during the construction of buildings;

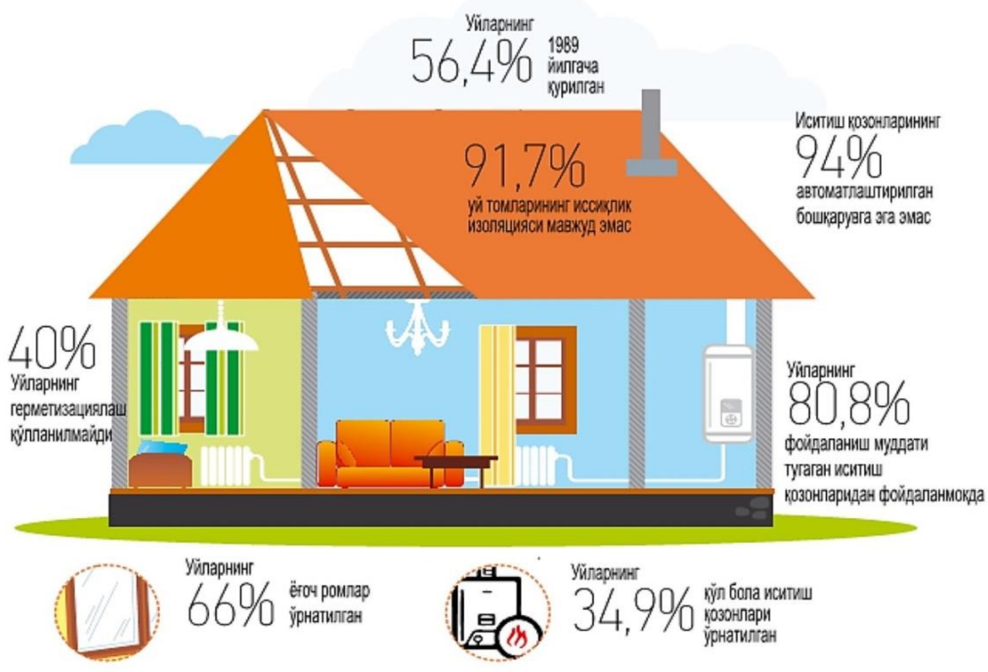

Figure 3. Building energy efficiency portrait

90% of residential buildings were built 25 years ago, when energy costs were relatively low, and the energy efficiency of buildings was not given much attention:

- heat-insulating materials;
- plastic frames, sealing measures, etc. are almost not implemented.

Wooden frames are installed in 66% of the studied residential buildings (installation of two-layer plastic frames allows to reduce heat consumption by 20%). 91.7% of house roofs do not have thermal insulation. Building sealing measures were implemented only in 60% of houses.

The low level of energy efficiency is also relevant for the heating and hot water supply system. In 34.9% of the houses, the useful work coefficient is 50-60% using non-standard (hand-held) heating boilers. For comparison: the efficiency of modern heating boilers with high energy efficiency is 91-95%. The service life of 80.8% of Isitittt boilers is more than 10 years. It should be noted here that the average service life of heating boilers should not exceed 10 years. 94% of the heating boilers in use do not have an automated control system. 67.7% of the hot water supply boilers installed in the household are boilers whose service life is more than 10 years.

Due to the limited use of thermal insulation for walls, roofs and frames, as well as the old boilers used for heating and hot water supply and the low coefficient of useful work, the average gas consumption per household per month is 8.3 cubic meters per 1 square meter of the house. As a result of the replacement of existing heating boilers with modern heating boilers with high energy efficiency and the application of thermal insulation measures, gas consumption per 1 sq.m. up to 5.5 cubic meters can be saved. As a result of the implementation of measures aimed at reducing energy consumption, the potential of saving energy resources is 7.2 billion per year. a cub. meter of gas or 1.8 billion dollars.

According to the results of the implemented working projects, the potential for reducing energy consumption due to heating of the roof and walls, replacement of heating boilers and switching to the use of energy-saving light bulbs in educational institutions - 42%, in healthcare institutions - is 44% (Table 1).

Table 1. Improvement of energy efficiency of buildings of social importance

	Energy consumption before applying energy-saving measures,	Energy consumption after applying energy-saving measures,	Energy saving potential
	kWh/m^2 *year	kWh/m^2 *year	
Healthcare institutions	223.4	125	44%

Educational institutions	185.7	107	42.40%

The total volume of investments required to increase the energy efficiency of educational and healthcare facilities is 480.1 million dollars. According to estimates, these measures will save 65.5 million dollars a year. The payback period of these projects is 4-10 years, based on gas export prices.

During the heating season, when the weather temperature rises, only 35% of the population sets the thermostat to a warmer temperature or lowers the gas pressure in the heating boiler. The remaining 65% of the population opened windows and ventilate the room. Therefore, the annual gas loss per household is 1200 cubic meters.

It was found that the population uses electricity more economically than natural gas. For example, almost 70% of the population turns off the light when there is no need to, which is twice as many people who control the gas pressure when the weather temperature rises. The existence of such an attitude towards gas is based on the relatively low price and the behaviour that has settled in the minds of people.

It should be noted that two schools were built in Andijan and Navoi regions as part of the project "Improving the energy efficiency of social buildings", four such schools were built in the Republic of Karakalpakstan, Fergana and Kashkadarya regions. Also, the buildings of two rural medical centres in the cities of Tashkent and Navoi were put out of repair. Innovative construction technologies were widely used in the construction and repair of these buildings. New buildings achieved 31% energy efficiency, and renovated buildings 67%.

Specifically, 10 building codes and regulations were revised and approved; 53 new conditions related to the energy efficiency of buildings have been introduced; More than a dozen experts from local partner organizations were trained in Denmark and Italy to learn the world experience of building energy-efficient facilities. Representatives of state bodies of our country participated in conferences held in developed countries and increased their knowledge and skills.

Some changes have been made due to the new project. In particular, 10 design regulations were revised and approved; 53 new terms related to the energy efficiency of buildings were introduced as norms; more than a dozen specialists from local partner organizations were trained in Italy and Denmark to learn the world experience of energy-efficient building construction. In addition, representatives of our country participated in conferences held in developed foreign countries and improved their knowledge and skills.

More than 1,000 architects, architects and designers of Uzbekistan participated in a series of seminars and training aimed at increasing the energy efficiency of buildings. The most important task in this direction is the issue of personnel training. In cooperation with Tashkent State Technical University and Tashkent Institute of Architecture and Construction, they developed new educational standards, educational modules and 2 educational programs.

The facade part of the two-story school building located in the Rishton district was insulated with special heat protection plates with high fire resistance, and the floor part was insulated with special mineral fibre cotton plates. A new 39th school was built and commissioned in the Kurgantepa district of the Andijan region.

The United Nations Development Program, the Global Ecological Fund and the State Architecture and Construction Committee (now the Ministry of Construction) built, repaired and reconstructed the buildings of the social housing fund in different regions of the republic within the scope of the project "Improving the energy efficiency of social buildings in Uzbekistan", in which is testing the practice of using modern construction technologies.

Conclusion

In conclusion, any buildings designed in a dry hot climate require that their architectural-structural solution be resistant to external influences in accordance with climatic parameters. Climatic indicators indicate the need to take into account the climatic effects and specific aspects of this area when designing buildings.

As a result of the use of energy-saving measures, the potential of saving energy resources is 7.2 billion per year. and the fact that it can form a cubic meter of gas is a sign that there is still a lot of work to be done in the field.

The heat-technical calculations carried out on the annual relative heat loss in the barrier structures show that the implementation of energy efficiency measures (options for thermal insulation of wall, roof, and basement structures) during the heating season will reduce the total heat loss from the building. 56% reduction in hardness can be achieved.

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