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ХАЛЫҚАРАЛЫҚ ҒЫЛЫМИ-ТӘЖІРИБЕЛІК КОНФЕРЕНЦИЯСЫНЫҢ

ЕҢБЕКТЕР ЖИНАҒЫ

СБОРНИК ТРУДОВ

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ENERGY SAVING OF BUILDINGS IS AN IMPORTANT ISSUE IN MODERN CONSTRUCTION

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In support of measures to ensure energy conservation at the state level, several dozen regulatory acts, methodological and program documents have been adopted. In addition to regulatory documents, a number of state standards are in force in the Republic of Kazakhstan.

The problem of energy conservation is an important part of the socio-economic policy of the state. On January 13, 2012, the Law of the Republic of Kazakhstan "On Energy Saving and Energy Efficiency Improvement" was approved. Special attention is paid to the energy efficiency of buildings and structures, since there are territories in the republic where the heating season reaches more than 200 days a year. The most stringent requirements for the efficient use of thermal energy are imposed on residential buildings and structures. The specific energy consumption of residential buildings in Kazakhstan (130 Wh/m2· per year) is significantly higher than in foreign countries. The thermal protection of a heated building is one of the most important operational criteria for assessing its quality, since the favorable microclimate of buildings, heat losses in winter, and the temperature of the inner surface of the fence depend on it. This characteristic determines the costs of heating the premises and maintaining a normative microclimate in them.

The main purpose of the Law of the Republic of Kazakhstan "On energy eaving and energy efficiency emprovement" is to systematically streamline the actively developing processes of regulatory and methodological support of energy saving at the state level using principles that take into account market conditions of management.

The Law establishes the basic concepts, principles, goals and subjects of activity in the field of regulatory and methodological support of energy conservation, the composition and purpose of the fundamental regulatory, methodological documents and applies to activities related to the efficient use of fuel and energy resources, energy-consuming facilities (installations, equipment, products of industrial and technical and household purposes), technological processes, works, services [1].

If the temperature in a solid, a stationary liquid or a gas is not the same at different points, then, as experience shows, heat is spontaneously transferred from areas of the body with a higher temperature to areas with a lower temperature. As already mentioned, this process is called thermal conductivity. Energy transfer is carried out due to thermal motion and energy interaction between microparticles (molecules, atoms, electrons), of which this body consists. At the same time, there is a change in body temperature, both in space and in time. The study of thermal conductivity is reduced to finding a spatio-temporal temperature change, that is, to solving an equation of the form:

$$t = f(x, y, z, \tau) \qquad (1)$$

This equation is a mathematical expression of the temperature field. Thus, the temperature field is a set of temperature values at all points of space for each moment of time. The temperature can be a function of one, two or three coordinates. Accordingly, the temperature field is called one-, two- and three-dimensional [2].

Currently, architecture and construction are entering a new stage of their development, associated with an increase in the thermal efficiency of buildings [3,4]. Work on improving thermal efficiency is developing, on the one hand, taking into account previous achievements in energy saving in the construction industry, and on the other hand, the latest innovative energy-saving solutions are used in heating and air conditioning systems of buildings [5-8].

The need for energy saving in the construction industry is related to the following circumstances:

• the volume of construction is increasing, and therefore the consumption of energy resources is increasing;

• of particular importance is the problem of environmental safety - reducing environmental pollution as a result of fuel combustion;

• the cost of energy resources is increasing;

• the task of expedient use of non-renewable energy resources as raw materials for industry is set;

• in addition, the task is to preserve resources in the aspect of protecting the interests of future generations.

There are three stages in the development of the concept of "energy saving" in the construction industry. After the first energy crisis at the end of 1973, the term "energy saving" meant the search for the simplest ways to reduce energy consumption for heat supply and air conditioning of buildings. In the early 1990s, this term implied the choice of such energy-saving technologies that simultaneously contributed to improving the quality of indoor microclimate. Currently, the term "energy saving" is associated with the concept of "sustainable building", that is, with the construction of buildings that provide high quality human habitat, environmental safety, preservation of the natural environment, optimal consumption of renewable energy sources and the possibility of reuse of building materials and water resources.

At the same time, the introduction of energy-saving solutions in mass construction should be economically justified. Otherwise, the investor will not be interested in investing in energy saving in buildings. In this regard, there is a need for a methodology that allows evaluating the effectiveness of energy-saving measures from an economic perspective. In addition, there is a need to identify the most promising low-cost ways to increase thermal efficiency for modern construction and, first of all, during the reconstruction of existing buildings.

The mass implementation of energy-saving measures in newly constructed and reconstructed buildings is mainly hindered by the following circumstances:

1. Lack of economic interest among investors, designers and equipment manufacturers in additional investments in energy saving facilities of buildings.

2. Lack of a scientifically based methodology for assessing the feasibility of implementing measures to improve the thermal efficiency of buildings.

3. The need to improve the existing regulatory framework to ensure the efficient use of energy resources.

It should be noted about the promising tasks that allow to ensure energy saving:

1. Determination of the most effective energy-saving measures in heat supply and air conditioning systems of buildings, characteristic of the current stage of development of the construction industry:

• a change in the district heating scheme associated with the abandonment of the use of central heating points (CTP) and the introduction of individual heating points (ITP), as a result of which it becomes possible to regulate and account for heat consumption at each specific facility;

• regulation of heat energy consumption on a separate heating device, taking into account the actual thermal balance of the room;

• the use of periodic ("intermittent") heating is the lowering of the internal air temperature below the standard value during part of the day, allowed in a number of buildings (schools, theaters, etc.);

• reduction of energy costs for heating ventilation air while improving the quality of the microclimate through the use of new ventilation systems.

2. Development of a methodology for the technical and economic assessment of energy–saving measures (hereinafter referred to as the Methodology), taking into account various mechanisms for the use of incomes in the future:

• when discounting (if additional income received as a result of investments in energy-saving measures is used as working capital);

• when increasing (capitalization - if the additional income received as a result of investments in energy-saving measures is used in the form of "portfolio" investments).

It should be noted that the Methodology should take into account the need for reliable forecasting of the dynamics of changes in the cost of thermal energy and the discount rate during the entire life of the energy-saving event. In turn, the use of this technique will allow:

• to compare different options for energy-saving solutions from an economic standpoint;

• to make the choice of the most effective solution in this sense;

• conduct an economic comparison of investments in energy-saving measures with alternative ways of using the investor's funds.

3. To establish the possibility of switching from a centralized heating point (CTP) to heat supply systems with an individual heating point (ITP) and solving a number of important practical issues:

– reduction of thermal energy consumption;

– reduce capital expenditures on the heat supply system by reducing the number of intra-block pipelines, eliminating the TTP and replacing the sectional wiring of heating pipelines in buildings by 25-30 %.

– equipping of heating devices with individual automatic heat flow regulators (thermostats) allowing to reduce the consumption of thermal energy for heating by 10-20 %;

– individual auto-regulation of heat transfer of heating devices should be supplemented with auto-regulation of heat supply for heating at the entrance to the building, including front-facing. By automatically regulating the supply of thermal energy for heating, heat savings of 15% and above of annual consumption are ensured;

– complex equipment of the heating system not only with individual thermostats, but also with regulators at the source of thermal energy or in the ITP, which will allow saving thermal energy for heating up to 25-35 %.

– minimization of energy costs for heating rooms, taking into account the performance of heating rooms both with the use of maximum power of heating equipment, and with the heating of the most heat-intensive parts of the room.

– the use of hygroregulated supply devices in areas with severe climatic conditions (Astana, Petropavl, Karagandy, Zhezkazgan, etc.), which allows to reduce the cost of thermal energy for heating and ventilation of a multi-storey residential building;

– a 20-30% reduction in the cost of thermal energy for heating and ventilation during the heating period when the building is equipped with mechanical supply and exhaust ventilation with individual apartment-by-apartment heat exchangers.

In order to effectively solve the problems of energy saving and choosing the right ways, it is necessary to develop a methodology for economic comparison of investments in energy-saving measures and alternative ways of using investor funds, taking into account the fact that in modern conditions, in the process of deciding on the direction of funds, investors consider several options for capital investments, physical (introduction of energy-saving measures) and "portfolio" (various types of "lending" money at interest).

The proposed methodology will allow comparing these capital investment options according to the degree of profitability. To make such a comparison, it is necessary to compile normative reference indicators.

To perform calculations of the economic efficiency of energy-saving measures, it is planned to select an experimental object, for example, a multi-storey residential building. Perform a detailed analysis of energy saving, which will confirm the practical applicability of the methodology of economic comparison of investments in energy-saving measures.

When developing energy saving measures or conducting an energy audit, the parameters of all elements of heating, ventilation and air conditioning systems and their design characteristics are determined from the building project. It is also necessary to clarify the annual operating mode of control systems and measurement of air parameters. The design load of ventilation and air conditioning units is determined from the project of the enterprise or organization. In the absence of such data, it can be determined by analytical methods taking into account the external and internal volume of buildings, specific ventilation characteristics and air temperature inside and outside the

building. The main characteristics that should be determined during the inspection of ventilation systems are: the actual load factors, the operating time of the installations during the day, the indoor air temperature and the average outdoor air temperature, the multiplicity of air exchange.

Energy saving measures in heating, ventilation and air conditioning systems are as follows.

1. The use of economically feasible heat transfer resistance of external fences during construction and additional insulation of external walls during the reconstruction of buildings. The event is intended to increase the heat transfer resistance of the exterior walls and reduce the heat losses of the building by improving its heat-shielding properties and the use of effective thermal insulation materials.

2. The device of ventilated exterior walls. The event is intended to increase the level of thermal protection of external walls.

3. Thermal protection of the outer wall at the place of installation of the heating device. The event is designed to reduce heat losses from external fences (walls) to which heating devices are adjacent.

4. The device of ventilated windows. The event is designed to reduce air permeability and increase the heat transfer resistance of window blocks.

5. Installation of additional (triple) glazing. The event is designed to reduce air permeability and increase the heat transfer resistance of window blocks

6. The use of heat-absorbing and heat-reflecting glazing. The event is designed to reduce heat access to the premises from solar radiation, which leads to comfort in the premises.

7. The device of glazed loggias. The event is designed to reduce the consumption of outside cold air penetrating into the room in winter and increase the temperature in the loggia (behind the outer wall of the room). It is necessary to produce a thermal balance of buildings and structures, which allows you to establish a relationship between heat losses and the amount of heat released by various sources inside buildings and structures.

In general, the compilation of thermal balances allows you to determine the efficiency of the installation, the consumption of fuel or electricity to produce a unit of thermal energy, the consumption of steam (or other coolant) to produce a single product. The heat balance is a ratio linking the arrival and consumption of heat and is made up per unit of output, per 1 kg of solid or liquid fuel, per 1 m3 of gaseous fuel or as a percentage of the introduced (total) available heat. The information obtained about the thermal balance of an organization or enterprise is used to study either an individual object or the organization as a whole. [2].

References

1. Law of the Republic of Kazakhstan "On energy eaving and energy efficiency improvement"

2. Пилипенко Н.В., Сиваков И.А. Энергосбережение и повышение энергетической эффективности инженерных систем и сетей. Учебное пособие. – СПб: НИУ ИТМО, 2013 – 274 с.

3. Кувшинов Ю.Я. Оптимальные параметры теплозащиты жилых и общественных зданий. В сб.трудов МИСИ «Оптимизация систем отопления, вентиляции, кондиционирования воздуха и теплогазоснабжения». – М.: 1980, №176.

4. Грудзинский М.М., Ливчак В.И. Эффективность группового автоматического регулирования расхода теплоты на отопление с коррекцией по температуре внутреннего воздуха. // Теплоэнергетика. – 1983.-№8. – С. 20-28.

5. Денисов П.П. Показатель влияния объемно-планировочного решения здания на расход тепла. //Жилищное строительство. – 1981. – № 1.

6. Journal of Research of the National Bureau of Standards, 1977, vol. 02, №2, p. 123-135.

7. City Hall in London: Schief gewickelt. // IntelligenteArchitektur. – 2003. № 3-4. – С. 22-35.

8. Jardinier M. Demand controlled ventilation: conciliating indoor air quality and energy savings. The 5-th International Conference of Cold Climate Heating, Ventilation and Air-Conditioning, Moscow, Russia, May 21-24, 2006 // Moscow, ABOK-Press, 2006.