# APPLICATION OF ENERGY-SAVING PRODUCTS IN RESIDENTIAL AND PUBLIC BUILDINGS OF UZBEKISTAN

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## ANNOTATION

The article provides information on the use of light structural and heat-insulating building materials and products based on them for the conditions of the Republic of Uzbekistan. The data on the physical and technical characteristics and on the comparative characteristics of wall building materials are given. The article also discusses the research of a number of authors on the need to use available high-performance thermal insulation materials to meet the requirements for energy-saving products used in new and reconstructed residential and public buildings.

**Keywords:** energy saving, heat loss, resource saving, thermal protection, heat resistance, sound insulation, energy intensity, deformability.

## INTRODUCTION

In capital construction, one of the most important areas in Uzbekistan has become energy and resource saving, since about half of the consumed fuel and energy resources are spent on the consumption and needs of the construction complex. According to static data, 90% of energy consumption in the building complex is spent on heating and air conditioning, 10% on the production of building materials and products, and 2% on construction [1].

It should be noted that most of the heat is spent on heating and air conditioning, as well as to compensate for heat losses, which is due to the following reasons [2]:

- Infiltration of heated air (up to 40%);
- Unregulated mode of operation of heating and hot water supply systems (up to 30%);
- Insufficient value of resistance to heat transfer of enclosing structures (up to 30%).

Studies by a number of authors show [3,4] that the reduction of an unreasonably large amount of energy consumption during the operation of construction sites is closely related to the introduction of new standards for thermal protection of buildings, which provide for a significant increase in the requirements for their thermal insulation in the cold and hot seasons. This means that there is a need to move from sanitary-hygienic and comfortable criteria for the thermal insulation of buildings to economic ones. In solving this problem, a special place is given to the reconstruction of operated residential and public buildings, the thermal performance of the enclosing elements of which do not meet modern requirements. Such reconstruction requires a significant expenditure of material and labor resources. In this regard, thermal protection work should be carried out after a feasibility study, and on the basis of these data, the development of a reconstruction project should be carried out. The design decision is made as a result of preliminary calculations, taking into account the experience in building practice of improving thermal protection, as well as the technological features of the work of each object.

Reconstruction of an object is most convenient and profitable when the building has a flexible space-planning scheme. In this regard, the reinforced concrete frame as the supporting frame of the building is the most optimal structural system, which allows, if necessary, to change the internal layout of the building, as well as to change the architecture of the facade beyond recognition.

A significant influence on the specific heat loss in residential and public buildings is exerted by their space-planning solutions, which make it possible to reduce heat gains into buildings in the summer and heat losses in the winter season. An analysis of the historical experience in Uzbekistan shows that great attention was paid to the creation of a favorable microclimate. The most striking expression of this was found in public housing, residential buildings had a predominantly southern orientation. Small window openings in the summer were protected by shutters, which greatly reduced the flow of radiative heat. And during the hottest hours of the day, the sun's rays absolutely did not fall into the premises. And in the winter period of the year, when the sun deviates much lower from the zenith, direct sunlight hits and the thermal regime in residential premises improves markedly. The creation of a rational ventilation regime and the arrangement of kitchens not connected with living rooms significantly reduced operational heat emissions. The outer walls had a large thickness (pakhsovye - 70-100 cm thick) and the roofs were also combined, multi-layered (reed layer - up to 20 cm or more; soil layer - 20 cm and clay mortar with adobe - 5-10 cm), with a total thickness of up to 70 cm. In general, they had a large heat capacity, significant heat resistance.

In modern multi-storey residential buildings, the situation is a little different. Designers are unable to deviate from the established design schemes with loggias located in front of the light front of the apartments. At the same time, loggias interfere with natural aeration, and thus ventilation in residential premises is much worse. And the illumination in them is a second light. In such buildings, in all rooms, except for those located on the ground floor and under the moistening action of the soil, an unfavorable heat and moisture regime is created. In addition, wall structures with increased average density and high thermal conductivity make it difficult to combat overheating in flight. Hence there is a need to develop new design solutions that meet local climatic conditions. A huge role in this is given to the design of external enclosing structures: walls, coatings, window fillings, floors of the lower floors. Heat, air and moisture are transferred through the enclosing structures.

The following requirements are imposed on external enclosing structures: a high level of thermal protection in the cold season, a high level of heat resistance in the warm season. In addition, they are subject to such requirements as low energy consumption of the inner layers during fluctuations in the heat flow inside the room, a high degree of airtightness, low moisture absorption, etc.

With the rapid development of industrial housing construction in the 60-80s of the last century, the construction of residential buildings was carried out in large-scale large-panel, standard series. House-building factories produced one, two and three-layer external wall panels, which had their own advantages and disadvantages.

Single-layer panels are the easiest to manufacture. Such panels, as a rule, have a heterogeneous structure both in plan and in cross section. If in terms of the panel this factor is random, then in terms of thickness it is inevitable. In lightweight concrete, the inhomogeneity of density over the panel cross section is explained by the low density of expanded clay, which tends to float up when vibrating, despite the weight. And the binder (cement mortar), on the contrary, due to its gravity, settles down and as a result, the phenomenon of stratification of the structure occurs. To increase the thermal resistance of single-layer panels, one should not increase their thickness, but improve the uniformity of the structure. Single-layer structures give moisture not only outside, but also into the room. As a result, the humidity in the room rises and creates an uncomfortable condition.

Two-layer wall panels consist of a bearing reinforced layer of dense lightweight or heavy concrete and an insulating layer of heat-insulating lightweight or cellular concrete or rigid insulation boards. The heat-insulating layer can be located both on the inside of the fence and on the outside. The most favorable mode of the premises is provided by two-layer panels with weather-resistant insulation located outside. They also have good internal heat resistance in conditions of flight overheating.

Three-layer panels consist of two outer reinforced concrete layers and insulation between them. As a heater, heat-insulating materials with various disadvantages are used. Mineral wool slabs, along with such positive properties as an exceptionally low thermal conductivity coefficient (about 0.04 kcal / m.h deg), low average density (100 kg / m ^ 3), negligible moisture content, have significant drawbacks, which in some cases negate their positive qualities: sedimentation of mineral wool, deterioration of heat-shielding properties in the manufacture of plates; high deformability of mineral wool products, which complicates the manufacturing technology of panels; the need for a device in the structural layers of stiffeners, which are "cold bridges". Improvement in the design of three-layer panels consisted in replacing the ribs with dowels, soft mineral wool insulation with polystyrene foam and thickening the inner bearing layer, which contributes to a more uniform temperature distribution on the inner surface of the wall [5]. Three-layer panels with solid foam or aerated concrete insulation have the significant advantage that with the correct shape of such lightweight concrete inserts, the second reinforced concrete slab has a good base for molding. The main disadvantages of three-layer panels were the low use of the strength properties of the outer reinforced concrete layers; decrease in the heat-shielding properties of the walls, in some cases in these panels the formation of "cold bridges" at the points of contact of reinforced concrete ribs; the need for careful sealing of the outer mouths of the seams.

When designing frame public and industrial buildings, light hinged wall panels are used. Such panels have good thermal performance, but only if a high culture of their production is ensured.

They must be manufactured in special factories using special conductors. The panels must be completely finished, which provides them with a degree of factory readiness of about 90-95%.
Such panels also have significant disadvantages. The scope of walls made of hinged panels with asbestos-cement sheathing is mainly limited to rooms with dry and normal temperature and humidity conditions. Panels with sheathing made of steel or aluminum profiled decking are poorly protected from mechanical stress, in addition, they are practically vapor permeable, have lower thermal inertia, lower sound insulation from airborne noise compared to brick walls, which reduces the level of comfort inside the building.
In the late 1980s and early 1990s, there was a sharp decline in the production of products at large-panel factories and volumetric block housing construction everywhere in the republic. In particular, during this period, four large-panel housing construction plants ceased to exist for various objective and subjective reasons. Monolithic construction with a frame structural scheme filled with piece materials, as well as buildings with brick walls with reinforced concrete vertical and horizontal load-bearing elements, the so-called complex structures, have received great development. Traditionally used wall structures made of brickwork 380 mm thick have indicators of heat transfer resistance far from meeting the requirements of modern design standards [3,6]. In this regard, in the design of residential and public buildings, new energy-efficient materials with increased heat resistance are being introduced, as well as effective designs of multilayer walls.
The company "Korizh Kurilish Tekhnologiyasi" manufactures a wide range of light structural and heat-insulating building materials and products of building structures and products based on them for the conditions of the Republic of Uzbekistan. The company produces foam concrete according to German technology and German equipment, which is an effective heat-insulating material, environmentally friendly products with high heat and noise protective qualities. Produced foam concrete and foam concentrate have a quality certificate [7]. The main physical and mechanical properties of foam concrete are given in table 1.

Table 1 Physical and technical characteristics of foam concrete

| Characteristics | Ед. изм | Foam concrete | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Average dry sample density | kg/m^3 | 400 | 600 | 800 | 1000 | 1200 | 1400 | 1600 |
| Dry thermal conductivity | VT/m ^0 C | 0,12 | 0,15 | 0,18 | 0,25 | 0,34 | 0,44 | 0,52 |
| Acoustic performance at 200 mm wall thickness | Db | - | 40 | 42 | 46 | 49 | 51 | 54 |
| Water absorption | % | - | 10,5 | 8,5 | 6,6 | 5,4 | 3,8 | 3,0 |
| Compressive strength | kg/sm ^3 | 5 | 15 | 25 | 50 | 75 | 100 | 125 |
| Frost resistance at least 25 cycles | | Not destroyed | | | | | | |
| fire resistance | min | 120 | 120 | 120 | 120 | 120 | 120 | 120 |

The walls of buildings made of foam concrete have a coefficient of thermal conductivity 3.5 times less than walls made of ordinary brick. Comparative characteristics of wall building materials are given in table **2.**

Table-2 Comparative characteristics of wall building materials

| Materials | Density kg/m^3 | Thermal conductivity VT/m$^0$S | Heat transfer coefficient | Weight m^2 wall for a given material |
|---|---|---|---|---|
| foam concrete | 800 | 0,2 | 0,82 | 245 |
| Ceramic brick | 1600 | 0,7 | 2,03 | 230 |
| silicate brick | 1800 | 0,9 | 1,77 | 1280 |
| cinder blocks | 1400 | 0,7 | 2,05 | 680 |
| Expanded clay concrete blocks | 1250 | 0,7 | 2,04 | 620 |
| Heavy concrete blocks | 2400 | 1,5 | 4,92 | 1060 |

The data presented in Table 2 indicate that there is a need to use available high-performance thermal insulation materials to meet the requirements for energy-saving products used in new and renovated residential and public buildings.

Most of the buildings are already existing developments, and their reconstruction represents a great reserve in energy saving using highly efficient thermal insulation materials.

It is necessary to develop new existing building codes and regulations to ensure a phased transition in energy consumption in newly built and reconstructed buildings.

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