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Analysis of Underground Projects of Energy-Efficient Residential Buildings

Matyokubov Bobur Pulatovich

Samarkand State Institute of Architecture and Construction, Uzbekistan

Abstract:
It is well known that energy saving in modern housing and housing sector remains an urgent problem. The main direction of comprehensive programs developed in this area is the development and application of energy-saving architectural solutions in buildings, as well as increasing the level of their thermal protection.Evidence suggests that doing this research is a requirement of the day, with the goal of developing constructive solutions for thermal insulation of basement walls and "increasing the energy efficiency of the basement of residential buildings".

Keywords:
Air humidity, building material surface temperature, dew point, condensation humidity, relative humidity.

1. Introduction. Research on lyoss soils in Central Asia has been going on for a long time. However, these works were mainly descriptive in nature. However, in connection with the rapid development of construction in the lyoss soils of Central Asia, regular fundamental research on lyoss soils is carried out. Lyoss gruts are found in a low-bonded, vigorous, sometimes scattered state. The degree of salinity in them depends on the amount of water-soluble salts in dry soils. Chemical analysis of such soils showed that the gravity of water shells surrounding solid rocks is 1600-11560 mg / kg, their ions - 180-1410, and sulfates - 620-2530 mg / kg.

Since the content of water-soluble salts in lyoss soils does not exceed 11-12%, they cannot be included in the category of sandy rocks. However, they can have a very detrimental effect on concrete.

These soils are widespread in populated areas of Uzbekistan. Especially in the ancient cities: Samarkand, Bukhara, Khiva, Shakhrisabz, Tashkent, Andijan, Fergana, Quqon and others, their folds are 20-30 m.

Lyoss soils (yellow or healthy soil) - also belongs to the group of glina-soils, which consists of small-grained and very porous rocks of yellowish color. It contains a lot of dust particles. The lyoss will have large pores that can be seen with the naked eye. The total porosity of Lyoss soils is up to 70%. The porosity of lyoss soils in the Central Asian region, R.H. According to Rasulov the following varieties differ from each other. The origin of the porosity of lyoss soils is limited by the presence of digging insects, usually due to the origin of large plants with a cylindrical channel appearance. The porosity between the aggregates of dust particles is formed due to the mutual crystallization and cementation of the substances.Porosity is caused by insufficient compaction of the particles of the bulk of the soil. These porosities are best seen when the soil structure is enlarged 30-70 times. Porosity is formed as a result of moisture drying between aggregates (the set of minerals that make up

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the rock) and inside the aggregate. The classification of lyos soils by porosity has been proposed by various researchers (Mavlyanov G.A., Mustafaev A.A., Rasulov Kh.Z.). Lyos soils contain a lot of salts. In desert regions, the content of calcium carbonate salts in lyos soils ranges from 2% to 17.5%. In addition to salts, the mass of lyos soils in the southern regions contains a small amount of gypsum. In desert areas, the amount of gypsum in lyos soils is 0.2%. In arid deserts, the gypsum content in lyos soils is 1.2-1.4%. The content of readily soluble salts in lyos soils increases from 0.2% in forests to 0.92% in deserts.

The effect of water on the structure of lyos soils is predominantly of an absorption nature and causes the penetration of water molecules into the interconnected places of particles, the appearance of luminous intensity and connection in them. As a result of such complex physical and mechanical interactions, the soil undergoes large deformation under the influence of a compressive pressure of a certain magnitude, called superabsorption. Therefore, very submerged soils have a different compression curve: the value of its porosity coefficient changes sharply and abruptly under the influence of constant compressive forces and wetting.

2. The main part. The use of energy-efficient, that is, heat-retaining materials, is a direct and correct way to reduce energy consumption. A lot of energy is stored in every home and every organization in our country.

We all know that the materials used as thermal insulation are the main mechanism for energy conservation. In the recent past, it was possible to calculate the types of thermal insulation materials on the one hand. For walls made of light bricks in large-panel construction, expanded clay, slag-like cast materials, lightweight or foam concrete, fiberboard, mineral wool, foam concrete slabs were used. Today, with the help of modern technologies, it is possible to produce highly economical and efficient thermal insulation materials with innovative properties.

Most of the underground external barrier structures also serve the load-bearing function in buildings. Therefore, they are usually made of dense, durable, but heat-conducting materials. Such constructions use materials that perform both load-bearing and thermal insulation functions. With their help, it is almost impossible to meet the heat-saving requirements imposed on the underground external barrier structures of some buildings. The main way to solve this problem is to divide the external barrier structures into different functions, ie load-bearing and thermal insulation layers, making them multi-layered, which has found its place in construction practice.

The long-term durability, thermal and physical-mechanical properties of thermal insulation materials are influenced by factors in the operation of the structures in which they are used. These factors include:

- variable heat and humidity conditions of structures;
- moisture absorption of the heat-insulating material in the structure due to capillary rise and diffusion of moisture;
- the effect of mechanical loads from its own weight.

Taking into account these factors, the following basic requirements are set for thermal insulation materials used to increase the energy efficiency of buildings:

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- thermal insulation material provides sufficient resistance to heat transfer when the thickness of the structure is minimal;
- the vapor permeability of the material must be such that there is no possibility of moisture accumulation in the structure during operation;
- no large load on the load-bearing structures from the thermal insulation layer;
- be strong;
- resistant to frost and high temperatures;
- waterproof (hydrophobic) and water resistant;
- be resistant to biological influences and do not emit toxic fumes when burned.

According to the type of main raw material, thermal insulation materials are divided into inorganic and organic materials.

Thermal insulation materials by density: ultra-light (OL) with grades D15, 25, 35, 50, 75 and 100; light (L) with marks D125, 150, 175, 200, 225, 250, 300 and 350; are divided into heavy (T) brands with grades D400, 450, 500 and 600.

Depending on their stiffness (relative deformation), they distinguish five types of insulating materials, namely soft (M), semi-stiff (P), sturdy (J) and high-stiffness (PJ) and hard (T). For soft materials, the compression should not exceed 30%, the half-strength should be 6 ... 30% and the hardness should be 6%. When the specific load is 40 kPa and 100 kPa, the relative compressive strength of high-strength and rigid insulating materials is not required to exceed 10%.

Table 1.1: Thermal conductivity class of materials..

Material class mark	Material class	Thermal conductivity, Wт/(м°C), +25^{0}C
A	Thermal conductivity is low	0,058
Б	Thermal conductivity is average	0,058...0,116
B	High thermal conductivity	0,116...0,15

Insulation materials are also divided into thermal conductivity classes (table 1.1).

Another widely used thermal insulation material in construction is foam glass, which is obtained by firing glass powder with gas-forming additives (e.g. dolomite, anthracite, dry matter).The cage will be hollow. Its voidness also reaches 80-95%. Thus, the thermal insulation properties are good. The thermal conductivity of different sources is set in different ways.

The foam is easy to pierce, flatten and process in a variety of ways. They adhere well to other structures using a variety of organic adhesives and silicate binders.

Its special advantages are the strength of the foam in comparison with other heat-insulating materials (2 ... 6 MPa), water resistance, incombustibility, frost resistance, ease of processing, practically unlimited service life, resistance to biological influences, chemical neutrality. ...

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The disadvantage is that it is more expensive than other materials, does not have the ability to temporarily accumulate moisture, that is, in the language of builders, "does not breathe."

Various heat-insulating materials are obtained on the basis of liquid glass by heating or vibration by adding special chemicals to the raw materials. These include materials such as glass silicate, glass phosphogel, glass cement, glass fiber, foam, urea, polyurethane foam. They differ from each other in the type of binder. Information about some heat-insulating materials obtained on the basis of water glass is given in table 1.2.

When choosing a material for thermal insulation, it is recommended to take as lightweight as possible. This is due to the fact that the loads from all layers associated with the installation of additional thermal insulation on the foundations of the building can be much higher, especially in multi-storey buildings.

Table 1.2**:** Thermal conductivity of cast (monolithic) thermal insulation materials based on liquid glass

Name	Density, кг/м^3	Thermal conductivity,
Glass bitumen	120-200	0,05-0,07
Glass-silicate	80-200	0,05-0,07
Glass cement	120-200	0,07-0,1
Glass-polymer	70-110	0,04-0,05

Monolithic thermal insulation materials also include asbominvata (asbestos-based mineral wool). Such materials are usually glued to the wall surface by spraying using special mechanisms and devices. Monolithic thermal insulation materials must consist of an adhesive. For example, asbestos-containing asbestos K -YI -30 - 42%, mineral wool (cotton) - 17%, aqueous solution of potassium liquid 60% - 41%. Consumption of components per 1 m3 of such material is as follows: asbestos K-YI-30-120-130 kg; mineral wool - 50-55 kg; 60% solution of potassium liquid glass in water - 125-130 kg or 80 kg of M400 cement and 50 l of water. Its technical characteristics - density - 285–315 kg/m^3, thermal conductivity =0,07

Due to the fact that raw materials for heat-insulating materials, such as crushed perlite, vermiculite, crushed igneous rocks formed as a result of volcanoes, are not available in Uzbekistan, they are practically not used in our construction and reconstruction.

Another large group of modern thermal insulation materials is polystyrene foam. There are the following main types:

1. Thermoplastics (softened when reheated):

- expanded polystyrene (PS);
- foamed polyvinyl chloride (PVC).

2. Notermoplast (hardens after the first heating period, does not soften when heated again):

- polyurethane foam (PU);
- phenol formaldehyde (FF), epoxy (E) and silicon-organic resins (K).

Of these, expanded polystyrene is the most common. They can be prepared in two ways: pressed (PS) or non-pressed (PSB). The design consists of tiny balls that stick together. Foam

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plastics have sufficient strength, high thermal insulation properties, low moisture absorption, relatively inexpensive, easy to use, the lower temperature limit has not been established. The disadvantage is that moisture can get into them and the structure can be damaged when freezing at low temperatures or under the influence of sunlight, is a combustible material, "does not breathe", i.e. does not have the ability to temporarily accumulate moisture.

Polyurethane foam is produced by the reaction of liquid components consisting of isocyanate and polyol. As a result of the reaction, air-filled microcapsules are formed. Such materials can be laid on uneven surfaces with additional thermal insulation, which creates a continuous layer, no seams, saves installation time, they can be used in the temperature range from -250 ° C to +180 ° C, resistant to biological influences, microorganisms, corrosion, non-corrosive, high elasticity.

It should be noted that polyurethane foam is flammable, combustion products are toxic, it is necessary to take measures to protect such a layer in the structure from the effects of fire.

Another insulating material belonging to this group is extruded polystyrene foam, which is processed using an extruder. This material has a solid, one-piece microstructure with a closed cell filled with air or gas. Cells are impermeable, gas or air does not pass from one cell to another. Polyurethane foam is the most durable, least waterproof, resistant to solar radiation and atmospheric precipitation, low heat transfer, does not react with many chemicals, non-toxic.

3. The final part. Improving the energy efficiency of buildings has become a requirement of the times. Improving the energy efficiency not only in newly designed and under construction buildings, but also in buildings built in previous years on the basis of the requirements of that period is an integral part of this topical issue.

The analysis conducted in the framework of this article shows that most of the materials that are considered effective as additional thermal insulation applied to the external barrier structures of buildings are products manufactured in special factories. There have been many positive comments about how they work in the construction.

In order to increase energy efficiency, the pros and cons of installing additional thermal insulation of the outer walls of buildings from the room and outside were analyzed. It is thought that the thermal insulation installed from the inside has a negative effect on the temperature and humidity regime of the external barrier structure. However, depending on the climate, the working environment in the building or room, the operational characteristics of the structures, including the humidity regime, there is almost no information about the degree of these effects.

4. Conclusion. This article discusses one of the most important issues today - the construction of underground structures of the building, their protection from freezing, waterproofing and insulation. Improving the thermal protection of residential and public buildings in order to save fuel and energy resources and reduce operating costs for heating is an urgent problem of construction. The solution to this problem can be achieved primarily through the use of structures covered with a layer of thermal insulation with high resistance to heat transfer of walls, basement walls and attic coverings.

The physical and mechanical properties of sedimentary soils, as shown above, change dramatically when wet, i.e. in the process: the strength characteristics of the soil (the angle of

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internal friction by 1.5-2 times and the viscosity s by 10 times) are significantly reduced by several times. , which leads to a sharp decrease in the bearing capacity of soils.

The results of monitoring the deformation of low-rise residential buildings in subsoil, compared with the results of calculating the deformation of these soils, with existing methods of calculating the deformation of the foundations of low-rise residential buildings, do not allow to determine the final value of foundation deformation with sufficient accuracy. the change in its deformation characteristics as it changes over time was not taken into account.

In order to increase energy efficiency, insufficient consideration of the requirements for the humidity regime of underground structures with additional thermal insulation of buildings and failure to analyze or misinterpret the operating conditions of such structures, failure to quantitatively and qualitatively assess operational requirements, often construction and causes problems that arise in the practice of operating facilities.

In increasing the energy efficiency of the outer walls of buildings, ie in the choice of material for thermal insulation, attention should also be paid to their performance under the influence of loads, heat retention properties and humidity regime.

When additional thermal insulation is installed inside and outside the concrete exterior wall structures of existing residential buildings, the temperature and humidity regime in the wall will change and depending on the methods used, it is important to determine the extent to which these changes occur in Uzbekistan.

Dividing the amount of energy used to heat a building into components, we see that about 1/3 of this energy is due to heat loss from external barrier structures. Conducting such an analysis for 2-storey buildings shows that, excluding the costs of hot water supply and heating of the exchanged air, the heat loss due to the underground part of the building is 10%.

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