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INCREASING THE THERMAL PROTECTION OF BUILDINGS

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Abstract:

One of the main requirements for building envelopes is maintaining a constant temperature inside the building. To create effective thermal insulation, special thermal insulation materials are used, which are characterized by low thermal conductivity and low density and are used for thermal insulation of building structures

Keywords: Thermal insulation materials, increased thermal protection, external enclosing structures, low ermal conductivity, wall insulation, material consumption, thermal characteristics.

When reconstructing, modernizing and overhauling buildings, it is necessary that the thermal characteristics of external enclosing structures be brought to the values determined by the requirements of KMK and ShNK for building heating engineering and current standards.

If necessary, determined on the basis of an instrumental-visual inspection report of the technical condition of buildings, the following should be carried out:

- work on additional thermal insulation of walls;
- additional insulation of the attic floor and above the basement;
- insulation of corners;
-sealing of panel joints and adjacent elements (eaves, balcony slabs, etc.)

Additional insulation options are assigned taking into account the actual values of the heat transfer resistance of structures, the required level of thermal protection, and the feasibility study of the selected additional insulation option.

During a full-scale examination of the thermophysical qualities of a building subject to reconstruction or repair, the reduced heat transfer resistance of the enclosing structures must be determined, taking into account the influence of joints, framing ribs and other heat-conducting inclusions in accordance with GOST, KMK and RSN

The value of economically feasible resistance to heat transfer of external walls and coatings using effective thermal insulation materials can be determined by the formula:

$$R_0^{Эк} = R_0^{Тр} \cdot r_{эф}$$

where: $R_0^{Тр}$ - the required heat transfer resistance of enclosing structures determined by the KMK formula, $\frac{М^2 \cdot ℃}{ВТ}$

$r_{эф}$ is the coefficient of thermal efficiency of enclosing structures, adopted for additional insulation.

The value of the reduced heat transfer resistance of the structure $R_0^{Пр}$ after reconstruction or repair should not be less than the economically feasible heat transfer resistance $R_0^{Эк}$

One of the main requirements for the enclosing structures of buildings and structures is maintaining a constant temperature inside the building. To achieve this, enclosing structures must conduct heat to a minimum extent. To create effective thermal insulation, special thermal insulation materials are used. They are characterized by low thermal conductivity and low density and are used for thermal insulation of building structures.

Additional insulation of walls should be carried out, as a rule, from the outside.

It is allowed to insulate single-layer walls from the room side with a slight deficit in heat transfer resistance (10-15%), mainly only in corners, panel joints and at the junction of ceilings, cornice and balcony slabs.

Thermal insulation materials are characterized by low thermal conductivity and low density; they are used for thermal insulation of building structures in order to reduce heat losses to the environment. Such materials have a porous structure and have a low average density ($\gamma_0 = 150 \div 600 kg/m^3$) and low thermal conductivity ($\lambda_0 = 0.027\text{-}0.84$ W/m^2 C^0) Effective thermal insulation materials help reduce the material intensity of construction, reduce fuel consumption for heating and electricity for air conditioning buildings, which has great prospects and ensures seismic resistance and increases the energy efficiency of buildings.

Thermal insulation materials are classified according to the following main characteristics: by type of main raw material, shape and appearance, structure, density, rigidity, thermal conductivity and flammability. Based on the type of

raw materials, a distinction is made between inorganic (mineral and glass wool, foam glass, perlite, vermiculite, etc.) and organic (wood fiber, polystyrene foam, polyurethane foam, etc.).

Based on their shape and appearance, they can be divided into piece-hard (bricks, blocks, slabs, cylinders, segments, shells), rolled and corded (mats, strands), loose and loose (mineral wool, expanded perlite, vermiculite, etc.).

According to their structure, thermal insulation materials are classified as fibrous (mineral wool and glass wool), granular (perlite sand, expanded clay), cellular (foam concrete, foam glass, foam plastics, etc.)

Recently, a new term has appeared - energy-efficient (energy-saving) buildings, that is, during the design, construction and operation of which all possible measures (energy-saving measures) aimed at saving thermal and electrical energy were carried out.

Effective thermal insulation materials are of organic and inorganic origin, but throughout the world in construction, preference is given to thermal insulation materials - mineral wool and products made from it.

Mineral wool and products made from it rank first among all thermal insulation materials in terms of production volume, due to their good performance properties, unlimited raw material base and relative ease of production.

Mineral wool is a material that consists of thin glassy fibers obtained from molten rocks (limestones, marls, dolomites, basalts, granites, diorites, etc.)

Increased thermal protection depends on the type of thermal insulation materials used. A significant increase in the heat-insulating properties of only the external enclosing structures of residential buildings can reduce heat loss in buildings by 40-60% compared to traditional solutions of enclosing structures.

Effective thermal insulation materials can be of organic or inorganic origin. All over the world, preference is given to inorganic materials, namely mineral wool and products made from it. This is due to the fact that most organic materials, being the most effective both in terms of properties and energy intensity of production, are combustible, which limits their use.

Physico-mechanical properties of thermal insulation materials.

Table No. 1

No.	Thermal insulation materials	Density, ɣ kg/m ^{3}	Strength , MPa	Coefficient thermal conductivity , ƛ $_0$ W (M ^{0} C)	Vapor permeability, MPa	Recommen-dations for insulation
1 .	Mineral fiber boards	50-225	0.04-0.15	0.048-0.054	0.40-0.53	C shade, attic floors , multi-layer coverings of non-attic pitched roofs
2.	Foam glass	200-400	0.05-0.07	0.07-0.11	0.02-0.03	The scope is not limited
3.	Cellular (foam concrete)	300-600	0.5-2.0	0.08-0.14	0.17-0.26	The same, except for pitched roofs

Walls made of three-layer panels should be insulated only from the outside. To insulate the walls, a continuous layer of effective thermal insulation material is installed using:

- soft and semi-rigid mineral wool slabs followed by plastering over a metal mesh;
- wall cladding with rigid slabs of polystyrene foam or other materials.

The most effective way is to insulate walls using soft and semi-rigid slabs installed on the outside of the walls. The main achievement of this method is the ability to ensure a tight fit of the insulation. The slabs are placed on the pointed protrusions of the rods, and a metal mesh with an anti-corrosion coating is installed on top of the insulation layer. Soft and semi-rigid slabs with a thickness of at least 100 mm are used and then a plaster solution, which is applied by torquetting.

When insulating the outer surface of the walls with rigid polystyrene foam and mineral wool boards, they are glued to the concrete surface with adhesives based on PVA emulsion or epoxy resin.

Repair of single-layer expanded clay concrete walls from the inside is carried out:

- installing an additional layer of monolithic expanded clay concrete 50-70 mm thick or lining the inner surface of the panels with prefabricated expanded clay concrete slabs, 50 mm thick, followed by grouting the surface of the slabs with cement- sand mortar. The density of expanded clay concrete should be no more than 1200 kg/m ^{3}. Then a layer of lime-cement mortar (lime: cement: sand) is applied over a metal mesh, the thickness of the plaster layer is 30 mm.

Mineral wool and products made from it rank first among all thermal insulation materials in terms of production volume, due to its performance qualities, unlimited raw material base and relative simplicity of manufacturing technology.

Mineral products are produced by gluing fibers with various binders (synthetic resins, bitumen, starch) or, less commonly, by stitching mineral wool covered on both sides with paper. They produce flexible, rigid and semi-rigid mineral wool products.

The need for repairs may be caused by the following factors:

- weathering of brick or masonry mortar;
- formation of cracks in structures (for example, settlement of the foundation, lack of expansion joints);
- destruction of the heat-insulating layer.

Types of repairs to external walls can be classified as follows:

- surface repair;
-repair with insulation of enclosing structures;
-repair with dismantling of old structures;

Surface repair - it includes those types in which the existing structures are preserved, and the physical, mechanical and thermal physical properties of the external walls do not change significantly, namely: repairs of joints and seams are carried out; plastering or painting facades; applying a protective coating to concrete or plastered surfaces.

Repair with insulation of enclosing structures - it includes insulation of enclosing structures: concrete, brick and plastered external walls, which can significantly improve the thermal insulation properties of the walls, therefore the most important elements of the new external wall design are thermal insulation and protective and decorative layers. The thermal insulation layer is necessary to increase the thermal protection characteristics of the fence, and the protective and decorative layer is necessary to protect the insulation from external influences and give the building an updated architectural appearance.

It is advisable to install additional thermal insulation on the outside of the wall, because as a result of external insulation:

-protection is provided for the main material of the wall (brickwork, concrete) from alternating freezing and thawing and other atmospheric influences;

- temperature fluctuations of the wall are leveled out - which helps to increase the durability of the enclosing structure;
- conditions are created for the formation of a more favorable indoor microclimate, due to an increase in the heat-storing capacity of the massive part of the wall;
- the area of the premises is preserved;
- it is possible to insulate buildings without creating uncomfortable living conditions or evicting residents;
- the architectural and artistic appearance of building facades is improved.

To insulate external walls, depending on the type of protective and decorative layer used, four methods can be distinguished:

1. Protective and decorative layer made of plaster composition - ("wet"), which can be divided into 2 types:

a) plastering in three layers of plaster, with a total thickness of 20-50 mm, the layers are applied over a galvanized metal mesh fixed to the wall surface using fasteners passing through the heat-insulating layer;

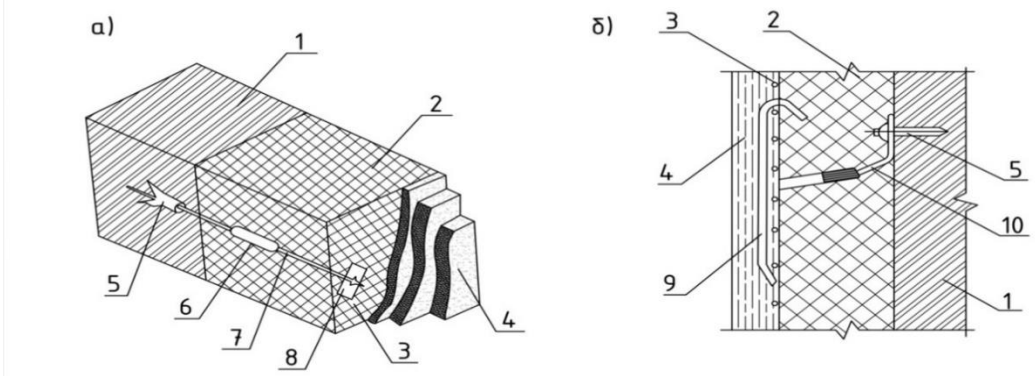
b) plastering in 2 layers - from two thin plaster layers with a total thickness of up to 12 mm, carried out using a polymer mesh attached directly to the insulation.

2. A protective and decorative layer in the form of a cladding made of hinged panels fixed to a mounting frame. Wall panels can be made of fiber cement, composite materials, ceramics, etc.

3. A protective and decorative layer in the form of large-sized hinged panels - shells.

4. Protective and decorative layer of brickwork.

Plastering in three layers is carried out by applying three layers: spray, primer, and covering, while the thickness of the marking is 20...50 mm, depending on the degree of unevenness of the base. In the lowest plaster layer, on the outer wall using special fasteners passing through additional thermal insulation. The last plaster layer can have varying degrees of roughness, which allows you to give an expressive look to the facades. (Figure 1)



Rice. **1 Wall insulation system with plastering in three layers:**

1-existing wall; 2-insulation; 3-steel mesh; 4-layer plaster; 5-expansion dowel; 6-anchor; 7- hook; 8-locking plate; 9-pin; 10-element fastening.

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