The Use Of Effective Soundproofing Materials In Modern Building Construction

Prof. Ph.D. Kasimova S.T.
Associate professor Talipova N.Z
Assoc. Omonova D.F
Associate Professor Kadabaeva Sh.S.

ABSTRACT

In Nowadays, life in a modern city is filled with noise, people's lives are saturated with a huge number of sounds from public transport, cars, and in homes - from the noise of air conditioners, elevators, etc. The constant presence of noise over 60 dB (decibels) is irreversible and leads to damage to people's hearing organs. To reduce noise and improve sound insulation, it is necessary to use soundproofing materials and structures.

Keywords: Sound insulation, building structures, airborne sound waves, impact noise, airborne noise, sound energy, basalt cardboard, impact noise, thermophysical properties, acoustic properties, thermosound insulation.

To create complete thermal insulation comfort during repair and construction work of buildings, various thermal insulation materials are used. But not all of them meet the necessary sound insulation requirements imposed today on building structures and structures of various purposes. And this is necessary, since we live in a very noisy world, we suffer from a huge number of sounds that we are forced to listen to constantly. There are more cars on the roads, and in houses - ventilation systems, air conditioners and elevators - the life of a modern city is filled with noise. That is why the creation of residential buildings with increased sound insulation is an urgent task for architects, builders and acoustics specialists.

Daily average noise exposure in the workplace of less than 80 dB (decibel) on the "A" scale (dB) does not pose a threat to people's physical health. The constant presence of noise levels over 90 dB causes irreversible damage to the hearing organs. In some cases, it is much more appropriate to use sound-absorbing materials in structures to reduce noise and as measures to improve sound insulation.

These materials can be used on individual surfaces (ceiling, wall) and their efficiency is proportional to the areas they occupy. In addition, sound-absorbing materials and structures are widely used to improve the acoustic characteristics of buildings and public spaces.

The main purpose of soundproofing materials, widely used in construction and architectural and construction acoustics, is to increase the reflection of airborne sound waves and prevent the spread of structural noise in building structures. Sound energy, when entering a material, is spent primarily on elastic deformation of its structural elements, which explains the attenuation of sound waves. Therefore, requirements are imposed on building soundproofing, on elastic properties (characterized by relative compression and dynamic modulus of elasticity).

Sound insulation is characterized by the following values: this is the relative compression when applying a load of 0.002 MPa (in effective materials - no more than 40%), characterizing rigid, with low deformability; semi-rigid, with medium deformability; soft, with high deformability soundproofing materials and products. The value of the dynamic modulus of elasticity, which is the main design characteristic, allows classifying building sound insulation as follows:

- The first group includes soundproofing materials in the form of slabs, rolls, mats, which are laid in a continuous layer during installation in building structures, and are also used to insulate multi-layer ceilings, walls and partitions.
- The second group includes strip and piece gaskets in structures of interfloor ceilings with "floating" floors and in multi-layer structures.
- Soundproofing materials of the 3rd group are used as backfill in interfloor ceilings to improve insulation from impact and airborne noise.

Heat and sound insulation materials include various types of building materials. The most popular on the construction market are mineral wool slabs, glass fiber-based slabs and mats, various types of panels made of synthetic components, as well as cellular concrete and plasterboard, which have a sound-reflecting effect.

In structures, the following are used as sound-absorbing layers:

- mineral wool slabs on a synthetic binder, semi-rigid, with fiber diameters of 5-10 μm, density of 50-100 kg/ m^3, moisture resistant, non-flammable;

- canvases made of super-thin glass fiber with a diameter of no more than 3 microns, density of 17-25 kg/m^3, non-moisture-resistant;

- products made of superfine glass fibers with a diameter of no more than 2 microns, a density of 7-15 kg/m3, lined on one or both sides with fabric or film, flame retardant;

- mats made of superfine basalt fiber with a density of 20-25 kg/m3, in a protective shell made of glass fabric, non-flammable and moisture resistant.

By form, soundproofing materials and products are divided into individual (blocks, slabs), rolled (mats, canvases), loose and bulk (mineral wool, glass wool; expanded clay, slag). At present, the most effective materials with high sound absorption coefficients in a wide frequency band (from 125 Hz to 8000 Hz) are products made of super-thin fiberglass. However, their use is permitted in the presence of special coatings that provide a high degree of protection against unwanted emission of fiberglass particles. This problem is known as "noise from neighbors above." If interfloor slabs are used incorrectly (the source can be a person moving or an object falling on the floor), almost all known types of acoustic waves characteristic of a solid body begin to propagate in the slab. These waves propagate through all elements of the building structure, and the task of reducing noise becomes very difficult. It is much easier to reduce this type of noise "at the source." Today, the most effective means of combating impact noise is the use of a "floating" floor structure, where a layer of elastic material is installed between the interfloor slab and the finished floor (parquet, linoleum).

The laboratory conducted tests of samples of a combined soundproofing layer consisting of basalt cardboard 5 mm thick (upper layer) and a layer of stitched heat and sound insulating glass fiber cloth PSHTZI 14 mm thick in order to determine the indicators of its soundproofing properties. Acoustic tests of samples of combined soundproofing materials consisting of basalt corton 5 mm thick laid on top of a layer of stitched heat and sound insulating glass fiber cloth PSHTZI showed that according to the values of the dynamic characteristics they belong to the class of effective soundproofing materials.

The use of combined soundproofing layers with a total thickness of 19 mm in floating screed structures with a surface density of the slab of at least 80 kg/m2 ensures an index of improvement in impact noise insulation by the floor Δ Lnw = 32 dB, which in the vast majority of real cases achieves compliance with regulatory requirements for impact noise insulation in building premises. Placing a cardboard layer between the floor slab and the PSHTZI layer practically does not change the value of the index of improvement in impact noise insulation by the floating screed laid on the combined layer, reaching values not exceeding 27 dB.

Termozvukoizol is a 3- layer material consisting of a fiberglass stitched fabric and a double-sided protective shell made of non-woven polypropylene stitched fabric and a double-sided protective shell made of non-woven polypropylene material, which allows for the complete elimination of the penetration of fiberglass and glass dust into the environment.

Characteristics of "Termozvukoizol":

- thickness - 14 mm;
-density-136 kg/m^3;
- thermal conductivity coefficient - 0.0388 Wt/m °C
- thermal resistance - 0.129 m^{2} $^{\circ C}$ /Wt;
- vapor permeability coefficient - 0.50 ml/ m.h.Pa ;
- sound absorption coefficient in the range of 500-8000 Hz - 0.22-0.87, i.e. up to 87%;
- average shock-insulating capacity in the range (60-4000) Hz-22 dBA , i.e. reduction of impact and shock noise by 13 times.

Due to the use of fluffed superfine glass fiber as a filler, TZI, despite its insignificant thickness, is characterized by high thermal and acoustic indicators, which allow this material to be widely used in various areas of construction. Thus, calculations show that the use of only one layer of TZI, for example:

a) in enclosing structures consisting of hollow bricks with a density of 1400 kg/m3 with lime-sand plaster on one side and finishing with gypsum board in one layer, it makes it possible to reduce the thickness of this structure by a quarter of a brick (6.5 cm) while maintaining the same level of energy saving. At the same time, the heat transfer resistance of TZI is 16 times higher than that of clay brick, 22 times higher than that of lime-sand plaster, and 6 times higher than that of dry plaster;

b) as a filler for sound-absorbing aluminum panels of the SPA-1532 type, it makes it possible to increase the efficiency of their sound absorption from 20% (without filler) to 95% (with filling with Termozvukoizol).

The most effective protection of buildings from noise is achieved with the help of modern heat and sound insulation materials. Such materials can be of natural origin (products based on stone wool, kaolin, expanded perlite, cellulose wool, flax tow, cork sheet) or synthetic (polyester foam, polyurethane foam, polystyrene foam, etc.).

Nowadays universal soundproofing materials based on natural raw materials, such as stone wool products, come to the fore. Since they do not contain binders in the form of formaldehyde resins. Their excellent soundproofing properties are determined by their specific structure - randomly directed finest fibers, when rubbing against each other, convert the energy of sound vibrations into heat. The use of such insulation significantly reduces the risk of vertical sound waves between wall surfaces, reducing the reverberation time, and thereby reducing the sound level in adjacent rooms. For soundproofing work at various facilities, it is recommended to use BZM mats with very good thermophysical and sound-absorbing properties to solve soundproofing problems.

BZM mats are made from a special super thin basalt fiber in a fiberglass sheath on all sides and stitched with fiberglass. Soundproofing properties:

- non-flammable, fire-resistant, fire-safe;
- chemically resistant, non-toxic;
- resistant to microorganisms and rodents, do not rot;
- do not increase the diffusion resistance of structures;
- have low hygroscopicity;
- vibration resistant;
- absorb noise and sounds perfectly.

Soundproofing of units and structures can be used :

-for acoustic cladding of walls and ceilings,
- in soundproof screens and cabins,
- for sound insulation in aircraft manufacturing, transport, metallurgy and chemical industries;
- in sound-proof chambers for acoustic certification of products;

- for noise suppressors in supply and exhaust ventilation systems, air conditioning, gas turbine and compressor units.

Sound absorption coefficients of BZM mats.

Table No. 1

Frequency range	Normal sound absorption coefficient at a thickness of BZM-mm		
	50	100	200
Low frequency 100-250 Hz	0.08-0.46	0.21-0.98	0.70-0.66
Midrange 250-1000 Hz	0.46-0.73	0.98-0.80	0.66-0.77
High frequency 1000-2000 Hz	0.73-0.86	0.80-0.85	0.77-0.83

Properties of basalt superfine fiber:

- excellent thermal-physical characteristics (1=0.039);
- application in the temperature range from -260 °C to 700 °C.
- ecological purity (absence of organic binders);
- elasticity and flexibility of the material, no shrinkage;
- mechanical strength and flexibility, the ability to insulate horizontal, inclined and shaped surfaces;
- resistance to aggressive environments (acidic, alkaline, etc.);
-high resistance to vibrations;
- unlimited shelf life of the material.

Technical specifications:

Table No. 2

No.	Indicators		
1	Completeness,	kg/ m^3	30
2	Average fiber diameter,	mm	No more
3	Humidity-	%	No more than 1
4	Temperature of use,	°C	From -269 to +700
5	Melting point,	°C	1100
6	Flammability group		NG (according to GOST 30244 KMK)
7	Thermal conductivity at 20	°C, W/m°C	0.036
8	Thermal conductivity at 300	°C, W/m°C	0.092

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