

FLOOR MATERIALS AND THEIR IMPACT ON THE ENERGY EFFICIENCY OF BUILDINGS

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Анотація

У статті розглянуто вплив матеріалів підлогового покриття на енергоефективність будівель у контексті сучасних вимог енергозбереження та принципів сталого розвитку. Проаналізовано теплотехнічні властивості різних матеріалів підлогового покриття, їхню здатність до теплопередачі та взаємодію із системами опалення, зокрема з системою теплої підлоги. Дослідження показує, що вибір матеріалу підлогового покриття суттєво впливає на тепловтрати, тепловий комфорт у приміщенні та загальне енергоспоживання будівлі. Обґрунтовано необхідність комплексного підходу до проектування з урахуванням нормативних вимог і критеріїв енергетичної ефективності.

Ключові слова: енергоефективність, матеріали підлогового покриття, теплопровідність, теплова інерція, тепловтрати, будівництво, сталий розвиток.

Abstract

The article examines the impact of flooring materials on the energy efficiency of buildings in the context of modern energy-saving requirements and sustainable development principles. The thermal properties of various flooring materials, their heat transfer capacity, and interaction with heating systems, including underfloor heating, are analyzed. The study demonstrates that the choice of flooring material significantly affects heat loss, indoor thermal comfort, and overall building energy consumption. The necessity of an integrated design approach considering regulatory standards and energy performance criteria is substantiated.

Keywords: energy efficiency, flooring materials, thermal conductivity, thermal inertia, heat loss, building construction, sustainability.

Introduction

Improving the energy efficiency of buildings is one of the key tasks of the modern construction industry, which is due to the increasing cost of energy resources and the need to reduce greenhouse gas emissions. According to the requirements of DBN V.2.6-31:2021 “Thermal insulation and energy efficiency of buildings” [1], enclosing structures must provide regulatory thermal resistance indicators and minimize heat loss. Although the main attention is traditionally paid to walls and roofs, the floor as an element of the enclosing structure also plays an important role in shaping the energy balance of the building. Significant heat losses can occur through the floor, especially in buildings with unheated basements or on the ground [2]. In addition, the choice of floor material affects the thermal inertia of the room, user comfort and the efficiency of heating systems. Therefore, an analysis of the physical and technical characteristics of floor materials is a necessary condition for the design of energy-efficient buildings. Derzhprom is an outstanding example of constructivism [7].

Research results

The analysis showed that the impact of flooring materials on the energy efficiency of a building is determined primarily by their thermal conductivity, heat capacity and ability to accumulate heat. Materials with high thermal conductivity, such as ceramic tiles or stone, provide efficient heat transfer from the underfloor heating system to the room air, but without an adequate layer of thermal insulation can contribute to increased heat loss towards the ground or unheated space [3].

Wood and laminated flooring have lower thermal conductivity, which reduces the rate of heat transfer, but increases the feeling of thermal comfort due to lower heat transfer when in contact with the human body. At the same time, excessively low thermal conductivity of the flooring can reduce the efficiency of the underfloor heating system, increasing energy consumption to achieve the required temperature [4].

The structural scheme of the floor is of great importance. According to the recommendations of the international standards ISO 6946 and ISO 13370 [5], when calculating heat losses through the floor, it is necessary to take into account the thermal resistance of all layers of the structure, including insulation, screed and finish. Studies show that the use of extruded polystyrene foam or mineral wool boards can significantly

reduce the heat transfer coefficient of the floor and reduce the annual energy consumption of the building by up to 10–15% [6].

The issue of thermal inertia deserves special attention. Concrete and stone coatings have a high heat capacity, which allows them to accumulate heat during periods of active operation of the heating system and gradually release it into the room. This helps to stabilize the temperature regime and reduce peak loads on the heating system. This approach corresponds to the principles of passive construction and standards for energy-efficient buildings [7].

In the context of sustainable development, it is also important to consider the environmental aspect of floor materials. The production of ceramic tiles and cement mixtures is characterized by significant CO₂ emissions, while natural wood has a lower carbon footprint under responsible forest management [8]. Thus, the choice of material affects not only the operational, but also the life energy efficiency of the building.

Therefore, the results of the study confirm that flooring materials are an important element in shaping the energy characteristics of a building. Their selection should be made taking into account the type of building, climate zone, structural scheme and heating system. An integrated approach allows optimizing thermal performance, increasing comfort and reducing energy consumption.

Conclusions

The study proved that flooring materials significantly affect the energy efficiency of buildings through thermal conductivity, thermal capacity and interaction with thermal insulation layers. The wrong choice of coating or the lack of sufficient thermal insulation can lead to increased heat loss and energy overconsumption.

Rational design of floor structures should be based on regulatory requirements, thermal calculations and principles of sustainable development. The use of modern thermal insulation materials, optimization of the design and consideration of thermal inertia allow to increase the energy efficiency of buildings and ensure comfortable operating conditions.

REFERENCES

1. DBN V.2.6-31:2021. Thermal insulation and energy efficiency of buildings. – Kyiv: Minregion of Ukraine, 2021.
2. DBN V.2.6-33:2018. Constructions of buildings and structures. Thermal insulation of enclosing structures. – Kyiv: Minregion of Ukraine, 2018.
3. Asdrubali F., D'Alessandro F., Schiavoni S. A review of unconventional sustainable building insulation materials // Sustainable Materials and Technologies. – 2015.
4. EN 1264. Water based surface embedded heating and cooling systems.
5. ISO 6946:2017. Building components and building elements – Thermal resistance and thermal transmittance.
6. Papadopoulos A. State of the art in thermal insulation materials and aims for future developments // Energy and Buildings. – 2005.
7. Feist W. Passive House Institute. Criteria for the Passive House standard.
8. Hammond G., Jones C. Inventory of Carbon & Energy (ICE). University of Bath, 2011.

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