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# PROCESSES OF HEAT TRANSFER FROM BUILDING STRUCTURES OF BUILDINGS

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**Abstract**
Reducing the amount of energy lost from the building is an urgent issue in ensuring the energy efficiency of the building. The amount of energy lost from the external barrier structures of the building makes up a large part of the amount of energy lost from the building. Therefore, it is possible to increase the level of energy efficiency of the building by reducing this consumption. This article presents and analyzes information about the types of heat transfer processes lost from the building's barrier structures and its impact on the building's energy efficiency.

**Keywords**: Energy efficiency, convection, radiation, thermal conductivity, resistance to heat transfer, wall, temperature, heat flow.

## Introduction

The issue of energy efficiency in the field of construction is one of the current issues. The fact that the territory of the Republic of Uzbekistan is very hot in summer and cold enough in winter requires additional energy for heating buildings in the cold season and cooling in the hot season. The limited energy resources mean that it is permissible to pay serious attention to the problems in this regard. The energy efficiency of buildings is explained by the thermal conductivity of the external barrier structures of the building. Below we will consider how the phenomenon of heat transfer occurs and what it depends on.

If the temperature is different at different points of an environment, it is possible to observe the movement of heat between these points. Heat always moves from a point of higher temperature to a point of lower temperature. This phenomenon can be observed in practice in the external barrier structures of buildings. In winter, heat passes from the indoor air of the building rooms to the outdoor air through the external barrier structures. The amount of heat consumed in the building is filled by various heating equipment. In summer, the reverse of this phenomenon can be observed. The necessary low temperature of the air in the "refrigerator" rooms is provided with the help of special cooling machines, in some buildings with the help of ventilation equipment and air conditioners. In this case, the movement of heat is directed from the outside to the inside [1].

The movement of heat from one point to another can take three forms. These are: through heat conduction, radiation and convection methods. We will consider these types below.

The movement of heat through thermal conduction is mainly observed in solid bodies. For example, we can see that when one end of any metal rod is heated, it heats up towards the other end. This phenomenon can occur not only in solids, but also in liquids and gases. In other aggregate cases, this phenomenon does not occur in the pure state. In solids and liquids, energy is transferred by means of elastic waves, in gases - by diffusion of atoms or molecules, and in metals - by diffusion of electrons. Most building materials are porous bodies, and all kinds of heat transfer can be observed in their capillary pores. However, in thermal physics calculations, it is assumed that the distribution of heat in the material takes place only at the expense of thermal conductivity.

The heat flow in thermal conductivity is directly proportional to the temperature difference.

$$Q=\lambda (t_2 - t_1) F \cdot z / \delta \qquad (1)$$

here, $\lambda$ - the heat transfer coefficient, Vt/(m·˚C).

$\delta$ - wall thickness, m.

*F*- wall surface, $m^2$.

*Z*- time, hour.

*t*- temperature, ˚C.

The second type of heat transfer is convection. Convection can be observed only in liquid and gaseous medium. Convection can occur in two ways. The first is natural, i.e. it occurs due to the temperature difference in the existing environment. In this case, a part of the liquid or gas with a higher temperature tries to move to a higher place than the liquid with a higher density due to the decrease in density. This is a heat transfer process that occurs due to the difference in densities. The second type of convection is artificial convection. In this case, the movement of air with a temperature change occurs under the influence of an artificial external force. For example through ventilators [2].

The third type of heat transfer is radiation. Thermal energy is transferred from the surface of the body to light energy, and this energy is absorbed by the surface of the second body and turns from light energy into heat energy. The surface of the floor of the building and the surface of objects falling on the light is heated by the rays of the sun falling from the windows of the building, and due to this heat, the temperature of the room also rises.

Resistance to heat transfer is denoted by the letter R [$m^2$ $^oC$/ Vt]

When the heat flow passes through the wall, it encounters 3 different resistances:

1- The resistance created by the existing difference between the temperature of the indoor air and the inner surface of the wall, is called heat absorption resistance:

$$R_{qq} \sim t_i - \tau_i \qquad (2)$$

2- The resistance due to the temperature difference between the inner and outer surface of the wall is called thermal resistance:

$$R_t \sim \tau_i - \tau_t \qquad (3)$$

3- The resistance associated with the difference between the temperature of the outer surface of the wall and the temperature of the outside air is called the resistance to heat transfer:

$$R_b \sim \tau_t - t_t \qquad (4)$$

*Q – heat flow.*

$t_i$ *- internal temperature*

$\tau_i$ *- temperature on the inner surface of the wall*

$t_t$ *- outside air temperature*

$\tau_t$ - temperature on the outer surface of the wall

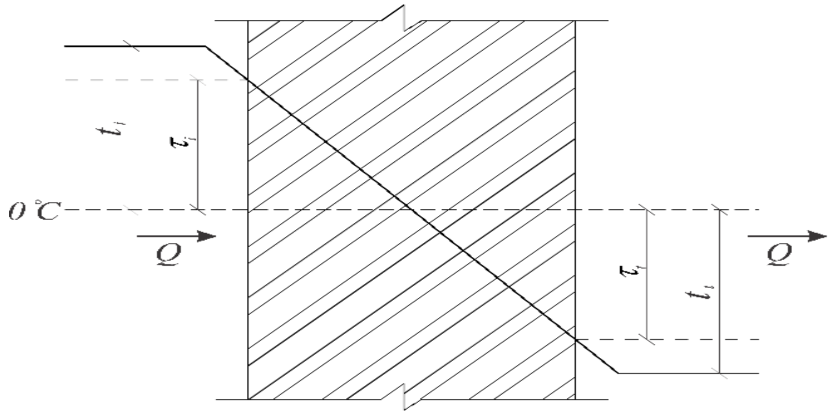


*Figure 1. Resistance of the heat flow in the cross-section of the wall*

The higher the resistance to heat transfer through the building's barrier structures, the more energy efficient the building is. The essence of an energy-efficient building is to minimize the amount of heat that can pass through the barrier structures. When designing the building's external protection devices for winter conditions, the total resistance of the device is compared with the required resistance.

When designing buildings for winter conditions, the total calculated resistance should be greater than or equal to the total authorized resistance.

$$R_{um}^{re} \leq R_{um} \quad (5)$$

The total calculated resistance of the device is determined by the following formula:

$$R_{um} = R_{qq} + R_t + R_b \quad (6)$$

The heat transfer coefficient inverse to R is denoted by α [Vt/ m $^2$ °C]

$$R = \frac{1}{\alpha} \quad (7)$$

This is the coefficient QMQ 2.01.04-18 is given in Table 5-6.

The thermal resistance of the protective device, if the device is single-layer, is determined by the following formula:

$$R_t = \frac{\delta}{\lambda} \quad (8)$$

If multi-layer, thermal resistance:

$$R_t = \Sigma\frac{\delta}{\lambda} + \frac{\delta_1}{\lambda_1} + \frac{\delta_2}{\lambda_2} \dots \frac{\delta_n}{\lambda_n} \quad (9)$$

is calculated by the formula.

Here, $\delta$- the thickness of the protective structure, m.

$\lambda$ - heat transfer coefficient. This coefficient QMQ 2.01.04-18 is given in Appendix 2.

The formula for finding the total allowable resistance is as follows:

$R_{um}^{re}$ = n ($t_i - t_t$) / $\Delta t^n$ $\alpha_i$ (10)

Here: n - coefficient that takes into account the location of the external protection device relative to the outside air. QMQ 2.01.04-18 is obtained based on Table 3 of. In most cases n = 1 is taken as. In unheated basements, n = 0.9 is taken as.
$t_i$ = calculated value of indoor air temperature, °C.
$t_t$ = calculated temperature outside in winter, °C.
$\Delta t^n$ = change of temperatures on the inner surface of the protective device with indoor air temperature. QMQ 2.01.04-18 is obtained from table 2 of.
$\alpha_i$ - coefficient of heat transfer of protective structures.
The resistance of barrier structures to heat transfer is important in the design of buildings. Construction standards and regulations stipulate that the following should be taken into account when designing buildings and structures in order to reduce heat loss in the cold season and heat inflow in the hot season:
a) volume-planning solutions, in which it is necessary to take into account the smallest area of the outer barrier structures, the location of the rooms with higher heat and humidity on the side of the internal walls of the building;
b) rational use of effective thermal insulation materials with a thermal conductivity coefficient not exceeding 0.1 W/(m·°C);
v) the area of light intervals, in which it must correspond to the minimum value of the standard value of the coefficient of natural illumination;
g) that the light spaces are protected by solar protection devices, in which the standard value of their heat transfer coefficient should ensure the unopposed penetration of solar energy in the cold season of the year;
d) reliable sealing of joints and seams in external walls and roofs during their use.
Calculated heat costs for heating and ventilation of the building being designed, as well as calculated cooling costs for air conditioning and cooling QMQ 2.01.18-2000 must correspond to the standard values specified in.
It is recommended to use single-layer and multi-layer constructions for external barriers.
In order to ensure the best performance properties when using multi-layer barrier structures, it is necessary to place layers with higher thermal conductivity and higher resistance to vapor transmission on their inner side. A heat-retaining layer made of effective heat-insulating materials should be placed on the outside or in the middle of the barrier structure.
The coefficient of thermal conductivity of the materials in the dry state in the heat-insulating layers of the barrier structures should not normally exceed 0.14 W (m·°C) [3-26].
In order to ensure the energy efficiency of buildings in construction, the use of materials with high resistance to heat transfer of external barrier structures of buildings will reduce the amount of energy loss that can be expected in the future. In local housing construction, the construction of barrier constructions based on cost rather than thermal conductivity will lead to an increase in energy consumption and energy consumption in buildings in the future. In most cases, it will not be possible to buy most of the rural houses. The reason for this is not only the lack of energy resources, but also the high energy consumption in such houses, and the fact that energy efficiency issues are not taken into account.

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