DETERMINATION OF HEAT AND WET MODES OF EXTERNAL WALL STRUCTURES AND RECOMMENDATIONS FOR CHOOSING A METHOD OF INSULATION

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ANNOTATION

The article describes the location of the layers in the optimization of the heat-humidity regime of the thermal insulation layer of the external wall construction of buildings and the calculation of the resistance of the wall to vapor permeability. The main purpose of this is to provide recommendations for the correct placement of the sequence of layers, taking into account the heat-humidity regime of the wall in the thermal insulation of wall structures.

KEYWORDS: ***thermal insulation, wall construction, heat-humidity regime, vapor permeability, multilayer wall, vapor permeability resistance, closed air gap, single line, dew point.***

INTRODUCTION

In order to improve the energy efficiency of buildings, the correct choice of the thickness of the insulation layers of each building and the correct execution of installation work will significantly save the energy efficiency of the building.

External building envelopes should be designed not only with durable thermal properties, but also taking into account the climate of the area where they are located, as well as frost resistance.

OBJECTIVES

When designing the enclosing structures of external walls, special attention should be paid to the humidity regime of the wall. For this reason, when designing an external wall, it is necessary to arrange the layers of the wall in such a way as to ensure the escape of water vapor in the wall structure between the layers. It is recommended to use a very low vapor permeability material for the insulation layer applied from the inside and a high vapor permeability material for the outside to prevent the wall layer from getting wet. Below (Figure 1) wall structures with different layers are described.

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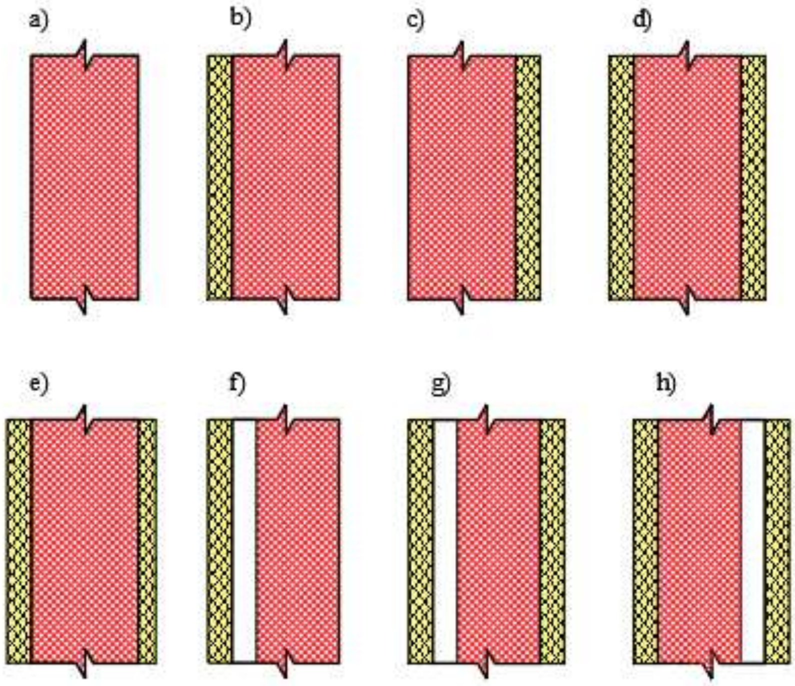

Figure 1. Wall with different layers construction schemes.

The single-layer structure is made of a structural heat-insulating material (scheme a in Fig. 1), which has the same structure throughout the entire thickness of the structure. If favorable climatic conditions are created in the building, the normal humidity regime is observed in such structures.

METHODOLOGY

In two-layer barrier structures, a layer with a high vapor absorption resistance is placed on the hot side, and a weather-resistant insulation coating is installed on the cold side (diagram b in Figure 1). Water vapor does not pass well through the thick layer of the structure, and at the same time, the vapor can freely pass between the insulating layer. This, in turn, provides a normal moisture regime for the wall structure. Placing a layer with high vapor resistance on the cold side and a layer of insulation on the hot side (diagram c in Fig. 1) creates an unfavorable humidity regime in the wall structure, which is especially noticeable in climatic regions with longer winters and high humidity.

The inner and outer layers of wall three-layer reinforced concrete panels are usually thinner than the middle layer (diagram d in Figure 1). The advantage of this solution is that water vapor escapes conveniently from the structure. If you provide the humidity of normal air in the room, it practically does not affect the structure. In addition, in such three-layer structures, fluctuations in the humidity regime occur much less frequently than in single-layer wall structures. It is desirable that the inner insulation coating of the three-layer wall structure is thicker than the outer insulation coating (Scheme e in Figure 1).

When the closed air wall structure is designed as shown in diagram " f " in Figure 1, the flow of water vapor to the insulating layer remains virtually unchanged.

It is impractical to have an air gap on the projected walls, as in diagram " g " in Figure 1. The optimal position of the inner air layer inside a three-layer wall barrier structure is shown in diagram h in Figure 1.

In special cases, it is recommended to insulate the outer wall with special moisture-proof layers to protect it from high humidity. [2]

Studies have shown that the dew point on the walls of local brick structures corresponds to the brick layer of the wall envelope. This causes moisture to accumulate in the brick layer of the wall, damaging the wall structure. Since the winter climate in our country aggressively affects building structures, the main reason for this is that on winter days the night temperature drops and water freezes moisture in the layers of wall structures, and the daytime temperature leads to the melting of ice in the layers of wall structures. ... This will lead to the collapse of the wall structures in a short time. In addition, moisture in the layers of wall structures increases the amount of heat transfer from the building material in the structural layer, which leads to large losses of heat from the building. As a result, more fuel has to be used to heat the building. To prevent these situations and improve the energy efficiency of the building, it is recommended to insulate the outer walls of the building.

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STATISTICAL DESIGN

The resistance to vapor absorption of barrier structures $R_п$, m²·h·Pa/mg, (from the inner surface to the plane with the possibility of condensation) should not be less than the required resistance to vapor absorption and is calculated as follows:

a) the necessary resistance to vapor absorption $R_{п1}^{тр}$, m²·h·Pa/mg (from the conditions for preventing moisture accumulation in barrier structures during year-round use) is determined by the following formula:

$$R_{п1}^{тр} = \frac{\left(e_в - E_{год}\right) R_{п.н}}{E_{год} \text{-} e_{н.год}} \quad (1)$$

b) the required resistance to vapor absorption $R_{п2}^{тр}$, m²·h·Pa/mg (from the conditions of limiting humidity in barrier structures during the period of negative average monthly outdoor temperature) is determined by the following formula:

$$R_{п2}^{тр} = \frac{0,0024 z_0 \left(e_в - E_o\right)}{\gamma_w \cdot \delta_w \cdot \Delta w_{ср} + \eta}. \quad (2)$$

In formulas (1) and (2):

$e_в$ - partial pressure of water vapor in indoor air at design temperature and humidity, Pa, is found by the following formula:

$$e_в = \frac{\phi_в}{100} E_в, \quad (3)$$

where: $\varphi_в$ - relative humidity in the room;

$E_в$ - partial pressure of saturated water vapor at a certain air temperature in the room;

$R_{п.н}$ - resistance to vapor absorption of the part of the barrier structure located between the outer surface of the barrier structure and the plane where condensation is likely to occur m²·h·Pa/mg;

$e_{н.год}$ - average partial pressure of water vapor in indoor air during the year, Pa;

z_o - the duration of the period of steam accumulation is taken equal to the period when the average monthly temperature of the outside air is positive;

E_o - partial pressure of water vapor in the aircraft, where condensation is possible, Pa, the average temperature of the outside air in the season when the average monthly temperature is negative;

γ_w - the density of the material of the wetting layer kg/ m³;

δ_w - the thickness of the wetting layer of the barrier structure, m, is assumed to be equal to the thickness of the thermal insulation layer (heat-retaining layer) of the multilayer barrier structure or 2/3 of the wall thickness of the same type (single-layer);

$\Delta w_{ср}$ - permissible limiting increase in the calculated mass fraction of moisture in the material of the wetting layer during the period of moisture accumulation,%. [3]

CONCLUSION

If the calculations are made taking into account the dew point and the insulation layer is determined on the basis of these results, i.e. if the temperature change to the recommended parameters occurs inside the gradient insulation layer, the wall structure and heat losses in the building will be ideally protected. Lady. Of course, in this case, the selected material for the insulating layer must have a very low level of hygroscopicity and moisture resistance. If mineral fiber is used as an insulating layer, it is necessary to protect it from outside moisture with an insulating layer during installation, otherwise an increased moisture level will form inside the insulating layer and as a result the insulating coating will not perform its function. will fail. When installing the insulating coating, special attention should be paid to ensure that the coating adheres firmly to the wall structure and does not form small cracks between layers.

When designing multilayer structures of external walls, the correct determination of the sequence of their layers is based on the heat and humidity regime of the structure. When laying the insulating coating, special attention should be paid to ensure that the coating adheres tightly to the wall structure and does not form small cracks between the layers. It is necessary to determine the thickness of the insulating coating based on its properties, paying special attention to the properties of resistance to heat, humidity and other external influences.

Based on the study of the above issues, we have created a special program for electronic calculators to determine the temperature between layers of multilayer thermal insulation of external wall structures "Determination of temperature changes in wall layers". This program is written in the "C ++" programming language, which performs calculations taking into account the temperature and humidity of the wall structure. This program is designed to be very easy to use and understandable. This program is registered by the Intellectual Property Agency under the Ministry of Justice of the Republic of Uzbekistan [4].

LITERATURE

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