THE HEAT DOES NOT COVER THE ROOF OF RESIDENTIAL BUILDINGS INCREASE PROTECTION

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ABSTRACT

This article presents the results of theoretical thermophysical studies of the coating of residential buildings to improve their thermal protection. Two options for increasing the level of thermal protection of the coating of the cores of buildings have been studied. The reed slab was studied in the first variant; in the second variant, polyurethane foam.

Keywords: Thermal physics, thermal protection, roofing, energy efficiency, building material, plate, construction, insulation, polyurethane foam, water vapor, temperature.

INTRODUCTION

At present, to increase the energy efficiency of buildings in all countries, various external wall and roof cladding structures with increased heat protection are used as external barrier structures. To increase the energy efficiency of buildings in Uzbekistan, in 2012 a manual entitled "Guidelines for the design of roofs and roofs of energy-efficient buildings" (KMK 2.03.10-95) was developed [3]. This manual is widely used in the design, construction, and renovation of roofs of buildings and structures.

MAIN PART

It is advisable if the proposed volume solutions are heat-physically based on thermal solutions that increase the thermal protection of coatings. For this reason, heat protection for used and attic residential buildings was considered as an example of local building material, a canopy slab, and a roofing structure made of polyurethane foam. The schematic diagram of this volume cover structure is shown in Figure 1.

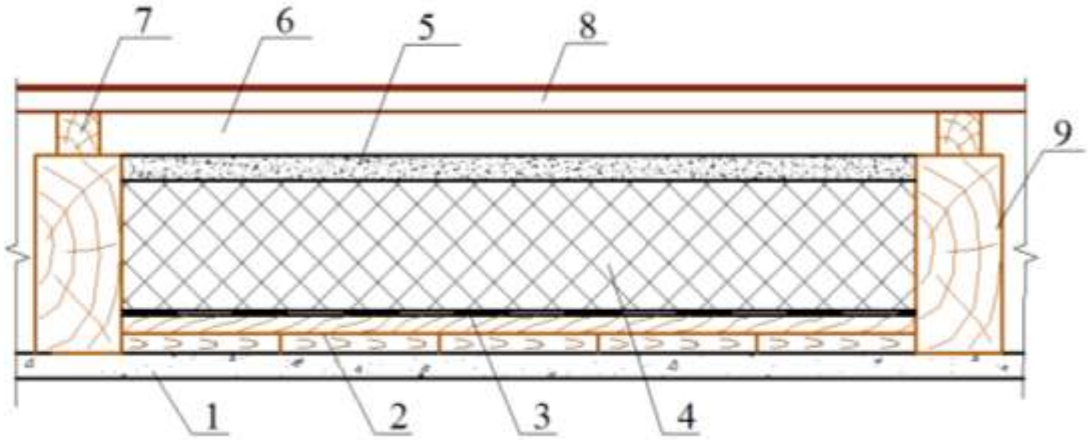

Figure 1. Calculation scheme of the roof covering structure with a heat-resistant reed plate. 1-cement-lime-sand plaster - $\gamma_0 = 1700$ кг/м^3, $\delta_1 = 0.03$ м;2-wooden slate (pine) - $\gamma_0 = 500$ кг/м^3, $\delta_2 = 0.044$ м;3-vapor barrier $\gamma_0 = 600$ кг/м^3, $\delta_3 = 0.005$ м;- 4-reed slab - $\gamma_0 = 200 - 300$ кг/м^3, $\delta_4 = ?$ м;5-sided plaster - $\delta_5 = 0.03$ м;6-hollow air layer $\delta_6 = 0.05$ м;- 7- ; beam 8-asbestos-cement sheet - $\delta_7 = 0.005$ м; 9-rafter.

To apply this design in practice, it is necessary to theoretically substantiate it thermally and physically. To do this, the total heat transfer resistance of this cover structure was determined, which should be compared with the heat transfer resistance of the first and second levels of heat protection by the requirements of KMC 2.01.04-97 *. In addition, in accordance with the requirements of paragraph 2.1 of the AML 2.01.04-97 *, it is necessary to substantiate the formation or absence of condensate moisture in these structural layers by graph analytic method.

Heat and physical calculations are performed in the following order:

Option 1: Determine the total heat transfer resistance of a roof structure made of heat-resistant reed plate.

$$R_y = R_И + R + R_T = 0.115 + 0.042 + 0.172 + 0.029 + \frac{\delta_4}{0,07} +$$

$$+0.086 + 0.14 + 0.011 + 0.043 = 0.595 + \frac{\delta_4}{0,07};$$

Hence $R_y = 0.595 + \frac{\delta_4}{0,07}$,.

Heat transfer resistance for the first level of heat protection for roofing, based on KMC 2.01.04-97 *

and for the $R_0^{тр} = 0,94$ (м^2 $\cdot$°C)/Втsecond degree $R_0^{тр} = 1,8$ (м^2 $\cdot$°C)/Вт.

slab $0.595 + \frac{\delta_4}{0.07} = 1,8$.

$$\delta_4 = 0.07(1,8 - 0.595) = 0.084$$

So, we accept the nominal size $\delta_4 = 0.10 m$.

In that case

$$R_y = \frac{0.10}{0,07} = 1,428 \ (м^2 \cdot °C)/Вт;$$

$R_y = 1,428 + 0.595 = 2.02 \geq R_0^{тр} = 1,8$ (м^2 $\cdot$°C)/Втekan.

№2: We accept polyurethane foam for thermal insulation of roofing felt. Its density is 60 kg / m ^{3}, heat transfer coefficient is 0.041 W / (m ^{2} ^{0}C).

Heat protection We determine the total heat transfer resistance of a polyurethane foam roof structure.

$$R_{у} = R_{и} + R + R_{т} = 0.115 + 0.042 + 0.172 + 0.029 + \frac{\delta_4}{0,041} +$$
$$+0.086 + 0.14 + 0.011 + 0.043 = 0.595 + \frac{\delta_4}{0,041};$$

Hence $R_{у} = 0.595 + \frac{\delta_4}{0,041}$,.

Heat transfer resistance for the first level of heat protection for roofing, based on KMC 2.01.04-97 *

and for the $R_0^{тр} = 0,94$ (м^2 ·°C)/Втsecond degree $R_0^{тр} = 1,8$ (м^2 ·°C)/Вт.

polyurethane $0.595 + \frac{\delta_4}{0.041} = 1,8$foam.

$$\delta_4 = 0.041(1,8 - 0.595) = 0.049\ m.$$

So, we accept the nominal size $\delta_4 = 0.10 m$.

In that case

$$R_{у} = \frac{0.10}{0,041} = 2,44\ (м^2 \cdot °C)/Вт;$$

$R_{у} = 2,44 + 0.595 = 3,03 \geq R_0^{тр} = 1,8$ (м^2 ·°C)/Втekan.

This means that the heat protection of the roof structure made of polyurethane foam meets the requirements of the first, second, and third-degree heat protection, given in the general heat transfer resistance KMK 2.01.04-97 *.

However, by the requirements of Clause 2.1 of CFM 2.01.04-97 *, it is necessary to determine whether condensate is formed in the layers of multilayer structures. For this reason, we determine whether condensate moisture is present in this structure in the following graph analytic method:

Of the roof structure using the following formula:

$$\tau_{и} = t_{и} - \frac{t_{и} + t_{T}}{R_{у}} R_{и}; \quad (1)$$

, $t_{и}$ –the temperature of the inner surface of the outer wall °C,; $\tau_{и}$ –indoor air temperature °C,; average monthly temperature for the coldest period $t_{Т}$ –of $R_{у}$ –outdoor air,; °Cexternal heat transfer resistance of м^2 · °C/Вт; $R_{и}$ –the outer wall heat resistance of the inner surface of the outer wallм^2 · °C/Вт;

$$\tau_{и} = 20 - \frac{20 - 0.5}{3,03} \cdot 0.115 = 20 - 0,74 = 19.26\ °C;\ \ E_{н} = 16,74\ \ C$$

$\tau_1 = 20 - 6,43 \cdot (0.115 + 0.042) = 18,99$ °C; $E_1 = 16,37$см. уст.

$\tau_2 = 20 - 6,43 \cdot (0.157 + 0.172) = 17,88$ °C; $E_2 = 15,29$ °мм. см. уст.

$\tau_3 = 20 - 6,43 \cdot (0.329 + 0.029) = 17,69$ °C; $E_3 = 15,18$ °мм. см. уст.

$\tau_4 = 20 - 6,43 \cdot (0.358 + 2.44) = 2.01$ °C; $E_4 = 5,33$ °мм. см. уст.

$\tau_5 = 20 - 6,43 \cdot (2,79 + 0.086) = 1.45$ °C; $E_5 = 5,01$ °мм. см. уст.

$\tau_6 = 20 - 6{,}43 \cdot (2.88 + 0.14) = 0.58\ °\text{C};\ \ E_6 = 4{,}77\ °\text{мм. см. уст.}$
$\tau_T = 20 - 6{,}43 \cdot (3{,}02 + 0.011) = 0.51\ °\text{C};\ \ E_T = 4{,}75\ °\text{мм. см. уст.}$

Temperature line, we determine the maximum elasticity of water vapor in the layers of the roof structure. Then, in this construction, we draw the true elasticity of water vapor on a certain scale. If the maximum elasticity line E of the water vapor and the true elasticity line ***e*** do not intersect, no condensate moisture will form in the barrier structure. Otherwise, condensate will form moisture.

Based on the values defined above, we draw a temperature line in Figure 2. Based on the temperature line in this figure, we determine the maximum elasticity of water vapor by determining the maximum elasticity of water vapor [1]. We determine the true elasticity of the water vapor inside and outside the tom structure in the following order for Samarkand.

$$e_{и} = \frac{\varphi_{и} \cdot E_{и}}{100} = \frac{55 \cdot 14.81}{100} = 8.15\ \text{мм. см. уст.}$$

$$e_{т} = \frac{58 \cdot 4.86}{100} = 2.82\ \text{мм. см. уст.}$$

All the identified indicators are represented in Figure 2.

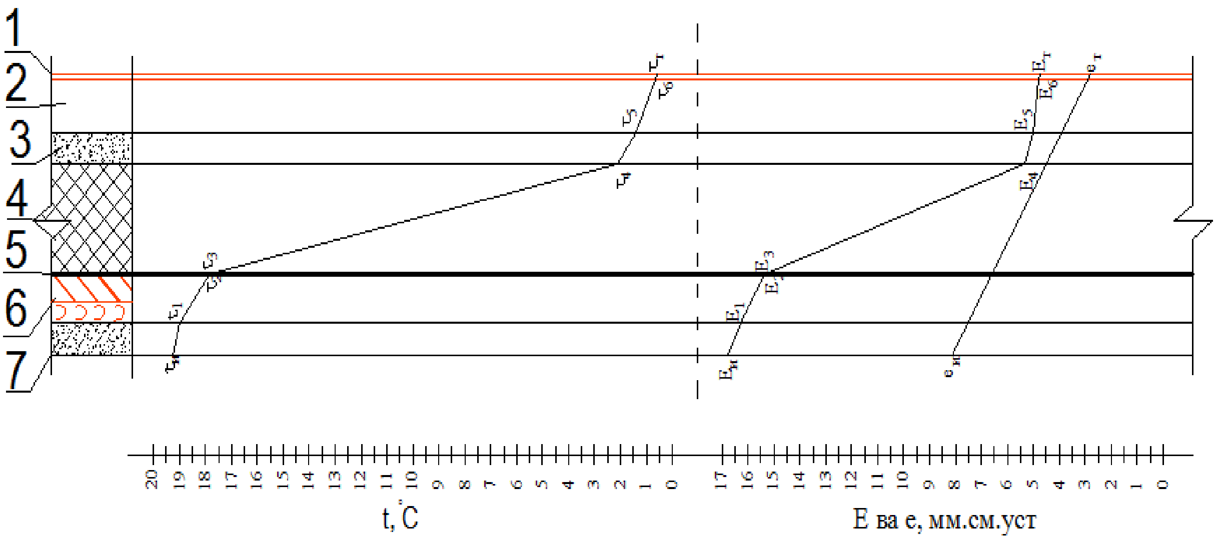

Figure 2. Heat protection Moisture condition of the roof structure made of polyurethane foam. Plaster 1; 2 wooden sheets; 3-vapor barrier; 4-polyurethane foam; Plaster of 5 somonis; 6th air layer; 7-asbestos-cement sheet.

IN CONCLUSION

As can be seen from the figure, the lines of maximum elasticity ***E of*** water vapor and true elasticity ***e*** of water vapor do not intersect, which means that no condensate moisture is formed in this structure.

From the above theoretical thermal-physical studies it can be concluded that:

1. The results of the calculations showed that no moisture condensate is formed in the layers of the roof structure;

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2. Calculations show that the heat protection of the roof structure with polyurethane foam panels is 33% higher than the thermal protection of the roof structure with heat protection reeds.
3. This indicator is sufficient for the conditions of Uzbekistan and meets the requirements of the AMF 2.01.04-97 *;
4. The design of this volume allows you to build a variety of energy-efficient and attic residential buildings.

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