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WAYS TO INCREASE THE ENERGY EFFICIENCY OF BUILDINGS AND THEIR EXTERNAL BARRIER STRUCTURES

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ABSTRACT

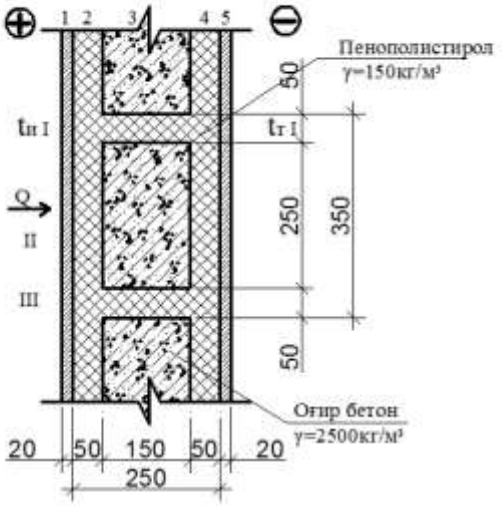
In this article the results of theoretical and field studies with different thermal design solutions of external walls to improve the energy efficiency of buildings.

Nowadays, rational use of natural energy resources remains one of the main tasks in all developed countries of the world.

In order to effectively use natural energy sources in Uzbekistan, in the reconstruction and perfect repair of residential, treatment, children's institutions, schools, lyceums, colleges and boarding schools, which are being built and used in accordance with the requirements of KMK 2.01.04-97*, which was adopted in 2011 as amended, their energy in order to increase its efficiency, it is necessary to increase the thermal protection of external barrier structures.[3]

Therefore, in order to increase the energy efficiency of buildings, thermal-physical practical experiments were carried out on external wall samples with different structural solutions in the laboratory of the "Building and Constructions" department of SamDAQU. Some of these are listed below:

In the joint enterprise "OOO SAM ROS KHOLOD" a non-removable form of polystyrene foam was prepared, in the laboratory of the "Building and structures" department of SamDAQU an external wall sample was built and thermal-physical experiments were conducted. this. The experiment was conducted based on the requirements of UzRTS-809-97 "Determining the thermal conductivity of barrier structures" method [4].

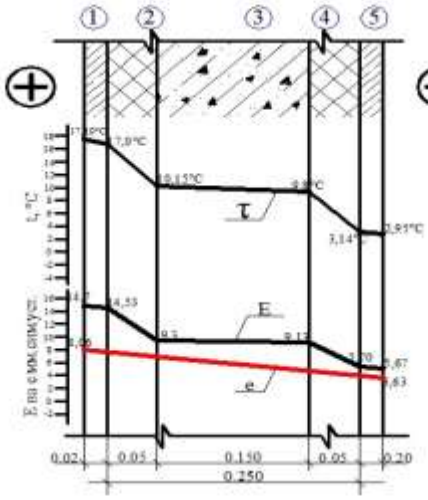


Experimental results were compared with theoretical studies.

The scheme of the wall structure is presented in (Fig. 1).

Figure 1. Scheme of non-removable formwork wall construction made of foam polystyrene.

The total thermal conductivity of this structure is R_y =2.49 м² .(м². °C)/Вт and the total thermal protection meets the requirements of QMQ 2.01.04-97 *. In addition, as can be seen from Figure 2, condensation moisture does not form in the layers of this structure.



2 - picture. Moisture status of non-removable formwork wall construction of expanded polystyrene

1 - Cement-sand plaster; 2 - Polystyrene; 3 - Cast heavy concrete; 4 - Polystyrene; 5 - Cement-sand plaster; In addition, various studies are being conducted in the field of using solar energy for heating buildings in our Republic. An experimental solar house with a heliosystem of the "Thromb Wall" type is located at 40° latitude in Princeton. Built in (New Jersey, USA), this latitude corresponds to our country. However, such buildings, i.e. "Tromb wall" type solar buildings with helio system, have not been designed and built in our country. In order to build this type of buildings in the climatic conditions of Uzbekistan, it is necessary to justify them as a result of thermal-physical theoretical and practical experiments. For this reason, we have installed a "Thromb wall" model on the outer wall of the laboratory of the "Building and Construction" department of SamDAQU, and thermal physics research is ongoing. In order to increase the energy efficiency of buildings with the help of local

materials, a constructive solution was developed for the external wall with non-removable formwork made of foam concrete, heat protection increased with foam polystyrene. The advantages of this construction are as follows:

1. The wall structure will be completely restored from local materials; 2. The period of construction of the building will be shortened sharply; 3. The energy efficiency of the building and its exterior will increase; Increases the overall earthquake resistance of the building.

In order to use this construction in practice, it is necessary to theoretically base it on a thermal-physical basis. For this, it is necessary to determine the total heat transfer resistance of the external wall construction, whose calculation scheme is shown in Fig. 3, compare this resistance with the heat transfer resistance given in QMQ 2.01.04-97*, and recommend the effective thickness of the wall. In addition, it is necessary to justify the formation of condensate moisture in the layers of this construction or not using the graphoanalytical method.

Thermal-physical calculations are performed in the following order.

Since the non-removable external wall construction of foam concrete shown in Figure 3 is not homogeneous, we cut it with planes parallel and perpendicular to the direction of heat flow and determine the thermal heat transfer resistance.

Figure 3. Scheme of a non-removable formwork wall construction of foam concrete.

We divide the construction into parts I and II by cutting it with a plane parallel to the direction of heat flow. The first part is made of foam concrete and the second part is made of heavy concrete and expanded polystyrene. We determine the heat transfer resistance for the first part using the following formula.

$$R_I=\frac{\delta_1}{\lambda_1}+\frac{\delta_2}{\lambda_2}+\frac{\delta_3}{\lambda_3}; \qquad (1)$$

For thermal physical calculations, we accept the following heat transfer coefficients[3].

1. Foam concrete, $\Upsilon_0 = 400 - 600$ кг/м^3, $\lambda = 0{,}14$ Вт/(м$^2 \cdot$ °C) ;
2. Heavy concrete, $\Upsilon_0 = 2400 \frac{кг}{м^3}$, $\lambda = 1{,}74$ Вт/(м$^2 \cdot$ °C) ;
3. Styrofoam, $\Upsilon_0 = 100$ кг/м^3, $\lambda = 0{,}041$ Вт/(м$^2 \cdot$ °C);

R_I=2,428 м$^2 \cdot$ °C/Вт. Surface of the first part $F_I = 0.05$.

The second part of the structure consists of foam concrete, heavy concrete and expanded polystyrene. Its heat transfer resistance. R_{II}=3.298(м^2 .°C)/ Вт.

We determine the thermal heat transfer resistance of this structure using the following formula [2].

$$R_{II} = \frac{F_I + F_{II} + F_{III} + \cdots.}{\frac{F_I}{R_I} + \frac{F_{II}}{R_{II}} + \frac{F_{III}}{R_{III}} + \cdots.} \quad (2)$$

Here, R_I, R_{II}, R_{III} ...,- thermal heat transfer resistance of individual layers, м^2°C/Вт; F_I, F_{II}, F_{III} ..., the surface of individual parts, м^2

The surface of the second part is $F_{II} = 0{,}25$..

Wall thermal heat transfer resistance, R_{II}=3.1(5 м^2 .°C)/ Вт.

Cutting the construction with a plane perpendicular to the direction of heat flow, 1;2;3;4;5;6; and divide into 7 layers (Fig. 3).

1st and 7th layers of foam concrete $R_1 = R_7 = 0{,}214(м^2 \cdot °C)/Вт$; 3 and 5 layers of foam concrete $R_3 = R_5 = 0{,}178(м^2 \cdot °C)/Вт$; 4th layer expanded polystyrene $R_4 = \frac{0{,}10}{0{,}041} = 2{,}439\ (м^2 \cdot °C)/Вт$;; Since part 2 is not homogeneous, we determine the average heat transfer coefficient of the construction using the following formula. [1.2]

$$\lambda_{ўр} \frac{\lambda_I x F_I + \lambda_{II} x F_{II} + \lambda_{III} x F_{II}}{F_I + F_{II} + F_{III}} = 1.473\ Вт/(м^2 \cdot °C),$$

Here, λ_I, λ_{II} ... is the thermal conductivity coefficient of the materials that make up the individual layers, $Вт/(м^2 \cdot °C)$; F_I, F_{II} ... surfaces of individual layers,

Then $R_2 = R_6 = 0{,}044\ (м^2 \cdot °C)/Вт$.

$$\text{So, } R_\perp = R_I + R_2 + R_3 + R_4 + R_5 + R_6 + R_7 = 3{,}311\ (м^2 \cdot °C)/Вт.$$

The heat transfer resistance of a non-homogeneous structure is determined using the following formula. [1.2]

$$R = \frac{R_{II} + 2R_\perp}{3} = \frac{3{,}157 + 2x\ 3{,}311}{3} = 3{,}259\ (м^2 \cdot °C)\ /\ Вт,$$

We determine the total heat transfer resistance of a non-homogeneous wall structure made of foam concrete.

$$R_{ум} = R_и + R + R_T = 0{,}114 + 3{,}259 + 0{,}043 = 3{,}416\ (м^2 \cdot °C)/Вт;$$

Therefore, the total heat transfer resistance of the non-removable formwork wall construction made of foam concrete that we recommend meets all the requirements of the level of heat protection specified in QMQ 2.01.04-97*.

Conclusion. The following can be concluded from the above theoretical and practical studies:

1. As a result of the calculations, it was found that the thermal protection of the non-removable formwork wall construction made of foam concrete is sufficient for the conditions of Uzbekistan and meets the requirements of QMQ 2.01.04-97*;
2. Heat transfer resistance of non-removable formwork wall construction made of foam concrete, thickness 38 cm. and it is 4.9 times greater than the heat transfer resistance of a brick wall with a density of 1600 kg/m3 and 1.3 times greater than the heat transfer resistance of a non-removable formwork wall structure made of polystyrene foam;
3. If this wall construction is based on thermal-physical practical experiments, it will provide an opportunity to build various energy-efficient buildings.

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