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IMPROVING THE ENERGY EFFICIENCY OF THE EXTERNAL WALLS OF RESIDENTIAL BUILDINGS BEING BUILT ON THE BASIS OF A NEW MODEL PROJECT

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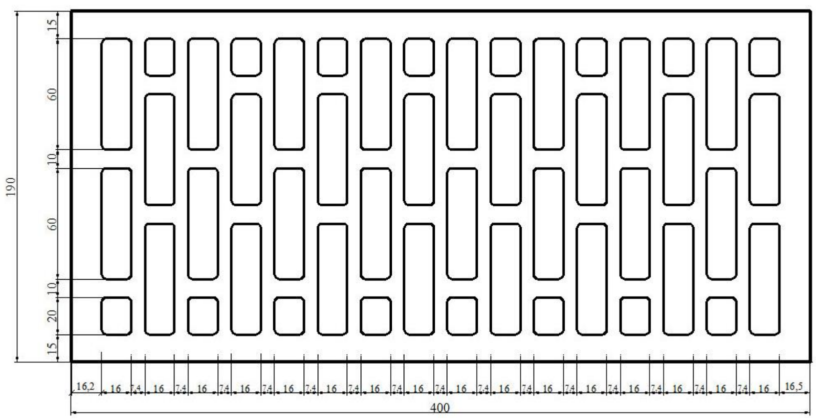
ABSTRACT

In this article, in order to increase the energy efficiency of external walls, the thermal conductivity coefficient and heat transfer resistance of small blocks consisting of multi-cavity, air-filled foam concrete are based on the results of theoretical research on thermal physics.

Due to the fact that the heat transfer coefficient of air in closed spaces and capillaries in the composition of building materials is small, i.e. 0.023 Вт/(м°С.), various fog structures with an empty air layer were used. However, the thermal physical properties of this type of external barrier constructions are low. Therefore, to correct this deficiency, the air layers in the wall are filled with expanded , minwata and other light materials. Because the thickness of solids is directly proportional to its thermal conductivity. Therefore, the use of such building materials in construction practice does not increase the energy efficiency of buildings. At the same time, when small blocks of lightweight concrete, ceramic brick and foam concrete are used as an external barrier structure, the structure consists of several or more layers of free air, and the energy efficiency of external barrier structures increases. Кичик блок таркибидаги бўш ҳаво қатламлар ўлчами қанчалик кичик бўлиб ва бу қатламлар сони қанчалик кўп бўлса унинг иссиқлик физик хусусиятлари шунча яхши бўлади. The smaller the size of free air layers in a small block and the greater the number of these layers, the better its thermophysical properties. Because the amount of heat from empty layers of air is not only due to thermal conductivity



possibly by light and convection. For the thermal and physical substantiation of this theory, we have developed several types of calculation schemes for a small block of foam concrete with air layers of more than 40-50. The recommended size of the foam concrete block is 400x190x190 mm, 390x190x190 mm. and 400x266x190 mm, the first of which consists of 48, the second - 64, the third - 70 air layer cavities (Fig. 1).. Such small blocks can be made using local materials. The thermal physical properties of such blocks, including heat transfer resistance and heat transfer coefficient, have not been studied for the conditions of Uzbekistan or have not been based on thermal physics. These structures consist of non-homogeneous materials located perpendicular or parallel to the direction of heat flow. The thermal physical calculation of non-homogeneous constructions is determined in the following order: We cut the construction with a plane parallel to the direction of the heat flow and divide it into separate layers (Fig. 2).

Figure 1. A small block of foam concrete with 48 holes.

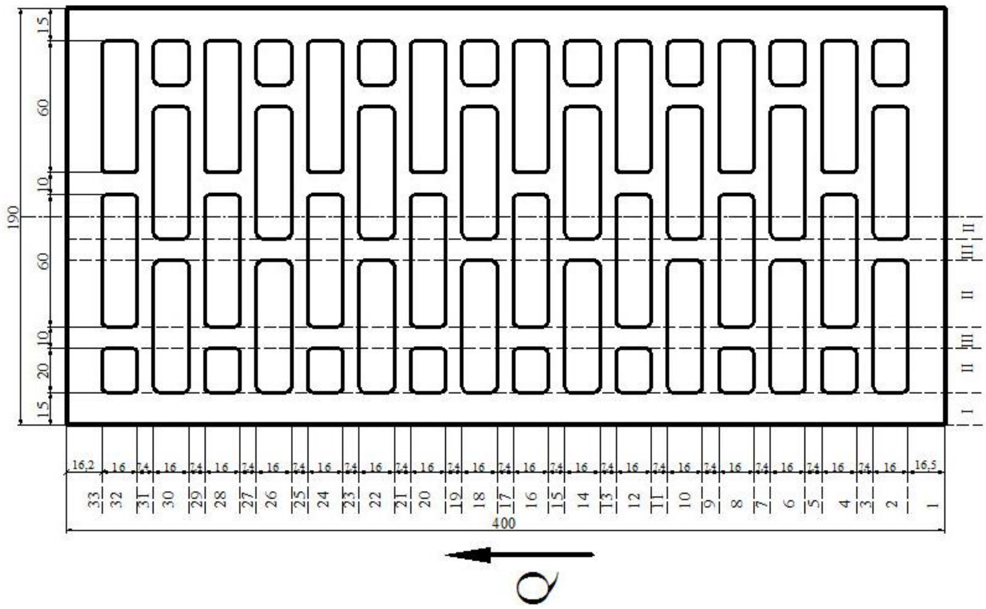
The average heat transfer resistance of this structure is determined using the following formula (1).

$$R_{\|} = \frac{F_{|} + F_{\|} + F_{|||} + \dots}{\frac{F_{|}}{R_{|}} + \frac{F_{\|}}{R_{\|}} + \frac{F_{|||}}{R_{|||}} + \dots} \qquad (1)$$

Here, R_{I}, R_{II}, R_{III} is the thermal heat transfer resistance of the separate layer material; F_{I}, F_{II}, F_{III} - surfaces of individual layers.

We cut the small block of porous foam concrete presented in Figure 1 with a plane perpendicular to the direction of heat flow and divide it into layers 1, 2, 3, and 3 separately (Figure 2).

Fig. 2. Calculation scheme of a small block of foam concrete cut with planes parallel and perpendicular to the heat flow.



The average heat transfer coefficient for parts of the small block with non-homogeneous composition is determined using the following formula (3).

$$\lambda_{\check{y}p} = \frac{\lambda_I \times F_I + \lambda_{II} \times F_{II} + \lambda_{III} \times F_{III}}{F_I + F_{II} + F_{III}} \quad (2)$$

Here, lI, lII, lIII…… are heat transfer coefficients of materials that make up individual layers; FI,FII,FIII - surfaces of separate layers.

If thermal physics calculations are performed by cutting the outer wall made of a small multi-cavity block with planes parallel and perpendicular to the heat flow, the calculations become more complicated due to the increase of the planes. Therefore, for practical calculations, it is possible to determine the average heat transfer coefficient of a single multi-cavity small block, and to determine the thermal heat transfer resistance of the entire external wall consisting of this small block (3). Therefore, we analyze the average heat transfer coefficient of a small block of foam concrete with 48 cavities. The dimensions of the small block are 400×190×190 mm. with a density of 1000 kg/m3 and heat transfer coefficient λ = 0.41 W/(m.0S). Thermal heat transfer resistance of free air layer QMQ 2.01. We accept 04-97* from Appendix 2. The thickness of the air layer is 16 mm. and its thermal heat conduction resistance is 0.15(m2. 0S)/W. Since the holes of the small block are located symmetrically with respect to the central axis of the unit, it is sufficient to perform the calculation for half of the unit. For this reason, we take half the width of the small block, that is, 95 mm, as the calculation surface.

Physical calculations of heat in the case where it is cut by a plane parallel to the heat flow:

I - Part. Foam concrete without holes: R_I =0.40:0.41=0.975; F_I= 15.

II- Part. Sixteen-hole foam concrete:

R_{II} = 0.144:0.41 + 0.15x16 = 0.351 + 2.4 = 2.751; F_{II} = 60.

III – Part. Eight-hole foam concrete

R_{III} = 0.272:0.41 + 0.15x8 = 0.663 + 1.2 = 1.863 . F_{III}= 20 .

We determine the thermal heat transfer resistance of a small block consisting of forty-eight hollow foam concrete using the formula (1).

$$R = \frac{15+60+20}{15:0975+60:2,751+20:1,865} = 1.982$$

We perform thermophysical calculations by cutting a small hollow block with a plane perpendicular to the heat flow:

Parts 1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23, 25, 27, 29, 31 and 33 in Figure 2 are made of solid foam concrete, the sum of their thermal heat transfer resistance

R =(0.0165:0.41)x2 +(0.0074:0.41)x 15 = 0.35(м^2.^{0}C)/Вт.

2, 4, 6, 8, 10 - and khakoza 32 - the thickness of the holes in the planes perpendicular to the heat flow is 16 mm. We determine the equivalent heat transfer coefficient of the air in the cavity: λ = δ:R = 0.016:0.15 = 0.106 Вт/(м.^{0} C).

We determine the average heat transfer coefficient of a layer of a small block with holes using the formula (2):

$$\lambda = \frac{0,41x35+0,106x60}{95} = 0,218$$

Thermal heat transfer resistance of these layers R =(0.016:0.218)x16 = 1.174. So, when this small block is cut with a plane perpendicular to the heat flow, the thermal heat transfer resistance is R = 0.35 + 1.174 = 1.524 (м^{2}.^{0} C)/Вт.

We determine the real thermal heat transfer resistance of a small block of forty-eight foam concrete using the following formula (1):

$$R = \frac{R_{II} + 2xR_{\perp}}{3} = \frac{1.982 + 2x1{,}524}{3} = 1.676(м^2.^0C)/Вт.$$

So, the average heat transfer coefficient of a small block of foam concrete with forty-eight holes:

λ = 0.400:1.676 = 0.238 Вт/ (м. ^{0}C).

According to the above theory (3), the outer wall of perforated foam concrete is 590 mm thick. equal to , its thermal heat transfer resistance R = $R_и$ + R + R_T = 0.026 + 2.478 + 0.026 = 2.531 (м^{2} ^{o}C)/Вт.

Conclusion

The following conclusions can be drawn from the results of theoretical thermal physics research presented above:

1. The coefficient of thermal conductivity of a small block of foam concrete with forty-eight holes is 48% less than the coefficient of heat conductivity of a block of foam concrete without holes;

2. The thermal heat transfer resistance of the wall made of foam concrete with forty-eight holes is 1.8 times higher than the heat transfer resistance of the wall made of foam concrete without holes and the thickness is 2.5 bricks, i.e. 64 cm. is 2.5 times greater than the heat transfer resistance of the wall;

3. Therefore, the heat transfer resistance of the wall made of foam concrete with forty-eight holes, which we recommend, meets the requirements of the first and second level of thermal protection of the heat transfer resistance specified in QMQ 2.01.04-97*. Such a situation increases the energy efficiency of residential buildings being built on the basis of a new model project.

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