Thermophysical accounting of the outer wall consisting of three-layer foam concrete

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Abstract: The paper gives the results of theoretical and experimental natural thermal - physical researches in the models of extiriol walls performed from the fixed formwork from polystyrenefoam. Determination of resistance of heattransfering, coefficient, thermal conductivity, temperature distribution in the thickness of the experimental samples, humidity and heatresistance of extiriol walls, erected from a fixed formwork from polystyrene. In addition calculation is made of masture condition of extiriol walls erected from permament formwork of polystyrenefoam.

Keywords: thermal conductivity, the energy efficiency of buildings, thermophysical, walls, foam concrete

All over the world, to improve the energy efficiency of buildings, external walls and roofing floors of various compositions with increased heat protection of the area are used as an external enclosing structure. In particular, in Russia you can get buildings whose outer walls are called "Warm House," which are restored using Non-removable formwork, etc. However, the main drawback of these types of heat-protective structures is their high cost. The heat-shielding structures of the outer wall, enlarged with foam, polystyrene foam and other mineral slabs, cost $50-$60 per square meter. [4]

As a result of theoretical studies in the field of thermophysics, a structural solution was developed for the design of a non-single-sex wall consisting of foam concrete. Unit dimensions are 600x600x200, 600x300x200, 600x300x100, 400x400x200, 400x300x300, 500x300x120mm.

The advantages of these constructions are as follows:

1. This structure is restored from local building materials;
2. Diversity - The district makes it possible to build energy efficient buildings;
3. Drastically shortens construction time;
4. The material costs of building construction are decreasing dramatically;
5. Increases the thermal protection of the external wall of the building;
6. Increases the earthquake of the building;
7. During the construction of the wall, a non-removable wall consisting of foam concrete will remain at the site of wall restoration.

To compare the results of the experiment with theoretical thermophysical studies, first of all, thermophysical calculations of this design should be performed. The calculation scheme of the wall structure, which we recommend for this, is shown in Figure 1.

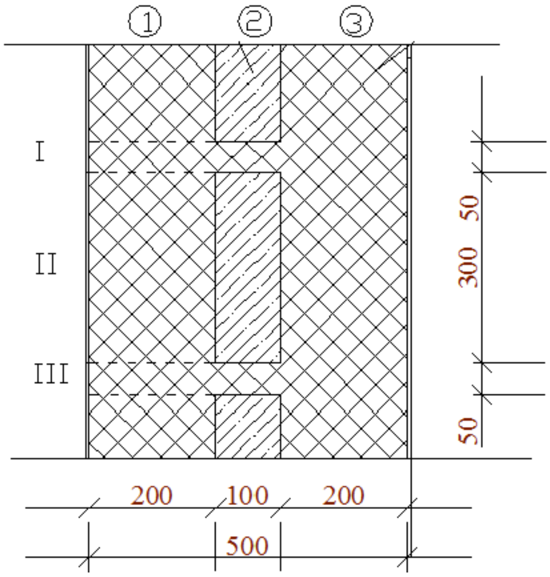

Fig. 1. Scheme of a non-removable formwork wall construction made of foam concrete

We determine the thermal heat transfer resistance of the non-removable formwork external wall construction of foam concrete shown in Fig. 1.

For heat-physical calculations, we accept the following initial data:

1. Mold made of foam concrete $\gamma_0 = 400 kg/m^3$, block density $\gamma_0 = 400 кг/м^3$, heat transfer coefficient $\lambda = 0.14 \text{vt/m}^\circ c$.

2. Heavy concrete, density $\gamma_0 = 2400 kg/m^3$, heat transfer coefficient $\lambda = 1.74 \text{vt/m}^\circ c$.

3. Foam concrete $\gamma = 400 kg/m^3$, thermal conductivity coefficient $\lambda = 0.14 \text{vt/m}^\circ c$.[5,6]

This structure consists of non-homogeneous building material parallel and perpendicular to the direction of heat flow.

We divide the structure into parts I, II, III by cutting it with a plane parallel to the direction of heat flow. The first and third parts are made of foam concrete with painted interior and exterior surfaces. We determine the thermal heat transfer resistance for these parts using the following formula.

$$R_I = R_{III} = \frac{0.500}{0.14} = 3{,}571 m^2 \cdot {}^\circ C / vt$$ Вт.

The surface of parts I and III $F_I = F_{III} = 0.05 \cdot 1 = 0.05m^2$.

The second part of the structure consists of heavy concrete covered with foam concrete on both sides.

$$R_{II} = \frac{0.20}{0.14} + \frac{0.10}{1.74} + \frac{0.20}{0.14} = 1.428 + 0.057 + 1.428 = 2.913 м^2 \cdot {}^\circ C / \text{BT}.$$

The surface of the second part $F_{II} = 0.30 \cdot 1 = 0.30 м^2$.

We determine the thermal heat transfer resistance of this structure using the following formula. [2,3]

$$R_{II} = \frac{F_I + F_{II} + F_{III}}{\frac{F_I}{R_I} + \frac{F_{II}}{R_{II}} + \frac{F_{III}}{R_{III}}}; \quad [1]$$

here, $R_I, R_{II}, R_{III} -$ thermal heat transfer resistance of separate layers, $м^2 \cdot {}^\circ C / \text{BT}$; $F_I, F_{II}, F_{III} -$ surfaces of separate parts, $м^2$;

$$R_{II} = \frac{0.05 + 0.30 + 0.05}{\frac{0.05}{3.571} + \frac{0.30}{2.913} + \frac{0.05}{3.571}} = \frac{0.40}{0.131} = 3.053 м^2 \cdot {}^\circ C / \text{Вт}.$$

We divide the structure into 1, 2 and 3 layers by cutting it with a plane perpendicular to the direction of heat flow. (Figure 1).

1st and 3rd layer, foam concrete $R_1 = R_3 \frac{0.20}{0.14} = 1.428 м^2 \cdot {}^\circ C /$ Вт;

To prevent layer 2 from being single-sex, determine the average thermal conductivity of the structure using the following formula. [2,3]

$$\lambda_{ўр} = \frac{\lambda_I \times F_I + \lambda_{II} \times F_{II} + \lambda_{III} \times F_{III}}{F_I + F_{II} + F_{III}} \quad [2]$$

here, $\lambda_I, \lambda_{II} \cdots$ thermal conductivity coefficient of materials forming separate layers, Вт $/ м^\circ c$;

$F_I, F_{II} \cdots$ surfaces of individual layers, $м^2$;

$$\lambda_{ўр} = \frac{0{,}14 \times 0{,}05 + 1.74 \times 0{,}30 + 0{,}14 \times 0{,}05}{0{,}05 + 0{,}30 + 0{,}05} = \frac{0.536}{0.40} = 1.34 Bm / м \cdot {}^\circ c \;;$$

Thermal thermal conductivity resistance of the second layer

$$R_2 = \frac{\delta_2}{\lambda_{ўр}} = \frac{0.10}{1.34} = 0.075 м^2 \cdot {}^\circ C / \text{В}m$$

so, $R_\perp = R_1 + R_2 + R_3 = 1.428 + 0.075 + 1.428 = 2.931 м^2 \cdot {}^\circ C /$ Вт;

The result of many practical studies and thermal calculations showed that always the value of coolant resistance (R_{II}) is equal to the value, and the value ($R_{\perp}$) is less than the value [3]

Therefore, the thermal conductivity resistance of the same-sex structure is determined by the following formula. [2,3]

$$R = \frac{R_{II} + 2R_{\perp}}{3} = \frac{3.053 + 2 \times 2.931}{3} = 2.971 м^2 \cdot {}^{\circ}C / \text{Вт};$$

We identify the total thermal conductivity resistance of a non-family wall structure consisting of foam concrete.

$$R_{ум} = R_и + R + R_T = 0{,}115 + 2{,}971 + 0{,}043 = 3.129 м^2 \cdot {}^{\circ}C / \text{Вт};$$

From the results of theoretical thermophysical studies we can conclude:

1. The general heat protection of the non-removable wall structure from the foam concrete recommended by us meets the requirements of all levels of heat protection specified in QMQ 2.01.04-97 *;

2. Resistance of the total thermal conductivity of the reinforced concrete wall structure $R_{ум} = 3.129 м^2 \cdot {}^{\circ}C / \text{Вт};$ 2.01 2nd level of thermal protection, given in the large QMQ 42% .04-97 *, and increases the energy efficiency of the building due to its 17% level.

References

1. Shukurov G.Sh., Boboev S.M. Physics of architecture. Part 1

2. "Construction thermophysics," a textbook. Tashkent "Trud" -2005. 160 b.

3. Shukurov G.Sh., Islamova D.G., textbook "Construction Physics." 2005 Samarkand 226 b

4. Fokin K.F. Strotelnaya teaches heat engineering. M.: Stroyizdat. 1973 g. 285 Art.

5. Shchipocheva E.V. The projection of energy-efficient civil diseases in a dry surgical climate is three-track - TTIMN. 2008

6. QMQ 2.01.04-97 * Construction heat engineering. Tashkent. 2011.

7. QMQ 2.01.01-94 Climatic and Physical Geological Data for Design. T 1996.

8. Шукуров, И. С., Сагатов, Б. Ў., & Ниятқул, Ғ. (2022). Том конструкциясини энергия самарадорлигини оширишда маҳаллий материалларини қўллашнинг муқобил ечимлари. Science and Education, 3(4), 548-554.

9. Шукуров, И. С., Сагатов, Б. Ў., & Нарзиқулов, Ғ. Н. Ў. (2022). Биноларнинг энергия самарадорлигини ошириш бўйича ривожланган

мамлакатлар ва Ўзбекистонда амалга оширилаётган ишлар таҳлили. Science and Education, 3(4), 601-608.

10. Asatov, N. A., Shukurov, I. S., Sagatov, B. U., & Usmonova, M. O. (2022). Binolarning pollardagi issiqlik yo’qotishlar xisobi. Science and Education, 3(4), 390-395.

11. Sagatov, B. U. (2022). O’zbekistonda energiya tejamkor binolar qurilishining ahvoli. Science and Education, 3(1), 261-265.

12. Asatov, N. A., Sagatov, B. U., & Maxmudov, B. I. O. G. L. (2021). Tashqi to’siq konstruksiyalarini issiqlik fizik xususiyatlariga ta’siri. Science and Education, 2(5), 182-192.

13. Uktamovich, S. B. (2016). About transfer of effort through cracks in ferro-concrete elements. European science review, (7-8), 220-221.

14. Sagatov, B. U. (2022). COMPOSITE MATERIALS FOR REINFORCING FERRO-CONCRETE ELEMENTS. Eurasian Journal of Academic Research, 2(3), 281-285.

15. Сагатов, Б. У. (2020). Исследование усилий и деформаций сдвига в наклонных трещинах железобетонных балок. European science, (6 (55)), 59-62.

16. Ашрабов, А. А., & Сагатов, Б. У. (2016). О передаче напряжений через трещины железобетонных элементах. Молодой ученый, (7-2), 41-45.

17. Матниязов, Б. И., Сагатов, Б. У., & Апроилов, А. А. И. (2023). Усиление железобетонных балок железнодорожных мостов композиционными материалами. Science and Education, 4(2), 687-691.