YEOJU TECHNICAL INSTITUTE IN TASHKENT
CENTRAL ASIAN JOURNAL OF STEM
http://stem.ytit.uz/

RESEARCH OF THERMAL PROPERTIES OF SMALL BLOCKS MADE OF LIGHTWEIGHT CONCRETE ON A POROUS FILLER FROM COAL MINING WASTE

O. D. Davronov - Ph.D., Associate Professor,
Yeoju Technical Institute in Tashkent
B. N. Inamov - Senior Lecturer at
Yeoju Technical Institute in Tashkent
B.B. Khasanov - Senior Lecturer, Tashkent Institute of Architecture and Civil Engineering

Annotation. The article identifies the thermal properties of barrier structures made of lightweight concrete, and the results are compared with a brick wall. The energy efficiency of these constructions is determined and the cost-effectiveness is calculated.

Annotatsiya. Maqolada yengil betonlardan tayyorlangan to`siq konstruksiyalarni issiqlik texnikasi bo`yicha xusisiyatlari aniqlanib, natijalar g`isht devor bilan taqqoslangan. Ushbu konstrusiyalarni energiya samaradorligi aniqlangan va iqtisodiy samaradorlik hisoblangan.

Аннотация. В работе определены теплотехнические характеристики ограждающих конструкций из легкобетонных полнотелых блоков и результаты сравнены с характеристиками кирпичной стены. Определен энергоэффективность таких ограждений и подсчитан экономия затрат.

Introduction

In recent years, housing construction has been rapidly developing in Uzbekistan. Providing the population with affordable housing is one of the priority tasks of the state. In this regard, projects of various types of residential buildings are currently being developed and introduced into construction practice. Improving design solutions, increasing their quality, and economic efficiency are, today, one of the important tasks of the construction industry. Unlike older buildings, modern homes are more comfortable and energy intensive. To improve the energy efficiency of multi-storey residential buildings under construction, innovative engineering equipment is used, new heat-insulating materials are implemented, and new operating technologies are being introduced.

In the conditions of our republic, one of the basic ways to solve these problems is to improve the thermal insulation qualities of building envelopes.

In recent years, the Department of Technology of Building Materials, Products and Structures of the Tashkent Architectural and Construction Institute has been conducting research on the development of lightweight concrete compositions

with porous aggregates obtained using local mineral resources and wastes from various industries in the Republic.

Lightweight concretes obtained with the use of porous aggregate from porphyry quartz and carbonized kaolinite clay, in terms of their physical and mechanical properties, resistance in aggressive environments and deformation characteristics, fully meet the requirements of regulatory documents. Especially noteworthy are the improved thermal properties of these concretes, which allow them to be used as enclosing structures. At the construction site of LLC "Kurilish-materialari invest", a pilot batch of small blocks of lightweight concrete, with a large porous aggregate, obtained using local rock-quartz porphyry and carbonized kaolinite clay-waste of the Angren coal deposit was made. Today, improving the energy efficiency of buildings is an important challenge facing scientists and builders. In solving these problems, an important role is played by the increase of the thermal insulation qualities of the building envelope by using new materials. The studied small blocks of lightweight concrete are one of these materials. The present work examines the thermal properties of these blocks and compares them with conventional brickwork. The results of heat engineering calculations of building envelopes using these materials for cold and hot periods are compared, in accordance with SNiP 2.01.04.-18 Building heat engineering [1]. A solid block with standard dimensions 390x190x188 mm is under consideration. To assess the thermal properties of the enclosing structure in accordance with the requirements of [1], their thermal resistance is determined. Lightweight concrete material D 1000, λ = 0.41 W/m · ^{0}C; s = 5.49 W/m · ^{0}C. Thermal resistance of the enclosing structure from a solid block with a thickness of = 0.39 m calculated according to [1] $R_{l.c.}$ = 0.95.

The reduced resistance to heat transfer to ensure the required, second level, thermal protection (R^0_{rq} = 1.8 (m2 · 0C) / W) will be equal to

$R^{tr}_{m.w.} = R^{tr}_0 - R_{l.c.}$ = 0,85 (m^2 ·^{0} C)/W.

The required thickness of mineral wool insulation should be determined:

$\lambda_{m.w.}$ = 0,06 W/m ·^{0}C;

$\delta^{tr}_{m.w.} = \lambda_{m.w.} \cdot R^{tr}_{m.w.}$ = 5,1 cm.

With a brick wall with a thickness of 1.5 bricks $\delta_к$ = 0,38 м and $\lambda_к$ =0,7 W/m ·^{0}C, the required thickness of mineral wool is equal to $\delta^{tr}_{m.w.}$ = 7.5 cm. Saving mineral wool when using solid blocks from light concrete is 7.5 - 5.1 = 2.4 cm or 32%. The thermal inertia of the enclosing structures is compared:

Brick wall: s_k = 9,2; $s_{m.w.}$ = 0,64,

D = $R_k \cdot s_k + R_{m.w.} \cdot s_{m.w.}$ = 5,8.

Wall of solid lightweight concrete blocks with $s_{l.c.}$= 5.49

D = $R_{l.c.} \cdot s_{l.c.} + R_{m.w.} \cdot s_{m.w.}$ = 5,77.

Let us compare the thermal resistance and thermal inertia of the enclosing structures with an equal thickness of the heat-insulating layer of mineral wool $\delta_{m.w.}$= 0.08 m.

Brick wall

$R_k + R_{m.w.}$ =1,88 (m$^{2\cdot0}$C)/W.

ISSN 2181-1628, Volume 1/2021

D = $R_k \cdot s_k + R_{m.w.} \cdot s_{m.w.}$ = 5,85.

Lightweight concrete solid block wall

$R_{l.c.} + R_{m.w.}$ = 2.28 ($m^{2 \cdot 0}$C)/ W.

D = $R_{l.c.} \cdot s_{l.c.} + R_{m.w.} \cdot s_{m.w.}$ = 6,076.

With practically the same thickness of the enclosing structures, the thermal resistance of a wall made of lightweight concrete solid blocks is 21%, and the thermal inertia is 4% higher than that of a brick wall. At the same time, the own mass of a wall made of a solid block is 1.8 times lighter than a brick one, which is important for seismic regions. Considering that a large proportion of heat loss in buildings occurs through the outer walls (about 35%), the use of lightweight concrete solid blocks instead of brick ones in low-rise buildings significantly increases their energy efficiency. Consider the economic feasibility of using these blocks. To do this, the consumption of materials for 1 m^3 of fencing is determined: 400 pieces of brick, 180 pieces of concrete block. If the market value of one brick is currently 800 soums, then the cost of one concrete block is within 1200-1300 soums. Cost savings per 1 m^3 of fencing only in terms of material cost is

800x400 - 1300x180 = 230,000 soums.

In addition, the construction of wall blocks made of lightweight concrete is carried out almost twice as fast as brick. According to preliminary estimates, the use of these blocks can reduce the consumption of thermal energy for buildings by up to 8%. Considering that the share of low-rise buildings in the Republic of Uzbekistan in mass construction is quite large, the economic effect of reducing fuel consumption will be significant. All this shows that the use of concrete blocks made of lightweight concrete obtained using porous aggregate of quartz porphyry and carbonized kaolinite clay as enclosing structures for low-rise buildings increases the energy efficiency of buildings and promises great economic benefits.

References

1. ҚМҚ (SNiP) 2.01.04-18 Stroitelnaya teplotexnika (Construction heat engineering) Tashkent, 2018.

2. Khodzhaev S.A., Kadyrov R.R., Khodzhaev S.A. (2017) Povishenie energoeffektivnosti jilischno-grajdanskix zdaniy (Improving energy efficiency of residential buildings) Edited by Doctor of Technical Sciences, Professor S.A. Khodzhaeva. Fan va texnologiya publishing house. Tashkent

3. Gaziev U.A., Shakirov T.T. (2010) Poristiy zapolnitel dlya legkix betonov na osnove otxoda ugledobichi i mesinix gornix porod (Porous aggregate for lightweight concrete based on waste from coal mining and mixed rocks) Materials of the Republican Scientific and Technical Conference “Resource-saving technologies in railway transport” TashIIT. Tashkent