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Improving the Heat Preservation Properties of the Exterior Walls of Brick Buildings

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ANNOTATION

Brick walls have a large thermal inertia: they heat up slowly and cool down slowly, so the greater the thickness of the wall, the greater the thermal inertia. In houses with brick walls, the internal temperature of the room changes little during the day, which is an advantage of brick walls.

KEYWORDS: simple, light and multi-hole ceramic bricks, solid (homogeneous) and lightweight (non-homogeneous) walls, cement-sand, cement-soil or cement-lime mixes, hot mixes, energy-efficient.

Introduction: Simple, light and multi-hole ceramic bricks and silicate bricks are used in bricklaying. The shape of the brick is a right-angled parallelepiped, the dimensions of the ordinary brick are 250x120x65 mm, and the size of the thick brick is 250x120x88 mm. The height of a brick wall row is the height of the brick and the thickness of the horizontal joint (12 mm). The thickness of the vertical joints is usually 10 mm. The height of each row is on average 77 mm for ordinary bricks and 100 mm on average for thick bricks. 13 rows of ordinary and 10 rows of thick bricks are laid on a brick wall 1 m high.

Brick walls are divided into solid (homogeneous) and lightened (non-homogeneous) walls. Solid brick walls are built from simple, light and multi-hole bricks using cement-sand, cement-soil or cement-lime mixtures. Here, cement, lime, soil are used as a binder, and sand is used as a filler. Since the heat transfer coefficients of brick and mixture are close to each other, monolithic brick walls are considered homogeneous walls from a thermotechnical point of view. The thickness of homogeneous brick walls is taken as a multiple of 1/2 brick (120 mm). The thickness in mm of a brick wall with a thickness of 1, $1\frac{1}{2}$, 2, $2\frac{1}{2}$, 3 will be 250, 380, 510, 640 and 770 mm, respectively (taking into account the thickness of the vertical seam of 10 mm). Based on thermal engineering calculations, if necessary, it is allowed to take the thickness of a brick wall greater than the specified dimensions by increasing the thickness of the longitudinal vertical joints. In a lightweight well wall, the extreme rows of a half-brick thickness at a distance of 140 ... 270 mm are interconnected by vertical transverse half-brick

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diaphragms at a distance of 530-1050 mm. Rows of bricks in the transverse diaphragm are tied in each row to the longitudinal edge rows. The hole formed between the longitudinal and transverse brick joints in the wall can be filled with expanded clay, slag and similar bulk materials, lightweight concrete, blocks of lightweight or cellular concrete.

Brick is a strong, durable material. Therefore, all the bricks produced in our Republic are suitable for laying the walls of low-rise buildings (Table 1).

Characteristics of masonry bricks Table 1

№	Brick	dimensions, мм	Mass of one brick, kg
1	Plain ceramics with plastic pressing	250x120x65	3,2 - 3,5
2	Plastic and dry pressed hollow core	250x120x65 250x120x88 250x120x138	2,2 - 2,8 2,7 - 3,7 4,6 - 5,8
3	Silicate	250x120x65 250x120x88	3,3 - 3,7 4,5 - 5,0

In order to increase the thermal insulation capacity of the walls of low-rise energy-efficient residential buildings, it is necessary to use thermal compounds for the type and the insulation. Heat mixtures - instead of sand, slag, expanded clay, tuff and other similar small fillers are used. They also increase the heat protection quality of the wall by 10-15%. A lightened brick wall, built with only an air layer 40-50 mm thick, is even more economical (Fig. 1).

In a lightened brick wall built with an air layer, the consumption of bricks is reduced by 15-20%, but according to the requirements of statics, the air layer is placed as close to the outer surface as possible, and in order to eliminate air permeability, the wall must be watered from both sides. If the air layer is filled with mineral fiber (bituminized mineral fiber), the energy efficiency of the brick wall increases by 30-40%, if foam plastic is used, this indicator increases to 200%. For the construction of a brick wall that is lightened by leaving an air layer, both ordinary bricks and energy-efficient bricks (multi-hole ceramic bricks, in which the volume of the holes is 20-45% of the volume of the brick) can be used. The use of energy-efficient brick reduces the mass and heat transfer of the wall compared to ordinary brick, which leads to a reduction in the thickness of the wall, while maintaining the heat-insulating properties of the wall. It is not allowed to use energy-saving brick in the construction of foundations, plinths, walls of rooms with high humidity, and stoves.

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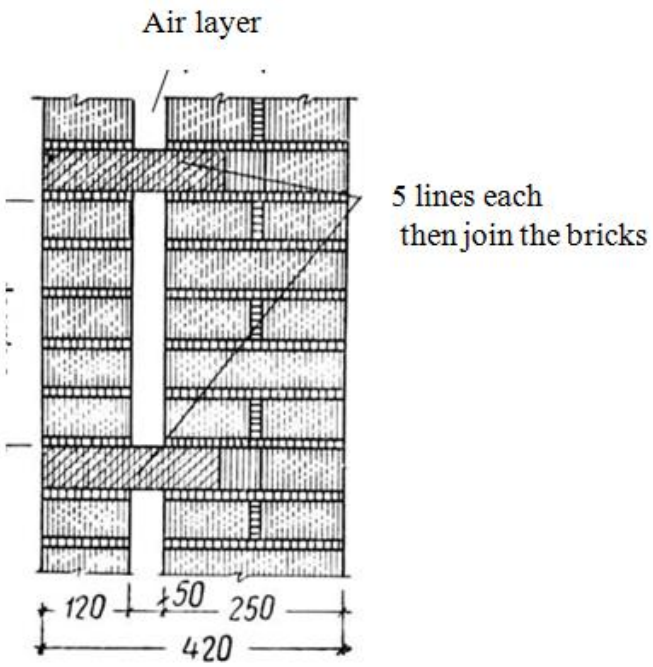

Figure 1. Lightened brick wall with an air layer

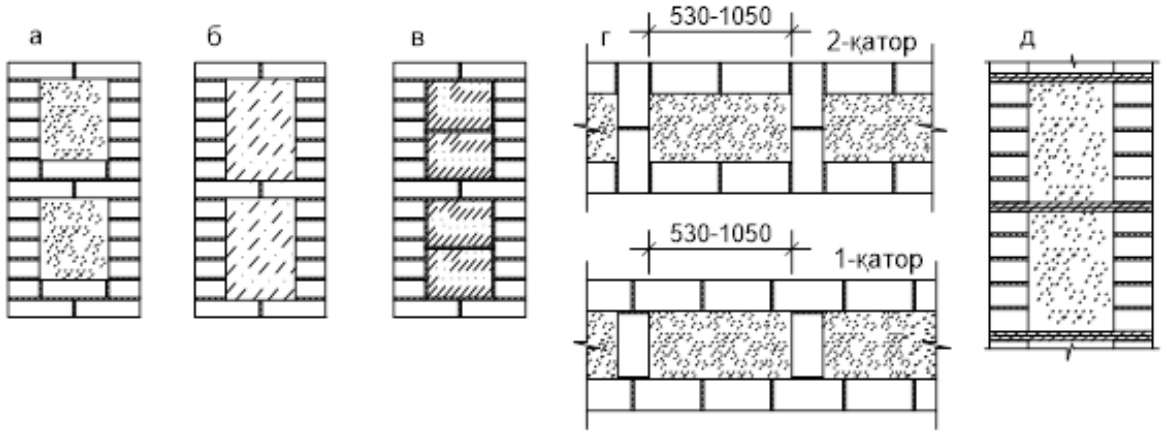

Figure 2. Lightened brick walls: a - filled with textile material; b - filled with lightweight concrete; v - filled with ready-made blocks; g - wall with a well; d - placement of horizontal reinforced viewing diaphragms on the well wall

In the construction of low-rise buildings, lightweight brick walls are used as a constructive solution that meets heat engineering and strength requirements without increasing the wall thickness, when it is necessary to increase the thickness of a solid brick wall according to heat engineering requirements, but this is not necessary according to strength requirements (Fig. 2). Currently, lightweight brick walls are used together with thermal insulation boards. They consist of two parts: 1 or 1.5 brick layers and an additional layer of thermal insulation of various shapes, i.e., cellular concrete and other thermal insulation materials).

When choosing them, it is recommended to take them as lightly as possible. Because the loads on the foundations from all layers associated with the installation of additional thermal

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insulation can become significantly larger, especially in multi-story buildings.

Examples of the construction solution of the external brick wall are given in Table 2, as can be seen from the table, the worst relative technical and economic indicators belong to the single wall made of ordinary clay and silicate bricks.

Options for the construction of an external brick wall Table 2

№	Brick	density, kg/m3	Wall construction	Wall thickness	The calculated temperature of the outside air is °C
1	Ordinary ceramic and silicate	1600-1900	From the inside, it is built integrally in cold mix	25	-5
2				38	-10
3				51	-20
4				64	-30
5			From the inside, it is built integrally in cold mix	25	-10
6				38	-15
7				51	-25
8				64	-35
9			50 mm thick air-layered, plastered inside and outside, whole-typed in cold mix	29	-10
10				42	-20
11				55	-30
12			50 mm thick air layer filled with mineral fiber, plastered inside and outside, cold mixed	29	-20
13				42	-30
14				55	-40
15			The well was built in cold mix, filled with bulk materials with a density of 1400 kg/m3, plastered from the inside.	38	-15
16				51	-30
17			Filled with 1000 kg/m3 bulk materials, internally grouted, built well in cold mix	38	-25
18				51	-40
19			100 mm thick, density 800 kg/m3 wood fiber or wood chip thermal insulation board is installed on the inside, built integrally in cold mix	25	-20
20				38	-30
21			150 mm thick, density 800 kg/m3 wood fiber or wood chip thermal insulation board is installed on the inside, built integrally in cold mix	25	-25
22				38	-35
23			50 mm thick mineral wool thermal insulation board with wood cladding is installed on the outside and plastered on the inside, cold-mixed.	25	-20
24				38	-30
25			Outside, a heat-insulating slab of mineral wool 100 mm thick with wood lining is laid, and inside it is plastered, densely packed with cold mixture.	25	-30
26				38	-40

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27	Multi Hole Ceramic	1100-1400	From the inside, it is built integrally in cold mix	25	-10
28				38	-20
29				51	-30
30			Plastered from the inside, placed integrally in hot mix	25	-15
31				38	-25
32				51	-35
33			50 mm thick air-layered, plastered inside and outside, whole-typed in cold mix	29	-15
34				42	-25
35				55	-35
36			50 mm thick air layer filled with mineral fiber, plastered inside and outside, cold mixed	29	-25
37				42	-35
38				55	-45

That's why it is not considered economically viable if the thickness of a brick made of ordinary ceramic or silicate brick is greater than 38 cm (1.5 bricks).

Conclusion: In order to reduce the consumption of bricks, to reduce the mass of the wall and the load falling on the foundation, the outer wall should be made of clay bricks with many holes, or with an air layer during construction, or if not, it should be made of wells. In addition, it will be necessary to use energy-saving thermal insulation, warm compounds for construction and cooling. The use of energy-efficient brick reduces the mass and heat transfer of the wall compared to ordinary brick, which leads to a reduction in the thickness of the wall, while maintaining the heat-insulating properties of the wall.

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