World Bulletin of Management and Law (WBML)
Available Online at: https://www.scholarexpress.net
Volume-17, December 2022
ISSN: 2749-3601

THREE-LAYER REINFORCED CONCRETE WALL PANELS FROM LIGHT AND HEAVY CONCRETE FORCIVIL BUILDINGS

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Article history:

Received: October 1st 2022
Accepted: November 1st 2022
Published: December 6th 2022

Abstract:

Assembling buildings is the next step in the transition from elements to construction. In such buildings, external and internal walls, partitions and roofs, curtain walls, stair marches and platforms are produced from large panels. But such large panel constructions are not without some drawbacks. One of the biggest disadvantages of such constructions is high production efficiency. In today's environment of energy resource problems, such shortcomings are again visible.

But such constructions cannot be completely abandoned. The reason is that when building buildings from such large wall-panel constructions, the number of assembly operations is drastically reduced, and construction periods are significantly reduced. Therefore, it is necessary to reduce the heat transfer coefficient of such structures either during the production process or during the renovation process.

This article presents developments on improving the energy efficiency of buildings. The energy efficiency of some structures was also analyzed.

Keywords: Large wall panels, Energy efficient constructions, heat transfer coefficient, renovation.

Increasing the thermal protection of civil buildings in order to save fuel and energy resources and reduce operating costs for heating is an urgent problem in construction. Its solution can be achieved through the use of enclosing structures with high resistance to heat transfer, primarily walls, as well as attic floors and coatings.

ATIn construction practice, various types of three-layer external wall panels of industrial buildings with external layers of light or heavy concrete are used. As a heater, heat-insulating materials (mineral wool, fiberglass and polymer), as well as lightweight concrete of low and medium density, are used.

The outer and inner layers of the three-layer panels are connected to each other with the help of connections that ensure their independent or joint work. Various types of links are used. These include: shear ties in the form of steel rods and reinforced concrete beams; combined, providing for the suspension of the outer enclosing layer to the inner carrier and the installation of a spacer; connections in the form of steel vertical trusses with a triangular lattice, the belts of which are located in the outer layers.

Three-layer panels with effective insulation and shear ties in the form of steel rods have been developed and used for curtain and self-supporting walls of horizontal cuts in industrial buildings. In the outer layers they use mainly heavy concrete. In these panels, all vertical loads are perceived by the internal bearing layer, and the outer enclosing layer is connected to the inner one using flexible connections in the form of steel pins protected from corrosion.

The advantages of such panels include the simplicity of the designs of connections and their installation. The panels are produced in horizontal molds with the front surface facing the mold tray. Carpet tiles are laid in accordance with the "Recommendations for finishing the facade surfaces of panels for exterior walls." Thermal insulation boards are laid tightly to each other (insulation thickness 100 ... 150 mm) or in two layers with offset joints in the layers.

Moreover, the upper part of the tie-pin is anchored in 5 cm of the outer enclosing layer. The conducted studies confirm the reliability of such a connection between the layers. Depending on the material and thickness of the heat-insulating layer, the area of construction, the temperature and humidity conditions in the room, the panel provides for a vapor barrier device in the form of a polyethylene film or roofing felt (between the thermal insulation layer and the inner reinforced concrete layer of the panel).

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In panels with thermal insulation made of mineral wool slabs, sack paper is laid between the outer concrete layer and mineral wool slabs, regardless of the temperature and humidity conditions of the premises and the climatic area of construction.

The disadvantage of the adopted design is the large heat loss through steel connections. For example, for three-layer panels sized 1.2x6m with expanded polystyrene insulation, with two-row placement of studs in height from reinforcement of a periodic profile with a diameter of 10 mm from class A-II steel with a length step of 0.8 m, the coefficient of thermal uniformity is 0.6.

Calculations show that with an insulation thickness of 15 cm, the deflection of the outer enclosing layer from its own weight relative to the bearing inner layer does not exceed 1.5 mm, which is less than that allowed for external walls (2 mm). Therefore, with a smaller thickness of the insulation, an increase in the thermal uniformity of the panels is possible by reducing the diameter of the ties-studs to 8...6 mm.

The heat transfer resistance of three-layer panels Ro, m2xC/W, is determined by the formula of SNiP "Construction Heat Engineering".

$$R_0 = 1/\alpha_B + R_K + 1/\alpha_H \quad (1)$$

where α_B - heat transfer coefficient of the inner surface of the enclosing structure, taken for walls equal to 8.7 W/(m2xoC); α_H - heat transfer coefficient of the outer surface of the enclosing structure, taken for the outer walls equal to 23 W/(m2xoC); Rk is the thermal resistance of the enclosing structure, m2xoC/W, determined for three-layer structures with sequentially located homogeneous layers as the sum of the thermal resistances of individual layers according to the formula

$$R_K = R_1 + R_2 + R_3 \quad (2)$$

Here R_1, R_2, R_3 - thermal resistance of individual layers of the enclosing structure, m2xoC / W, determined by the formula

$R = \delta / \lambda$ (3)

where δ - layer thickness, m; λ -calculated coefficient of thermal conductivity of the layer material, W/(mhoC).

To evaluate the calculated values of the resistance to heat transfer of various types of three-layer panels with a heat-insulating layer of effective insulation, they were compared with building envelopes, which are widely used in modern construction.

As analogues of strip-cut wall panels, constructions of the 1.432-12-80 series "Walls made of reinforced concrete three-layer panels on flexible ties with effective insulation for buildings with normal and wet conditions, including those with a design seismicity of 7.8.9 points" were used. as well as panels according to the series 1.030.1-1 "External walls made of single-layer panels for frame public buildings, industrial and auxiliary buildings of industrial enterprises."

Three-layer panels according to the 1.432-12-80 series are designed with outer layers of heavy concrete of strength class B 12.5 on Portland cement with a thickness of 10 and 5 cm, and the middle layer is made of polystyrene foam with a density of 100 kg / m3.

Single-layer panels according to the 1.030.1-1 series are designed from expanded clay concrete of strength class VZ.5 with an average density of 1100 kg/m3 with improved thermophysical characteristics.

The comparison revealed that the heat transfer resistance of single-layer panels, even with improved thermal characteristics at a thickness of 25...65 cm, is 1.95...3.46 times less than that of three-layer panels. Their use to meet the requirements of the second stage of thermal protection of buildings is not advisable - the material consumption of walls increases sharply due to an increase in their thickness, as well as the energy consumption for their manufacture.

Thus, in the transition to new requirements for thermal protection, the use of single-layer enclosing structures made of lightweight and cellular concrete turned out to be ineffective, since their thickness significantly increases, and as a result, their weight, material consumption, energy intensity and cost.

Obviously, with the new increased requirements for the thermal protection of buildings, the walls must be made multilayer using effective heat-insulating materials.

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World Bulletin of Management and Law (WBML)
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Volume-17, December 2022
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Volume-17, December 2022
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