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Design of Thermal Protection of Exterior Walls of Residential Buildings

Sadriddin Sayfiddinov

Professor of department "Building and structures" at Tashkent institute of architecture and civil engineering, Tashkent, Uzbekistan.

ABSTRACT:The article presents the results of theoretical studies to improve the energy efficiency of exterior walls. An energy-efficient constructive solution for the installation of external walls is proposed during their reconstruction and overhaul.

KEY WORDS: design, residential buildings energy, efficiency, external walls, exterior walls.

I.INTRODUCTION

Nowadays, mankind has come close to the global environmental and energy crisis. This stimulates the development of developments related, firstly, with the use of renewable energy sources, and secondly with the intensification of the energy consumption process itself, thereby reducing heat losses in heating and air conditioning.

Currently, the main task is to transform the architecture of the building so that it needs as little as possible heating and cooling.

For this, the energy efficiency of buildings should depend on:

- From thermal protection of building envelopes;
- The level of thermal protection based on calculations of the heat balance of the building;
- Calculation of reduced heat transfer resistance;
- Requirements for constructive and architectural solutions of buildings in terms of their thermal protection;
- Methods and calculations for determining the resistance to air-vapor permeation, heat resistance of the external walling of the building's heat and power parameters, and reduction of the specific heat consumption.

In the heat engineering design of thermal protection of buildings in each case, the following tasks are successively solved:

- Determination of the parameters of the external climatic conditions CNR 2.01.01-94 Climatic and physic-geological data for design and methods for assessing positive and negative impacts;
- Determination of the humidity regime of the premises of buildings and the operating conditions of buildings;
- Determination of energy efficiency class of buildings; (residential, medical, children's) public and industrial [1-2];
- Determination of the level of thermal protection (CNR, CRN) [1-3] for individual building envelopes (walls, joints, windows, coatings) according to normalized values of heat transfer resistance or normalized specific heat energy consumption for heating.

Building envelope design:

- with the determination of the estimated heat engineering characteristics of building materials and structures (γ, c, λ, s, μ, J, ρ);
- the calculation of the reduced resistance as individual elements of the building envelope (CNR);
- determination of thermal protection $R_d^{\text{тр}}$;

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- if necessary, changes are made both to the design of the building as a whole and to the building envelope [1-2];

- The selection and calculation of light-transparent fencing and structures for the required resistance to heat transfer and air permeability (CNR);
- Calculation of the heat resistance of building envelopes in the summer;
- Determination of compactness indicators, the ratio of the total inner surface of the outer walls to the heated volume.

II. METHODS OF RESEARCH

Drawing up a section of the project "Energy Efficiency" (from the classification of buildings, taking into account the geometry of buildings, specific energy consumption).

Calculation of the outdoor temperature $t^{j}_{n}C$ based on the average temperature of the coldest five-day period with 0.92 (CNR or the nearest points); 2-the duration of the heating difference Z, days and the average t of outdoor air t^{cp}_{cp} during the heating period (CNR). The value of hail day D_d –the course of the heating period is determined by the formula [3]:
$D_d = (t_b - t_{from\ transfer}) * Z_{from\ transfer}$

Table.1. Air parameters inside residential and public buildings

City	18^0 C	$18^0 CR_0^{requirements\ \ transfer\ .}$
Tashkent	2000	2200
Urgench	2500	2800
Termez	1300	1400

Air parameters inside residential and public buildings from the conditions of comfort:
a) t_b^{heat} no higher than residential 20-22 C, (φ-55% medical 21-22 φ = 55, pre-school 22-23 φ = 55 t_b^{heat} permissible residential 24-28, φ = 60% not higher than kindergartens.)
b) humidity conditions (dry, normal, wet or wet);
c) the temperature of the inner surface of the outer enclosures of buildings (in corners, slopes, joints) at calculated t_n and φ_n - air dew point temperature, t_b = 10.7 0C, polyclinics t_b = 10.7 0C preschool institutions-12.60 C.

Characteristics of building materials and structures for conditions A and B; calculated coefficient of thermal conductivity V t / (m 0 C);
- estimated heat transfer coefficient S, W / (m_2 0C);
- specific heat (in dry condition) C0-kJ / (kg 0 C);
- vapor permeability coefficient μ, kg / (m * h * Pa), vapor permeability resistance RH, m^2 * h-Pa / mg;
- thermal resistance of air layers R_h-m^2 * 0 C / W;
- window heat transfer resistance (certified value) - air permeability and its certified value RH, m^2 * h * Pa / kg;
- ρ is the absorption coefficient of solar radiation on the surface of the fence.

Principles for determining the standardized level of thermal protection of buildings.
New CNR [3] provide the design of thermal protection of buildings at a given consumption of thermal energy to maintain the established microclimate parameters, premises with ensuring sanitary and hygienic conditions. 3 obligatory interconnected standardized temperature indicators are established for thermal protection of buildings based on:

- standardized values, heat transfer resistance for individual building envelope thermal protection of buildings;
- the normalized values of the temperature difference between the temperatures of the internal air and on the surface of the building, the structure and the temperature on the internal surface of the building above the dew point temperature;
- the standardized specific indicator of the consumption of thermal energy for heating, which allows varying the values of the heat-shielding properties of the enclosing structures, taking into account the use of architectural, construction, heat engineering and engineering solutions aimed at saving energy resources.

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In the process of building design, it is determined by calculating the specific heat energy consumption indicator, which, depending on the thermotechnical properties of the building envelope, the space-planning solution of the building, the heat generation and the amount of solar energy entering the building's premises, the efficiency of engineering systems and heat supply systems, i.e. this indicator should not exceed the normalized indicator.
Block design circuit for thermal protection according to CNR [3]

The choice of heat-shielding properties of building envelopes should be performed in the sequence:

1. Determine the climatic indicator of the type of building.
2. Select outdoor climatic parameters.
3. Select the humidity regime of the building.

Improving the energy efficiency of existing buildings should be carried out during overhaul, reconstruction, expansion and functional reassignment.

The requirement of CNR and CRN is considered fulfilled if the actual resistance to heat transfer of the external building envelope is at least 90% of the established values of CNR.

III.CONCLUSION

Consequently, drawing up an energy passport of buildings it is part of the design and acceptance documentation and is set out in the following sequence:

- information about the type and functional purpose of the building, its number of storeys and volume; architectural composition, orientation;
- data on space-planning decisions indicating parameters;
- orientation, area of walling, flooring, coatings, space heating;
- climatic characteristics of the construction area, data on the heating period;
- design solutions for thermal protection of buildings, reduced resistance to heat transfer elements of the building separately and in general;
- building characteristics - specific heat energy consumption for heating during the heating period and their relation to m2 of the heated area;
- energy efficiency class of buildings;
- recommendations and increase the energy efficiency of buildings.
- the energy passport of the building, its form [1], must contain:
- general information about the project;
- settlement conditions;
- information on the functional purpose and type of building;
- volumetric planning and layout indicators of the building;
- design and energy indicators of the building, including indicators of energy efficiency, heat engineering indicators;
- information on comparison with standardized indicators;
- recommendations for improving the energy efficiency of buildings;
- results of measuring energy efficiency and thermal protection after a year of operation.

Furthermore, algorithm of energy passport of buildingsdivided into two the following "Indicators A" and "Indicators B" of the choice of the method of compliance with the standardized indicators of thermal protection:

1) Indicator A:
according to elemental standards for building envelopes;
selection of element-wise quantities R in degree-day;
calculation of specific heat energy consumption q_*Q;

2) Indicator B

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in terms of energy consumption
selection of specific heat energy consumption q_*Q
determination of element values by q for $R_0^{tr} \geq R_0 \geq R_{min}$
calculation of specific heat energy consumption $q \leq q_{heating}$

After checking temperature limits on the inside $\Delta t_b \leq \Delta t_p$. The next stage will calculation of reduced resistance to heat transfer of air permeability, protection against moisture, heat resistance, condensation loss check according to "b".The include energy pass of the building. Finished by check for compliance of calculated indicators with standardized indicators.

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