Development of engineering calculator to copmutation the heat flux for heating of buildings on extended feature settings

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Abstract
The algorithm of the calculator is based on the method of determining the amount of heat energy and heat carrier in water systems of municipal heat supply. The author carried out a systematic analysis of thermal loads on heating of buildings in Russia according to the data of implemented building projects. With this in mind, new coefficients a, n were calculated to determine the specific heating characteristics of the building for newly constructed buildings. The calculation algorithm is implemented in the software product, using html programming.

Keywords
heating, heat flow, calculation algorithm, engineering calculator

1. Introduction

The calculation algorithm is based on the method of determining the amount of heat energy and heat carrier in water systems of municipal heat supply [1].

The disadvantage of this method is overestimated specific heating characteristics, as a result of which, when calculating thermal loads according to the set of rules by designers [2], the data with the method for enlarged parameters of the object[1] significantly differed. This is justified by the introduction of new building materials for thermal protection of buildings, the use of automated individual heat points, new heating devices with higher heat transfer coefficients, the use of new materials for thermal protection of pipelines, as a result of which the consumption of thermal energy for heating buildings and reducing the specific heating characteristics of buildings are reduced [3].

2. Research method

To solve this problem, a systematic analysis of thermal loads on heating of buildings built after 2000 years in Russia was carried out according to the data of implemented projects in various climatic zones. As a result, the coefficients a, n were corrected for calculating the specific heat flux in formula 4 [1]. The new coefficients a, n are obtained empirically, including for various purposes of buildings (residential and other purposes).

The algorithm for calculating the heat flow to the building implemented in the engineering calculator is described below.

The heat flow for building heating (hourly) is determined by the following formula [1]:

$$Q_{\text{o}} = \alpha \cdot V \cdot q_{\text{o}}(t_{\text{in}} - t_{out}) \cdot (1 + K_i)\,, \qquad (1)$$

where α is the correction factor (taken in accordance with Table 1 [1]); V is construction heated volume, m^3; q_{o} is specific heat flux for heating of the building Watt/м$^{3\cdot\circ}$grad; t_{in} is the air temperature in the heated room in accordance with [5], grad.; t_{out} is outdoor air temperature for heating design in accordance with [4], grad.; K_{i} is coefficient of air infiltration for heating buildings.

Specific heat flow for building determined by the formula:

$$q_{\text{o}} = \frac{a}{\sqrt[n]{V}}\,, \qquad (2)$$

where a,n are the new coefficients obtained (for residential buildings a=1, n=7; for other buildings a=1, n=5), V is the heated building volume, m^3.

The coefficient of air infiltration for heating buildings is determined by the formula:

$$K_i = 0{,}01 \cdot \sqrt{2 \cdot g \cdot L \cdot (1 - \frac{273+t_{\text{out}}}{273+t_{\text{in}}}) + \omega^2}\,, \qquad (3)$$

where g is the acceleration of gravity, m/s^2; L is the height of the building, m; ω is the average wind speed during the heating period according to [4], m/s.

3. Results of the study

Figure 1 shows a comparison of the specific heat flow for heating residential buildings before 1958 years, from 1958 to 2000 years, from 2000 years of construction. The specific heat flow for heating buildings in time intervals ranges up to 30%.

Currently, this method [1] is not used everywhere in the Russian Federation, although in some resource-supplying organizations it has been used and is used to conclude contracts with consumers and pay for heat energy in the absence of heat meters or during their non-working condition, the absence of project documentation for heating and ventilation. The application of these values is possible in different time intervals, depending on the materials of the enclosing structures. This should be taken into account when choosing specific values of heat flow for heating buildings.

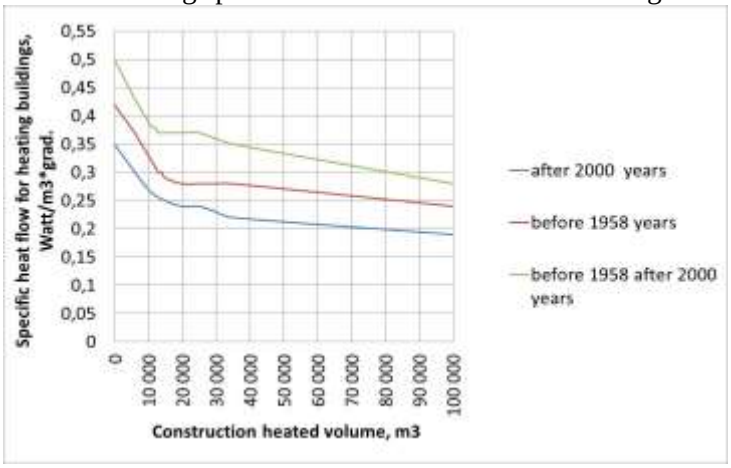

Figure 1: Diagram of the dependence of the specific heat flow for heating buildings according to data [1] and new data of coefficients *a, n*

4. Conclusion

The author carried out a systematic analysis of thermal loads on heating of buildings built after 2000 in Russia according to calculations from building projects. With this in mind, new coefficients a, n have been developed for calculating the specific heating characteristics of buildings. Taking into account the method of determining the amount of heat energy and heat carrier in water systems of municipal heat supply [1] and the derived new coefficients, the algorithm for calculating the heating of buildings according to the enlarged parameters of the object is corrected. The calculation algorithm is implemented in the software product, using html programming.

5. References

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