THE INFLUENCE OF SOLAR RADIATION ON THE TEMPERATURE REGIME OF FENESTRATION PRODUCT

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Objective. The report presents the results of numerical modeling of the energy flow through a window structure built into the window opening of a building. The calculated area includes a window opening with jambs, a window block, assembly seams, a window sill, as well as part of the hull wall where the window opening is located. The window model consists of a three-chamber profile, a frame and a two-chamber double-glazed window. A foam is used as a sealant and heat insulation between the window and the window opening. The purpose of this work is to create a three-dimensional CFD window model and conduct numerical experiments to study aerodynamics and heat transfer through window structures in real climatic conditions of their operation when exposed to solar radiation.

Development results. In the considered CFD model of energy transfer through fenestration product, two main mechanisms are taken into account: heat transfer between the air inside and outside the room and solar radiation. Infiltration air flow into the room is not counted. Heat transfer between air is carried out by heat conduction and convection. Radiation heat transfer between the elements of the window structure is also taken into account. Solar radiation depends on the geographical location of the building in question, air pollution and cloudiness. In this model, solar radiation is determined by the geographical coordinates of Kyiv and corresponds to 12 o'clock of the winter solstice day under conditions of moderate cloud cover. In the CFD model, the radiant energy flux is divided into two intervals by wavelength: $1.0 \times 10\text{-}7 \div 3.0 \times 10\text{-}6$ m and $3.0 \times 10\text{-}6 \div 1.0$ m. The first interval corresponds to the spectrum of solar radiation (shortwave radiation), the second interval - longwave radiation. Such a separation is necessary because, by its properties, glass almost completely transmits radiation with wavelengths from the first interval and practically absorbs radiation with wavelengths from the second interval.

Conclusion. As a result of numerical experiments, a significant effect of solar radiation on the formation of the temperature regime of the window system and the non-transparent elements of the building's facade adjacent to the window was established. In particular, in the daytime under the influence of solar radiation, the temperature of the opaque elements of the window construction and the surrounding walls of the facade from the environment under conditions of natural convection exceeds the air temperature by more than 30° C, which in turn affects the temperature distribution and thermal resistance of the glass unit. Thus, the consideration of solar radiation is a prerequisite for the calculation of the temperature regimes of window systems.