POLITECHNIKA ŚLĄSKA

KATEDRA OGRZEWNICTWA, WENTYLACJI I TECHNIKI ODPYLANIA

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MODELOWANIE ROZDZIAŁU POWIETRZA WENTYLACYJNEGO W HALI PŁYWALNI

Rozprawa doktorska

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Gliwice 2017

ABSTRACT

The doctoral dissertation entitled '**Modelling of ventilation air distribution in the indoor swimming pool**' encompasses complex research in the field of ventilation air distribution modelling in the indoor swimming pool. Its aim was the experimental validation of the numerical model CFD of air, heat and moisture flow in the ventilated indoor swimming pool for various methods of moisture emission modeling, as well as the application of validated model to research of ventilation air volume rate impact on thermal-moisture conditions in the swimming pool, connected with the assessment of energy expenditures. The scope of the study encompassed the actual school swimming pool. The doctoral dissertation includes study, experimental and simulation sections.

In the study section, the current state of knowledge of indoor swimming pools ventilation was presented, in particular required air parameters, heat and moisture sources, air volume rate calculations, methods of ventilation air treatment with heat recovery and air distribution systems in this type of facilities. Also, in this section the review of literature sources related to the research of turbulence models, moisture emission from pool water, ventilation air distribution and energy analysis of ventilation systems in indoor swimming pools is included.

Experimental identification of air, heat and moisture flow in the actual indoor swimming pool and the research of temperature distribution on the facility's walls with the use of thermovision were carried out in various periods of year. Research results were used during further stages of the dissertation as boundary conditions for numerical computations, as well as the data for numerical model validation.

In the first stage of numerical research, the numerical model CFD of ventilation air distribution in the swimming pool was prepared and improved with the use of Ansys CFX software and experimental research results. Turbulence model which suited turbulent air jets modelling the best was selected. Discretization grid was selected and tested. The own method of moisture emission modelling from water pool was proposed, based on implementation of various formulas describing this emission to the computer software and the selection of the one which most appropriately reproduced the course of phenomena.

Then, for the selected formula of moisture emission modeling, a full experimental validation of numerical model of air, heat and moisture flow in the indoor swimming pool was carried out.

The validated model was used in multi-variant numerical research on the impact of ventilation air volume rate on thermal-moisture conditions in the facility. It was concluded that a reduction of air volume rate value resulted in deterioration of these conditions. Therefore, the own method of their improvement in lifeguard's occupation zone with the use of local air supply was proposed.

In the final stage of the dissertation, with the use of IDA ICE software, the impact of changes in air volume rate on energy consumption for ventilation during whole year was evaluated. Also, the possibility of reducing this consumption with the use of two-stage heat recovery system was tested. Furthermore, it was examined, to what extent the installation of local air supply impacted the increase in energy expenditures.

Results of the dissertation, as well as developed and verified research methods are utilitarian and can be applied in new indoor swimming pools design and also during modernization of ventilation systems in existing facilities in order to improve thermal-moisture conditions by virtue of occupants and maintenance of building's good technical condition.