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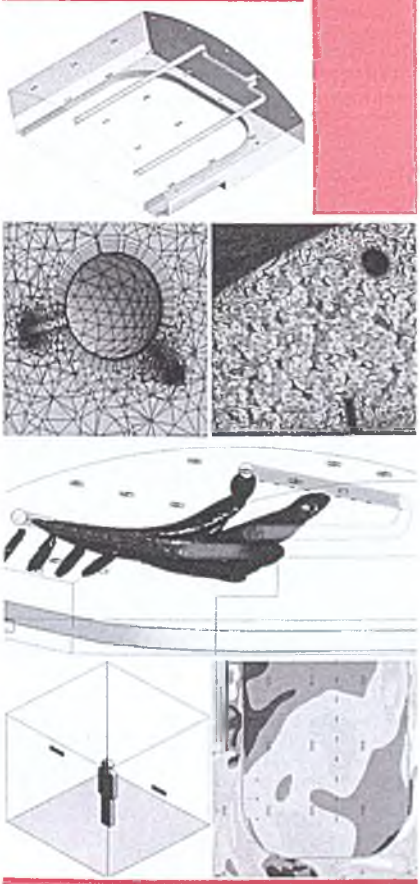
ROZPRAWA DOKTORSKA



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Rozprawa doktorska

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Abstract

PhD thesis about *Modelling of the ventilation air distribution system in the indoor ice rink arena* applies to the numerical modelling of air, heat and moisture flow in the ventilated, actual ice rink arena. The aim of this study was the experimental validation of the numerical model of the tested facility. In addition to this was research on improving flow, thermal and humidity conditions in such an object due to the presence of people and maintaining a good technical condition, conducted with the use of the validated model. The usage of the Computational Fluid Dynamic (CFD) technique and based on this method Ansys CFX software was necessary for that purpose. PhD thesis contains study, experimental and simulation sections.

The study part presents the ice rink arenas' characteristic from the view point of ventilation, including in particular the requirements of air parameters, heat and moisture sources and air distribution systems in such buildings. Additionally, a review of the literature in terms of the current state of knowledge about ventilation issues of indoor ice rinks and research in this respect, both experimental and numerical is included in this section.

The scope of the research encompassed the actual ice rink arena "Tafla", belonging to the Sports Centre of the Silesian University of Technology in Gliwice.

The experimental part applies to the detailed experimental identification of flow, thermal and humidity conditions of the tested facility. The short-term and long-term measurements of indoor, outdoor and supply air were carried out. The research of ventilation conditions in the object also included thermal imaging measurements and visualization by smoke test. The results of experimental research were used to obtain data for boundary conditions of numerical calculations and for experimental validation of simulation results in order to check whether the developed numerical model correctly reproduces phenomena occurring in the ventilated ice rink arena.

The numerical modelling of air, heat and moisture flow in the indoor ice rink by the means of Ansys CFX 14.5 software was carried out in the simulation part. Tests with the use of a simplified model of the ice rink were performed before main numerical calculations. The numerical model of the tested ice rink arena including an existing air distribution system was developed. Boundary conditions were prepared on the basis of the facility stocktaking and experimental identification results. The moisture emission numerical modelling from the ice surface was improved, proposing our own method of boundary conditions setting. Based on the improved numerical model of the actual ice rink arena, a detailed experimental validation of numerical calculation results was carried out.

On the basis of the validated numerical model of the indoor ice rink the improvement of flow, thermal and humidity conditions in the facility was investigated. The impact of different ways of dehumidification and ventilation air distribution on excess moisture removal from the object was evaluated as well as the effects of low emissivity ceiling installation.

In the last part, the final conclusions were drawn, which can also be guidelines for the design of the ventilation and dehumidification systems in ice rink arenas. Future research directions on these issues were also indicated.