Oponent review on doctoral thesis titled

OPTIMUM REPRESENTATION OF HEAT SOURCES IN SIMULATIONS OF AIR FLOW IN INDOOR ENVIRONMENT

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The topic of the thesis is focused on the issue of the correct distribution of air in large spaces with a large number of heat sources, such as lecture halls, theaters, cinemas, atria etc. depending on the occupancy of the visitors using mathematical modeling of heat transfer by natural convection. It is a specific but very topical problem, because in connection with the increasing demands on the quality of the internal environment, there are increasing requirements for the design of environmental technology systems.

The work contains 96 pages. It is divided into 9 chapters and literature, its own publications and attachments. The individual chapters go on logically. The first chapter is an introduction to the presented work, the second chapter is devoted to the theory of internal environment with heat sources, flow around obstacles and various thermal conditions, methods of solution including CFD methods and experimental methods and is supplemented by quality references to literature and detailed conclusions related to the given issue . The third chapter specifies the aims of the work. These were elaborated in chapters 4-6, where the problems of meshing, the creation of an appropriate mathematical model of turbulence with specific boundary conditions and the interaction of heat sources with convection with a view to achieving a reasonable calculation time were very precisely solved. Very important is the practical application of the method in solving the internal environment in the church of St. Anna, occasionally used as a lecture and concert hall. Method evaluation and conclusion are in chap. 8 and 9.

Achievement of the objectives of the work

The objectives of the thesis were summarized in Chapter 3. It is worth highlighting the creation of a methodology for the practical use of CFD methods due to low computational requirements. The methodology was developed and tested for mesh quality and minimization of cell numbers, turbulence models and specific heat sources and their interactions. During the testing of the methodology, literature sources and physical experiment were used. The significance of the new methodology has been validated for real application to the interior of the church. Achieving the goals was theoretical and time consuming in simulation of flow and temperature fields for different boundary and ambient conditions and validation of results using experimental methods.

Analysis of the present state of the problem.

The second chapter was focused on a very complex and high-quality theoretical and practical analysis of the current state of the problem, a number of references to literature are presented with the results and conclusions applicable to the given problem and also confronted with the solution.

Theoretical and practical contribution of dissertation work, suitability of methods used

The contribution of the work is mainly a demanding study of the mass, momentum and heat transfer with regard to the possibilities of numerical and experimental solution of the internal environment and its use in securing an internal comfort environment in a specific case of the church. At a high level, a methodology was developed for the use of CFD methods in real application based on both literature backgrounds and own experimental research.

The solution of the internal environment is very topical both from the theoretical and application point of view. Therefore, it is the subject of interest theoretically to master and describe in detail modern mathematical and experimental methods of the internal environment and to use the knowledge in other applications. The thesis proves that mathematical modeling is not a routine matter, but requires a creative, theoretically demanding user approach. An important result of the thesis is the possibility of using the solution methodology in other applications.

Presentation of doctoral thesis

The thesis is clearly categorized into chapters. Graphic processing in the theoretical parts is illustrative and in the computational parts it describes the essence of the solution. The work is written after the methodological and pedagogical very well and can be seen as a quality study material for students of master and doctoral studies.

Formal comments:

- p. X - in the definition of units use brackets or indexes, eg J/(kg K)=J kg^{-1} K^{-1}
- p. 32, Chap. 4.2.2 - the results of comparison of different mesh are not evaluated

Questions to the doctoral student:

- p. 31, third paragraph - how the time to get the stabilize variable after the position change was defined
- p. 48-49 - what is the thermal distribution using contours?
- p. 50 - profile comparison should be reported in %
- How significant are the gravity forces in the large dimension problem to talk about stratification of flow?

- Has doctoral student experience with OpenFOAM versus ANSYS Fluent in connection with solved problems?

The doctoral student demonstrated high professional knowledge and ability to solve internal issues. The work is a set of a large number of mathematical results and quality experimental data, which presents the ability of the doctoral student to work systematically on the solution of the problem, theoretically to justify the evaluation, to modify the input data. The software used (though very complex) is really "just" a tool to solve. The doctoral student has achieved the goals of the dissertation.

The results of the doctoral dissertation have been published in conferences and journals, and I assume that the topic of the dissertation will be published.

The dissertation is of high theoretical and application level and contains original results of scientific work. The thesis can be considered as the basis for the development of this field of study with a view to the development of mathematical models and their combination for solving similar problems. The thesis fulfills the requirements for doctoral thesis in accordance with § 47 of Act No. 111/1998 Coll. about the universities and therefore deliver the defense at the Faculty of Mechanical Engineering in Prague.

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Ostrava, 20/01/2019

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