Opponent Review of Doctoral Thesis

Author: Ing. Robert Wawerka
Title: Nearly Zero-Energy Building Retrofitting: Case Study of a Conventional Single Family House in Denmark
Study programme: Civil Engineering
Field of study: 3608V001 Building Structures

The Faculty of Civil Engineering Brno University of Technology has appointed me, by the letter dated 22.1. 2016, as an opponent for the doctoral thesis of student Ing. Robert Wawerka. The opponent review of doctoral thesis is prepared according to §45 of the Degree Regulations of the Brno University of Technology.

The thesis is written on 112 pages all together and consists of six main chapters. The individual chapters are clearly and logically structured and include following parts: Introduction, Literature review, Objectives, Methodology, Analysis and results, Conclusions and recommendations. The thesis is further complemented by an abstract in the Czech language, the list of figures, the list of tables, the list of abbreviations and the list of using literature.

The structure of thesis conforms to principles and requests to the structure of scientific work. The author has studied and used appropriate number of bibliography sources used and quoted in the thesis. It is the evidence of the deep theoretical knowledge and very good orientation in the problem discussed in the thesis.

A) The topicality of the chosen dissertation topic
The doctoral thesis describes the study of energy performance of a pilot energy retrofitted residential building (in Denmark) towards nearly zero-energy with using progressive design technologies – energy modelling, monitoring, optimisation and verification. The solved theme is also very current and relevant in the context of legislative changes in the field of energy performance of buildings in the Czech Republic.

B) The fulfillment of the objectives of the thesis
The thesis objectives are comprehensive studies and theoretical and experimental analysis of a single-family house energy retrofitting into a nearly zero-energy building via different passive and active design methods together with renewable energy systems implementation.
The aims and methods are clearly described, author represents the ideas and knowledge with sufficient theoretical background. All objectives were fulfilled and detailed in this thesis.

C) Methods of processing
The thesis applies the theoretical and experimental analysis expertise in the field of design and energy performance of buildings. The using scientific methods of processing include two main parts:
- theoretical methods are applied to analyse and validate building operation, thermal comfort and energy uses that are modelled in a computer simulation software,
- experimental methods are used to measure and validate real building operation, energy consumption, thermal comfort and which data for selected object.
All methods of research work are appropriate to the aims and assumptions formulated in the thesis.

D) Results solutions, new knowledge and benefits of the thesis
The results of the doctoral thesis demonstrates the fulfillment of the objectives set. For specific benefits of this thesis I consider: the original solutions of building energy retrofitting method into nearly zero-energy building in practise, the comparison between a several dynamic energy simulation softwares with the focus on selected criterias, determine the suitability of dynamic simulation modeling for the correct prediction of the energy performance of buildings.

E) Contribution to the development of science and technology
Author describes recommendations for further research in the chapter 6.3. The most substantial important nearly zero-energy findings requiring furthermore development and research are describes in the 6 points.
I appreciate that the author included among the most important findings also research on system application in the Czech Republic weather conditions.

F) Formal adjustment of work and its language level
The thesis is written very clearly, graphic design is at a high level, I have no comments to formal aspect. The thesis fullfills the formal requests on very good level.

H) Reviewer Comments
I have several of the following substantive comments and questions to the presented work:

- On page 50 – Definition of boundary conditions: software DesignBuilder works on the basis of numerical simulation methods, among the boundary conditions of calculation also includes a convective heat transfer coefficients on the inside and outside surface of the structures. Could you explain, what values were used in this study?
- On page 67 – Daylight analysis: for the daylight simulation study there was set the required daylight factor of 2.0 % (according to BREEAM) and visible reflectance of the internal wall, ceiling and floor (Table 13). Are these requirements the same for the residential buildings in the legislation of the Czech Republic?
- Are the effects of thermal bridges included in the calculation of building envelope? And what a mathematical process is used?
- What parameters were used in the calculation of mechanical ventilation (min. fresh air per person or per area)?
Final evaluation of the doctoral thesis

PhD thesis documents that the student has met clearly defined objectives thesis, which is on the high theoretical and application levels and includes significant original approaches. Therefore, I recommend the dissertation for defence. And after successfully answering comments and questions during defense

I recommend

to award PhD degree to Ing. Robert Wawerka

Ostrava 18. 3. 2016

doc. Ing. Iveta Skotnicová, Ph.D.