OPPONENT REVIEW
of PhD. thesis elaborated by Ing. Mohamad Kheir Mohamad
on the topic
Control system of building using modelling and simulation

This opponent review was elaborated in reference to the letter of the Dean of Mechanical Engineering Faculty STU doc.Ing.Jaroslav Katolicky,PhD from March 2014 to oppose the PhD thesis submitted by the candidate.

The PhD thesis was elaborated at the Energy Institute of FME VUT in Brno. The presented thesis is focused on modelling and simulation of HVAC system, particularly on modelling of indoor climate conditions and its changes in relationships to indoor loads and outdoor influences.

This topic is related to energy savings in building climate systems and also to keeping appropriate conditions for occupants. The thesis itself is consists of 6 main chapters plus obvious parts as conclusion, introduction, list of indexes etc.

Chapters numbered as 2 and 3 are describing theoretical bases and necessary descriptions of circumstances and they are used later in a core part of the thesis.

However, the core part of the thesis – that means issues related to the own scientific contribution of the candidate are presented later in chapters 4,5,and 6. In chapter 4 there is presented modelling of indoor thermal processes, chapter 5 is focused on modeling of CO₂ concentrations in halls and rooms and chapter 6 deals with indoor humidity issues.

Evaluations:

In general, there is no doubt that the problematics of indoor climate conditions and their modelling belongs still to up-to-date topics in HVAC branches, despite many research works carried out in this topic so far all over the world.

To evaluate the presented theses itself, there must be said that they are formally on acceptable level, which is obvious for this kind of works. The size of the thesis is also appropriate (103 pages of the core texts). However, this constatation surely does not mean a perfect level – English used in the text is rather poor, reading of longer text parts is difficult or almost impossible and the formatting is not suitable as well.(they is no spacing between paragraphs.) Figures showing used controlled algorithms are almost not readable and they have in fact only fine-art function, not the real one. (e.g. fig 40)

However, more important than the formal aspect is the content of the thesis. By my opinion, contentwise the theses are fullfilling the objectives and it proves the expert abilities of the candidate. I appreciate using of modern simulation and high quality software tool as MATLAB/SIMULINK surely is and above all – the validation of simulation results through EBI system. Using mentioned Laplace transformation and system of differential equations is also not a trivial skill (I hope that candidate has really this skill).
Comments, questions and objections:

Despite relatively positive results achieved by the candidate in the thesis, there appeared some mistakes and weaker parts which should be explained. My questions to this are following:

- Why was used relatively unsofisticated on-off method at controlling of temperature?
- Explain the equation (21), especially why you have time derivation $dT/dt$ on left side of the equation (which means in fact heat flow) and no flow units on the right side. Do you see the disproportion or not?
- Equation (22): for obtaining $T_1$ – which boundary conditions (borders of integrals) were used when you really used this equation at simulation?
- Why are used thermal symbols known in Civil Engineering ($k, U, E$) instead of ($\lambda, \alpha, Q$) used in Mechanical Engineering?
- Please reason the temperature curve in the Figure 29

Conclusion

Despite the above mentioned objections I recommend the PhD thesis for a defence in front of State commision for PhD degrees, however - there is expected that especially the second objection will be answered in a full range.

Awarding the title „Philosophiae Doctor“ to the candidate is recommended after successfull defence of his thesis.

In Bratislava 25.5.2015  
doc. Ing. Michal Masaryk, PhD.  
opponent