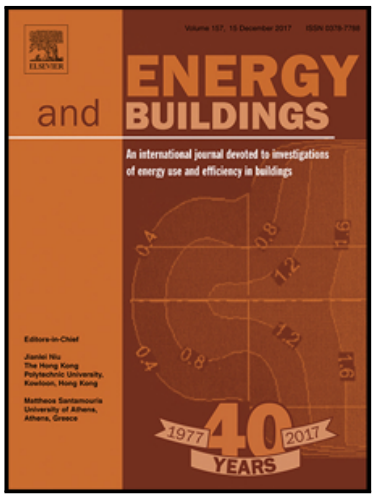

Analysis of the impact of simulation model simplifications on the quality of low-energy buildings simulation results

Marcin Klimczak, Jacek Bojarski, Piotr Ziembicki, Piotr Kçskiewicz

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Analysis of the impact of simulation model simplifications on the quality of low-energy buildings simulation results

Marcin Klimczak[a], Jacek Bojarski[b], Piotr Ziembicki[c,*], Piotr Kęskiewicz[a]

[a] *Wrocław University of Science and Technology, Faculty of Environmental Engineering, C.K. Norwida 4/6 str., 50-373 Wrocław, Poland*
[b] *University of Zielona Góra, Faculty of Mathematics, Computer Science and Econometrics, Prof. Z. Szafrana 4a str., 65-516 Zielona Góra, Poland*
[c] *University of Zielona Góra, Faculty of Civil Engineering, Architecture and Environmental Engineering, Prof. Z. Szafrana 15 str., 65-516 Zielona Góra, Poland*

Abstract

The requirements concerning energy performance of buildings and their internal installations, particularly HVAC systems, have been growing continuously in Poland and all over the world. The existing, traditional calculation methods following from the static heat exchange model are frequently not sufficient for a reasonable heating design of a building. Both in Poland and elsewhere in the world, methods and software are employed which allow a detailed simulation of the heating and moisture conditions in a building, and also an analysis of the performance of HVAC systems within a building. However, these systems are usually difficult in use and complex. In addition, the development of a simulation model that is sufficiently adequate to the real building requires considerable time involvement of a designer, is time-consuming and laborious [1]. A simplification of the simulation model of a building renders it possible to reduce the costs of computer simulations. The paper analyses in detail the effect of introducing a number of different variants of the simulation model developed in DesignBuilder on the quality of final results obtained. The objective of this analysis is to find simplifications which allow obtaining simulation results which have an acceptable level of deviations from the detailed model, thus facilitating a quick energy performance analysis of a given building.

Keywords: Energy performance, Computer simulation, Construction engineering, Energy performance analysis

1. Introduction

A rise in energy consumption in a global scale is unavoidable [2–7]. It is a measure of success of the economy and community of a given country. The highest increase of energy consumption concerns the consumption of electric energy and fossil fuels (mainly in transportation). It is also very likely to reverse the current, decreasing trend concerning heat demand in urban agglomerations due to the more and more popular technologies of using heat for the production of other forms of energy, for example, cooling (most frequently in the form of the so called „chilled water") for the needs of air-conditioning systems in buildings serving various purposes [8]. This may result in increasing the production of district heat (generated and distributed in the district heating systems).

Rationalisation of heat use can and should be implemented in two different directions. The first is connected with enhancing the efficiency of heat sources and heating networks, whereas the other concerns a reduction of the demand for this type of energy by affecting and convincing designers of buildings and installations, as well as their users, to increase their activity and to take appropriate actions in order to optimize energy efficiency of buildings being designed and also to implement actions that would improve the technical parameters of already existing buildings. It should be underlined that optimisation of energy efficiency of buildings cannot be performed without employing advanced computer technologies, including building energy simulations and modern BIM technologies (Building Information Modelling). Currently, there are many types of programmes available on the market, which are used for energy optimisation of buildings, heating networks and district heating substations. These applications vary in their capabilities, the quality of results obtained and in the level of their complexity. In fact, the latter in many cases limits the utilization of these applications only to specially trained engineers. Moreover, professional software, especially BIM type systems, is very expensive to buy and to operate and this fact hinders or sometimes even makes it impossible for smaller design offices to use it. In this context, it is of crucial importance to develop a methodology for introducing simplifications to the building simulation model that would not affect adversely the quality of simulation results, and at the same time would make it possible to shorten the time and reduce the costs of building energy simulations.

*Corresponding author