Hybrid heating system for open-space office/laboratory

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Introduction

Open-space office/laboratory are quite common in Scandinavia and they are usually designed for multipurpose work. There are office area where is possible to work standing up and in the same time to work at the desk. For this purpose a hybrid heating system made by electric convectors and panel radiators is investigated. Two step response tests of the hybrid heating system are performed at the laboratory of Umeå University. The first test is executed during the week, disturbances from heat sources degrading the quality of the results. The second test is performed during week-end. The error analysis shows a maximum discrepancies of +0.6 °C between measured and simulated data. However, a thermal time constant of the room can be deducted and use it for controlling purposes.

Experiment and results

The laboratory has a volume of about 200 m^3 and it is positioned in contact with the ground. The room faces to the outside environment for only one surface while all the other walls and the ceiling are adjacent to other heated zones. Two electric convectors are positioned in the room, the first at the left corner, the second in the middle of the room. The electricity heats up a resistance which in turn heats up the air. The electric convectors are set-up at the power of 3000 W each. At the opposite side of the first electric convector a system of five panel radiators is attached to the wall. The panel radiator system has a nominal power of 1500 W at the standard condition of 55/45/20 ˚C [1]. The indoor air temperature is tracked every 15s by thermocouples TT and recorded on computer.

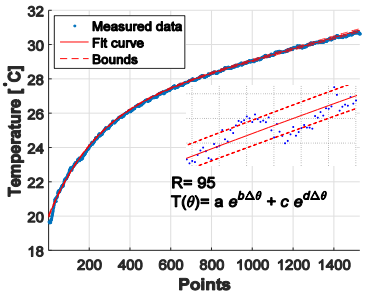

Figure 1: Step response with fitted curve

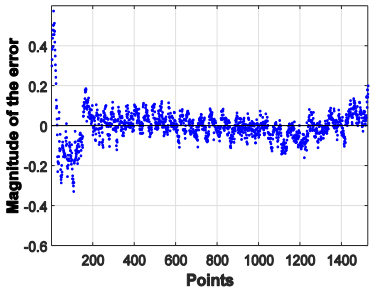

Figure 2: Error analysis

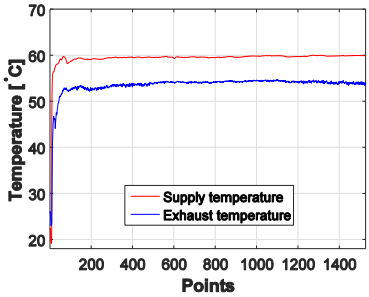

Figure 3: Supply and exhaust heat flow

Figure 1 shows the fitted curve of the indoor air. On the x-axis there is the time. The time between each point detected is 15s. The blue spots are the measured data. The red solid line is the fitted curve shown in the equation. The red dash lines represent the bounds at 95% interval of confidence. **Figure 2** shows the magnitude of the error between the fitted curve and measured data. **Figure 3** shows the temperature of supply and exhaust flow of the radiator system during the experiment.

Conclusions and Outlook

The fitted curve does not shows good accuracy with the measured data in the first hour of the test. This because the electric convectors and panel radiators take time to heat up themselves and them to transfer the heat to the air. The process of step response of the room underlines that, the system can be considered as one storage element with dead time. A thermal time constant of the room can be deducted and use it for controlling purposes.

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References:

[1] Soleimani-Mohseni M.**;** Modelling and Intelligent Climate Control of Buildings; Ph.D. dissertation; Dept. of Building Service Engineering; Chalmers University of Technology; 2005; Göteborg, Sweden, ISBN: 91-7290-599-4