Aalto University
School of Engineering

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Personalized control of airflow needed for good indoor climate

Title of the dissertation	Indoor climate with personalized and centralized room systems
Contents of the dissertation	The indoor climate has a significant impact on occupant satisfaction, wellbeing, and health. For the existing design practice, there is a demand to design novel ventilation systems to create an excellent indoor climate in an energy-efficient manner. More generally, a paradigm shift from a uniform indoor environment to a non-uniform indoor environment accommodating various individual preferences is needed. There also is a need to introduce more advanced systems where users can influence their own local micro-environment. Thus, the objective of the thesis is to investigate the performance of convective and combined convective and radiant cooling systems with personalized control by experimental laboratory studies. The indoor climate in this study was assessed by analyzing the thermal comfort and indoor air quality in a simulated office space with physical measurement and subject tests. This thesis studies different air distribution methods. The studied diffuse ceiling ventilation is similar to fully mixed ventilation. Compared with diffuse ceiling ventilation alone, the combination of convective cooling and local radiant cooling systems created a lower air temperature and higher air change efficiency in the micro-environment near the workstation with less draught risk. With the micro-environment system, the local low velocity unit and personalized ventilation air terminal device can supply the outdoor air directly to the breathing zone. Therefore, the air quality and local thermal comfort near the workstation can be maintained at the same time. Furthermore, with the personalized control of the local airflow rate, the perceived air quality and thermal sensation are more acceptable for the subjects under various activity levels. This research illustrates that there is significant variation between human subjects in the micro-environment control preferences, and this emphasizes the need for personalized control to ensure that all occupants are satisfied with the indoor conditions.
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