

Improved Thermal Comfort and Sensation with Occupant Control of Ceiling Personalized Ventilation System: A Lab Study

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Abstract : This study aims at determining the extent to which occupant control of microenvironment influences, improves thermal sensation and comfort, and saves energy in spaces equipped with ceiling personalized ventilation (CPV) system assisted by chair fans (CF) and desk fans (DF) in 2 experiments in a climatic chamber equipped with two-station CPV systems, one that allows control of fan flow rate and the other is set to the fan speed of the selected participant in control. Each experiment included two participants each entering the cooled space from transitional environment at a conventional mixed ventilation (MV) at 24 °C. For CPV diffuser, fresh air was delivered at a rate of 20 Cubic feet per minute (CFM) and a temperature of 16 °C while the recirculated air was delivered at the same temperature but at a flow rate 150 CFM. The macroclimate air of the space was at 26 °C. The full speed flow rates for both the CFs and DFs were at 5 CFM and 20 CFM, respectively. Occupant 1 was allowed to operate the CFs or the DFs at (1/3 of the full speed, 2/3 of the full speed, and the full speed) while occupant 2 had no control on the fan speed and their fan speed was selected by occupant 1. Furthermore, a parametric study was conducted to study the effect of increasing the fresh air flow rate on the occupants' thermal comfort and whole body sensations. The results showed that most occupants in the CPV+CFs, who did not control the CF flow rate, felt comfortable 6 minutes. The participants, who controlled the CF speeds, felt comfortable in around 24 minutes because they were preoccupied with the CFs. For the DF speed control experiments, most participants who did not control the DFs felt comfortable within the first 8 minutes. Similarly to the CPV+CFs, the participants who controlled the DF flow rates felt comfortable at around 26 minutes. When the CPV system was either supported by CFs or DFs, 93% of participants in both cases reached thermal comfort. Participants in the parametric study felt more comfortable when the fresh air flow rate was low, and felt cold when as the flow rate increased.

Keywords : PMV, thermal comfort, thermal environment, thermal sensation

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