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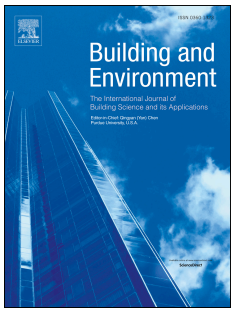

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An Innovative Personalized Displacement Ventilation System for Airliner Cabins

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Abstract

In airliner cabins, mixing ventilation systems with gaspers are not efficient in controlling contaminant transport. To improve the cabin environment, this investigation proposed an innovative ventilation system that would reduce contaminant transport and maintain thermal comfort. We manufactured and installed the proposed ventilation system in an occupied seven-row, single-aisle aircraft cabin mockup. Air velocity, air temperature, and contaminant distribution in the cabin mockup were obtained by experimental measurements. The investigation used the experimental data to validate the results of CFD simulation. The validated CFD program was then used to study the impact of the locations and number of exhausts on contaminant removal and thermal comfort in a one-row section of a fully occupied Boeing-737 cabin. Although the diffusers in the proposed system were close to the passengers' legs, the air velocity magnitude was acceptable in the lower part of the cabin and the leg area. The proposed system provided an acceptable thermal environment in the cabin, although passengers could feel cold when placing their legs directly in front of the diffusers. The four-exhaust configuration of the new ventilation system was the best, and it decreased the average exposure in the cabin by 57% and 53%, respectively, when compared with the mixing and displacement ventilation systems.

Keywords: Computational fluid dynamics (CFD); Contaminant transport; Mixing ventilation; Displacement ventilation; Air supply diffuser.