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Assessment of Interior Environmental Quality and Airborne Infectious Risk in a Commuter Bus Cabin by Using Computational Fluid Dynamics with Computer Simulated Person

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Abstract : A commuter bus remains important as a means to network public transportation between railway stations and terminals within cities. In some cases, the boarding time becomes longer, and the boarding rate tends to be higher corresponding to the development of urban cities. The interior environmental quality, e.g. temperature and air quality, in a commuter bus is relatively heterogeneous and complex compared to that of an indoor environment in buildings due to several factors: solar radiative heat – which comes from large-area windows –, inadequate ventilation rate caused by high density of commuters, and metabolic heat generation from travelers themselves. In addition to this, under conditions where many passengers ride in the enclosed space, contact and airborne infectious risk have attracted considerable attention in terms of public health. From this point of view, it is essential to develop the prediction method for assessment of interior environmental quality and infection risk in commuter bus cabins. In this study, we developed a numerical commuter bus model integrated with computer simulated persons to reproduce realistic indoor environment conditions with high occupancy during commuting. Here, computer simulated persons were newly designed considering different types of geometries, e.g., standing position, seating position, and individual differences. Here we conducted coupled computational fluid dynamics (CFD) analysis with radiative heat transfer analysis under steady state condition. Distributions of heterogeneous air flow patterns, temperature, and moisture surrounding the human body under some different ventilation system were analyzed by using CFD technique, and skin surface temperature distributions were analyzed using thermoregulation model that integrated into computer simulated person. Through these analyses, we discussed the interior environmental quality in specific commuter bus cabins. Further, inhaled air quality of each passenger was also analyzed. This study may have possibility to design the ventilation system in bus for improving thermal comfort of occupants.

Keywords : computational fluid dynamics, CFD, computer simulated person, CSP, contaminant, indoor environment, public health, ventilation
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