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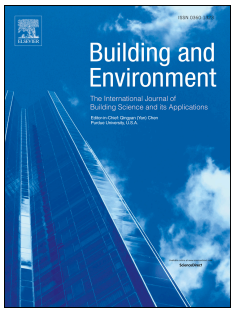

Anti-short-circuit device: A new solution for short-circuiting in windcatcher and improvement of natural ventilation performance

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Anti-short-circuit device: a new solution for short-circuiting in windcatcher and improvement of natural ventilation performance

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Abstract

Windcatcher is an effective technique for naturally ventilating a space and improving indoor air quality. A common problem for modern and traditional windcatchers is air short-circuiting. Air-short-circuiting in windcatchers occurs when the air entering through the supply channel immediately exits through the exhaust channel without circulating and mixing inside the enclosed space. Several previous works on windcatchers have observed the “short-circuiting” effect and concluded that it has a negative impact on the ventilation performance however, no work have provided a solution to eliminate this effect. The present study will address this issue by incorporating a component called the anti-short-circuiting device (ASCD) and investigating its potential to eliminate air short-circuiting in windcatchers and improve ventilation performance. Two methods were employed in this research: experimental and Computational Fluid Dynamics (CFD) study. For the experimental work, three scaled models were studied in a wind tunnel. The CFD modelling was validated using the air velocity measurements and good correlation was observed with average error below 10%. The results showed that the ASCD windcatcher with angles between 20°-80° prevented air-short-circuiting while supplying up to 40-51 l/s per occupant, which is higher than the minimum recommendations of ASHRAE62.2 and BS5925. In addition, the windcatcher without ASCD showed 8% higher CO_2 concentration in the room, indicating that the ASCD windcatcher was more effective in removing stale air out of the room. Furthermore, the average air velocity in the room at sitting height with the ASCD windcatcher was 19-28% higher than windcatcher without ASCD.

Keywords: Windcatcher; Natural ventilation; Short circuit; Indoor air quality; Fin; Badgir