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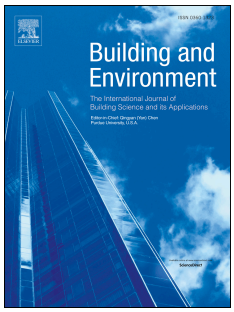

Parametric study of air curtain door aerodynamics performance based on experiments and numerical simulations

Dahai Qi, Sherif Goubran, Liangzhu (Leon) Wang, Radu Zmeureanu

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Parametric Study of Air Curtain Door Aerodynamics Performance Based on Experiments and Numerical Simulations

Dahai Qi, Sherif Goubran, Liangzhu (Leon) Wang, Radu Zmeureanu

Centre for Zero Energy Building Studies, Department of Building, Civil and Environmental Engineering, Concordia University, 1455 de Maisonneuve Blvd. West, Montreal, Quebec, H3G 1M8, Canada

Abstract

Air curtains have been widely used to reduce infiltration through door openings and save heating/cooling energy in different types of buildings. Previous studies have found that there exist three aerodynamics conditions: optimum condition (OC), inflow break-through (IB), and outflow break-through (OB) conditions, which are important for categorizing air curtain performance subject to such key parameters including supply speed and angle, and presence of a person during an actual operation. However, few studies have focused on the effects of these parameters on air curtain performance in terms of resisting infiltration and reducing exfiltration. This research presents a parametric study of air curtain performance based on reduced-scale experiments and full-scale numerical simulations. It was found that increasing air curtain supply angle improves air curtain performance when it is operated under the OC and IB conditions but creates excessive exfiltration under the OB condition. Increasing supply speed of air curtain generally improves the air curtain performance whereas this improvement deteriorates with the increase of supply angle under the OB condition. The presence of person, either directly under or below the air curtain, almost has no effect on the infiltration/exfiltration during the OC condition. Moreover, the person in the doorway can block airflow from both directions, contributing to less infiltration under the IB condition and less exfiltration under the OB condition than without the person. This study provides valuable insights into air curtain aerodynamics performance under different operational conditions and key contributing parameters.