

Accepted Manuscript

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

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PII: S0360-1323(17)30563-2

DOI: [10.1016/j.buildenv.2017.12.005](https://doi.org/10.1016/j.buildenv.2017.12.005)

Reference: BAE 5203

To appear in: *Building and Environment*

Received Date: 21 September 2017

Revised Date: 4 December 2017

Accepted Date: 8 December 2017

Please cite this article as: Qi D, Goubran S, Wang L(L), Zmeureanu R, Parametric study of air curtain door aerodynamics performance based on experiments and numerical simulations, *Building and Environment* (2018), doi: 10.1016/j.buildenv.2017.12.005.

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1 **Parametric Study of Air Curtain Door Aerodynamics Performance Based on** 2 **Experiments and Numerical Simulations**

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7 **Abstract**

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

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