

# Wind tunnel experiments of cross-ventilative cooling in a generic isolated building with heated wall

Kosutova, K.; Vanderwel, Christina; van Hooff, T.A.J.; Blocken, B.; Hensen, J.L.M.

*Published in:*

Proceedings of the 7th European and African Conference on Wind Engineering (EACWE 2017), 4-7 July 2017, Liege, Belgium

Published: 04/07/2017

*Document Version*

Accepted manuscript including changes made at the peer-review stage

**Please check the document version of this publication:**

- A submitted manuscript is the author's version of the article upon submission and before peer-review. There can be important differences between the submitted version and the official published version of record. People interested in the research are advised to contact the author for the final version of the publication, or visit the DOI to the publisher's website.
- The final author version and the galley proof are versions of the publication after peer review.
- The final published version features the final layout of the paper including the volume, issue and page numbers.

[Link to publication](#)

*Citation for published version (APA):*

Kosutova, K., Vanderwel, C., van Hooff, T. A. J., Blocken, B., & Hensen, J. L. M. (2017). Wind tunnel experiments of cross-ventilative cooling in a generic isolated building with heated wall. In Proceedings of the 7th European and African Conference on Wind Engineering (EACWE 2017), 4-7 July 2017, Liege, Belgium

**General rights**

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal ?

**Take down policy**

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

# Wind tunnel experiments of cross-ventilative cooling in a generic isolated building with heated wall

K. Kosutova <sup>(a)</sup> \*, C. Vanderwel <sup>(b)</sup>, T. van Hooff <sup>(a,c)</sup>, B. Blocken <sup>(a,c)</sup>, J.L.M. Hensen <sup>(a)</sup>

(a) *Building Physics and Services, Department of the Built Environment, Eindhoven University of Technology, P.O. box 513, 5600 MB Eindhoven, The Netherlands*

(b) *Aerodynamics and Flight Mechanics Research Group, University of Southampton, Bldg 13, Highfield Campus, SO16 7DY, Southampton, United Kingdom*

(c) *Building Physics Section, Department of Civil Engineering, KU Leuven, Kasteelpark Arenberg 40 – bus 2447, 3001 Leuven, Belgium*

## Abstract

Ventilative cooling can be an energy-efficient measure to reduce indoor overheating while maintaining the thermal comfort of the occupants. An accurate assessment of the effect of ventilative cooling on the indoor air and surface temperatures and convective heat fluxes can be performed using numerical modeling with Computational Fluid Dynamics (CFD) provided that these simulations are validated with high-quality wind-tunnel experiments. This paper presents wind tunnel measurements and an analysis of cross-ventilation in an isolated building with a heated sidewall. The measurements were performed in an atmospheric boundary layer (ABL) open circuit wind tunnel with a closed test section with dimensions  $0.9 \times 0.6 \times 4.5 \text{ m}^3$  at the University of Southampton in the UK. A generic cubic building with dimensions  $150 \times 150 \times 150 \text{ mm}^3$  was considered. The forward and rear-facing walls had openings with dimensions  $70 \times 40 \text{ mm}^2$  (L  $\times$  H) ensuring cross-ventilation of the building and one of the sidewalls of the building was heated to  $60^\circ\text{C}$  to create a source of buoyancy. The measurements were performed for a Reynolds number (Re) of 15,600. The indoor velocities and turbulence levels in the vertical center plane were acquired using Particle Image Velocimetry (PIV), and temperatures were also obtained in both the vertical center plane and a vertical plane 50 mm from the heated wall using NTC sensors. In addition to the PIV measurements, surface heat fluxes were measured at six locations on the heated wall. The measurement data can be used for the validation of CFD simulations and results from other numerical models of non-isothermal cross-ventilation flows, which is at the moment very difficult due to a lack of published experimental data.

**Keywords:** Wind tunnel experiments, PIV, natural cross-ventilation flow, convective heat transfer, ventilative cooling.

---

\*Corresponding author: Katarina Kosutova, Building Physics and Services, Eindhoven University of Technology, P.O.Box 513, 5600 MB Eindhoven, the Netherlands. Tel.: +31 (0)40 247 3523  
E-mail address: k.kosutova@tue.nl