

Natural ventilation in cities: the implications of fluid mechanics

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Innovations :

Description of the MAGIC project. Precise explanation of the objectives, the means and the experimental setup used.

Abstract Analysis

Abstract

Research under the ****Managing Air for Green Inner Cities**** (MAGIC) project uses measurements and modelling to investigate the connections between external and internal conditions: the impact of urban airflow on the natural ventilation of a building. The test site was chosen so that under different environmental conditions the levels of external pollutants entering the building, from either a polluted road or a relatively clean courtyard, would be significantly different. Measurements included temperature, relative humidity, local wind and solar radiation, together with levels of carbon monoxide (CO) and carbon dioxide (CO₂) both inside and outside the building to assess the indoor–outdoor exchange flows. Building ventilation took place through windows on two sides, allowing for single-sided and crosswind-driven ventilation, and also stack- driven ventilation in low wind conditions. The external flow around the test site was modelled in an urban boundary layer in a wind tunnel. The wind tunnel results were incorporated in a large- eddy-simulation model, Fluidity, and the results compared with monitoring data taken both within the building and from the surrounding area. In particular, the effects of street layout and associated street canyons, of roof geometry and the wakes of nearby tall buildings were examined.

Key Ideas of Abstract

What ?

- Project ****Managing Air for Green Inner Cities**** (MAGIC)

What for ?

- measurements and modelling to investigate the connections between ****external**** and ****internal**** conditions: impact of ****urban airflow**** on the natural ventilation of a building.

Test Site : chosen so that the levels of external pollutants can enter from polluted road or clean courtyard => significant difference.

Measurements :

- temperature,
- relative humidity,
- local wind,
- solar radiation,
- levels of carbon monoxide (CO),
- carbon dioxide (CO₂)

Measurement location :

- inside and outside the building to assess the indoor–outdoor exchange flows

Modeling :

- Wind tunnel : external flow around the test site was modelled in an urban boundary layer
- Simulation : incorporation of large- eddy-simulation model, Fluidity, and the results compared with monitoring data taken both within the building and from the surrounding area. In particular, the effects of street layout and associated street canyons, of roof geometry and the wakes of nearby tall buildings were examined.

Limitations

- Depends on the choice of parameters ?