Performance evaluation methods of night ventilation

Kim Goethals

Supervisor: Arnold Janssens

I. Perspective and goals

Today, governments, world-wide, take measures to reduce the energy consumption and to reduce greenhouse gas emissions. For example, the European Directive on Building Performance of Buildings – better known as EPB – imposes minimum energy performance requirements on new and renovated buildings. Meanwhile, a significant savings potential lays in night ventilation, which introduces outside air at night to cool down the interior building fabric. Unfortunately, predicting its performance may be troublesome. At the legislative level, no simplified calculation method is available – necessitating its development. Secondly, energy simulation tools (BES) commonly used in building design, use predetermined correlations for modeling the convective heat transfer (CHT) related to the internal air flow pattern – neglecting the case-specificity. Identifying the relevant parameters may promote the use of night ventilation and advance the modeling.

II. Approach

To derive the factors part of the new simplified calculation method, the author performed numerical simulations using BES. For this purpose, BES is regarded sufficient because of the far-reaching simplification of the new method. On the other hand, to get insight in air flow patterns and the related heat transfer, both experiments and computational fluid dynamics (CFD) are performed. Although CFD proves to be a more cost-effective research tool, experiments are still necessary to validate the CFD.

K. Goethals is with the Department of Architecture and Urban Planning, Ghent University (UGent), Gent, Belgium. E-mail: Kim.Goethals@UGent.be .

III. Results

Bearing the Belgian legislative approach in mind, the author worked over the current monthly mean calculation method, adding a ventilation heat transfer coefficient for night ventilation. This factor takes into account the air flow rate, the time fraction of operation, the temperature difference between in- and outside and the amount of thermally active building fabric. Up till now, the impact of last-mentioned factor is not modeled properly.

Further, the author investigated the sensitivity of the CHT predicted by CFD to the simulation approach. Meanwhile, experiments were performed to produce more validation data. Finally, the author broadened the research to a sensitivity analysis of the CHT to room-specific characteristics. Currently, only the impact of the diffuser location relative to the heavy building fabric was investigated for a 2-D setup.

IV. Conclusions

Defining a variable amount of active building fabric could make the adapted simplified method apt for legislative purposes. Further, the sensitivity analysis indicates that more detailed approaches are necessary for designing night ventilation, such as CFD.

Acknowledgements

This work was funded by the Brussels Institute for Environmental Protection and the Institute for the Promotion of Innovations through Science and Technology in Flanders.