Assessing the Potential of Ventilated Facades on Reducing a Buildings' Thermal Load Using Decoupled COMSOL Simulations

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Abstract

Solar radiation is a prominent contributor of energy in buildings, and can be transmitted directly into a building through opaque surfaces, but it can also be absorbed by building components (i.e. walls, roofs etc.). Both cause heat addition to the building interior. The application of ventilated facades can help reduce thermal loads during high temperatures and solar radiation, which in effect reduces the energy consumption due to air-conditioning systems. This is a passive cooling technique that could be developed to a greater extent in order to improve indoor climatic conditions and the microclimate around buildings. This study discusses the use and effect of ventilated facades, with an external facade cladding, a sub-structure anchored to the wall surface of the building under solar radiation, while designing facade elements numerically using COMSOL, to create the highest achievable velocity inside the air cavity. The mass air flow inside the cavity, due to buoyancy effects (natural convection) and wind (forced convection), can carry away heat load passively. Results show that energy saving is increased with a ventilated facade over a conventional facade, and is more effective for higher solar radiation and higher air velocity inside the cavity. In the second part of the study it becomes clear that facade elements can be designed in such a way that they increase the air velocity inside the cavity to remove more heat efficiently. An improvement of up to 75% of the air velocity is reached in some parts of the cavity for the implemented design in comparison to the reference case.
Reference

Figures used in the abstract

Figure 1: Schematization of the heat balance model.
**Figure 2:** Graphical display of the velocity in the middle of the cavity for design 3, 3B and 3H for upward and downward flow.

**Figure 3:** Air velocity near construction details design.