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Characterisation of Wind-Driven Ventilation in Complex Terrain Conditions

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Abstract : The physical effects of upstream flow obstructions such as vegetation on cross-ventilation phenomena of a building are important for issues such as indoor thermal comfort. Modelling such effects in Computational Fluid Dynamics simulations may also be challenging. The aim of this work is to establish the cross-ventilation jet behaviour in such complex terrain conditions as well as to provide guidelines on the implementation of CFD numerical simulations in order to model complex terrain features such as vegetation in an efficient manner. The methodology consists of onsite measurements on a test cell coupled with numerical simulations. It was found that the cross-ventilation flow is highly turbulent despite the very low velocities encountered internally within the test cells. While no direct measurement of the jet direction was made, the measurements indicate that flow tends to be reversed from the leeward to the windward side. Modelling such a phenomenon proves challenging and is strongly influenced by how vegetation is modelled. A solid vegetation tends to predict better the direction and magnitude of the flow than a porous vegetation approach. A simplified terrain model was also shown to provide good comparisons with observation. The findings have important implications on the study of cross-ventilation in complex terrain conditions since the flow direction does not remain trivial, as with the traditional isolated building case.

Keywords : complex terrain, cross-ventilation, wind driven ventilation, wind resource, computational fluid dynamics, CFD
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