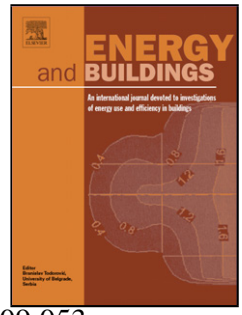

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Cross-ventilation of a Room in a Courtyard Building

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Abstract

The influence of courtyard height on the cross-ventilation of a room abating a courtyard building is addressed in this work. While the cross-ventilation performance of isolated buildings has been thoroughly documented in the literature, the phenomenon is still not tackled in the context of a courtyard building, both in isolated as well as urban conditions. This has important implications on the design of such buildings (both new and retrofitted). A numerical approach using Computational Fluid Dynamics (CFD) is used to address these challenges. A courtyard model is first validated in 2D and 3D, using various turbulence models with existing data in order to determine whether a 3D approach is necessary for this study. Three generic buildings having different heights with a room located on the leeward side are then tested. This is performed for an isolated building and an urban scenario. Results show that there is an increase in the ventilation flow rate with increasing building height. Moreover, this flow is directed from outside the building and into the courtyard. This result has been confirmed for all scenarios tested. The consideration of rooms located in positions other than the leeward side of the building is left for future consideration.

Keywords:
Cross-ventilation, Courtyard building, Computational Fluid Dynamics (CFD), Natural ventilation, Street canyon

1. Introduction

1.1. Background

The flow over isolated buildings has been investigated in quite some detail during the later half of the last century. These studies often consider buildings having a simple cubical shape. Such studies are important for various reasons, including the wind pressure distribution on building walls which can then be used for wind induced natural ventilation calculations.

There have also been various studies on the performance (both thermal and aerodynamic) characteristics of courtyard buildings (for example Almhafdy et al. [2, 1, 3], Alvarez S and JL. [4], Berkovic et al. [6], Ghaffarianhoseini et al. [12], Jamaludin et al. [14], Taleghani et al. [32]). These are mostly based on Computational Fluid Dynamics (CFD) such as the work by Rajapaksha et al. [25]. The