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A multi-fidelity simulation framework with uncertainty quantification for predicting natural ventilation in a slum house in Dhaka, Bangladesh[1] YUNJAE HWANG, CATHERINE GORL, Stanford University, STANFORD WIND ENGINEERING LAB. TEAM — A preliminary study conducted in Dhaka, Bangladesh indicated that there might be an association between the presence of cross ventilation in a slum house and the incidence of pneumonia, which is the leading cause of death in children under five. The objective of this study is to establish a validated computational framework for accurately estimating household ventilation rate in terms of air change per hour (ACH) and to support further investigation of the association. To achieve this objective, we first perform high-fidelity large-eddy simulations (LES) that solve for three-dimensional flow and temperature fields in the home. The LES results are used to develop a relationship for ACH as a function of indoor-outdoor temperature difference and wind conditions. Then, the relationship is implemented into a computationally efficient low-fidelity model with uncertainty quantification (UQ) to predict the mean and 95% confidence interval (CI) of both ACH and volume-averaged temperatures. The model predictions are validated against the field measurements, and the results are interpreted to improve our understanding of the ventilation mechanisms and identify robust ventilation strategies that will work under a variety of weather conditions.

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