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Utilizing Computational Fluid Dynamics in the Analysis of Natural Ventilation in Buildings

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Abstract : Increasing urbanisation has driven building designers to incorporate natural ventilation in the designs of sustainable buildings. This project utilises Computational Fluid Dynamics (CFD) to investigate the natural ventilation of an academic building, SIT@SP, using an assessment criterion based on daily mean temperature and mean velocity. The areas of interest are the pedestrian level of first and fourth levels of the building. A reference case recommended by the Architectural Institute of Japan was used to validate the simulation model. The validated simulation model was then used for coupled simulations on SIT@SP and neighbouring geometries, under two wind speeds. Both steady and transient simulations were used to identify differences in results. Steady and transient results are agreeable with the transient simulation identifying peak velocities during flow development. Under a lower wind speed, the first level was sufficiently ventilated while the fourth level was not. The first level has excessive wind velocities in the higher wind speed and the fourth level was adequately ventilated. Fourth level flow velocity was consistently lower than those of the first level. This is attributed to either simulation model error or poor building design. SIT@SP is concluded to have a sufficiently ventilated first level and insufficiently ventilated fourth level. Future works for this project extend to modifying the urban geometry, simulation model improvements, evaluation using other assessment metrics and extending the area of interest to the entire building.

Keywords : buildings, CFD Simulations, natural ventilation, urban airflow
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