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Predicting Indoor Air Quality and Thermal Comfort using Energy Simulation and Computational Fluid Dynamics

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Buildings are designed in order to provide a healthy and a comfortable indoor environment for the occupants. Indoor air quality and thermal comfort are considered as the principal criteria for assessing the performance of buildings. Poor indoor air quality can lead to "Sick building syndrome" and other health related issues. Undesirable thermal comfort levels can affect the productivity of occupants in a drastic manner, especially in office buildings. Such issues can be addressed successfully at the early design stage of buildings using modelling and simulation methodologies. On this basis, the paper predicts the Carbon Dioxide (CO_2) levels and thermal comfort of occupants in an office building to be constructed at Ratmalana, Sri Lanka using Energy Simulation and Computational Fluid Dynamics (CFD). Three-dimensional computational model of the building consists of 1,692,867 hybrid mesh volumes. EnergyPlus v. 8.0 is used as the Energy Simulation tool and it predicts internal building envelope temperatures to be applied as boundary conditions for the CFD simulations. ANSYS Fluent 15.0 is used as the CFD tool for the analysis. The k-ε RNG model predicts turbulence with enhanced wall treatment approach. Diffusion of emissions is predicted by the species transport model in Fluent. Simulations predict the CO_2 concentration on occupant planes of the building. Furthermore, thermal comfort values at ankle level, waist level and neck level of occupants have also been predicted. The simulation results provide the building designers with a basic understanding of CO_2 and thermal comfort levels to be expected in the indoor environment at the intended location of the building, enabling them to take vital design decisions to enhance the performance of the same.

Keywords:Indoor Air Quality, **Thermal Comfort, Energy Simulation, Computational Fluid Dynamics**

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