Document details

Back to results | 1 of 2 Next

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CFD investigation of indoor hygrothermal performance in academic research storage room: Measurement and validation (Article)

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Abstract

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Poor hygrothermal performance exacerbates deterioration risk from mould growth, corrosion and damage to archival materials. Improved microcomputers' computational power has significantly advanced computational fluid dynamics (CFD) models and research developments in indoor airflow, heat transfer and contaminant transport. Nevertheless, numerous uncertainties exist in the CFD experiments which require adequate clarifications for improved results' reliability. This paper presents the measurement and validation of a CFD model for the investigation of the hygrothermal performance in an indoor environment with known cases of microbial proliferations. The room, 5.2 m × 4.8 m x 3.0 m high, is air-conditioned and ventilated by constant air volume (CAV) system controlling the indoor airflow and hygrothermal profiles with ceiling mounted four-way supply diffuser and extract grille for indoor air distribution. The methodology combines in-situ experiment and numerical simulation with a commercial CFD tool using the standard k-e model. Microclimate and airflow parameters obtained from in-situ experiments were used as boundary conditions in the CFD. The study shows a good agreement between the predicted and measured indoor hygrothermal profile with less than 10% deviation. The results indicate that the model can be employed for further investigation with high confidence.

Author keywords

CFD simulation Hygrothermal performance In-situ experiments Indoor climate Uncertainty assessment

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