

Investigating Indoor Air Quality in Bathrooms: A Comparative Analysis of Bathroom Fans and Windows Using Autodesk Computational Fluid Dynamics (CFD)

*Mr LEE Tsz Chun, BEng (Hons) in Building Services Engineering,
Department of Construction, Environment and Engineering
Supervisor: Dr ZHOU Yang, Phil, Lecturer*

BACKGROUND & OBJECTIVES

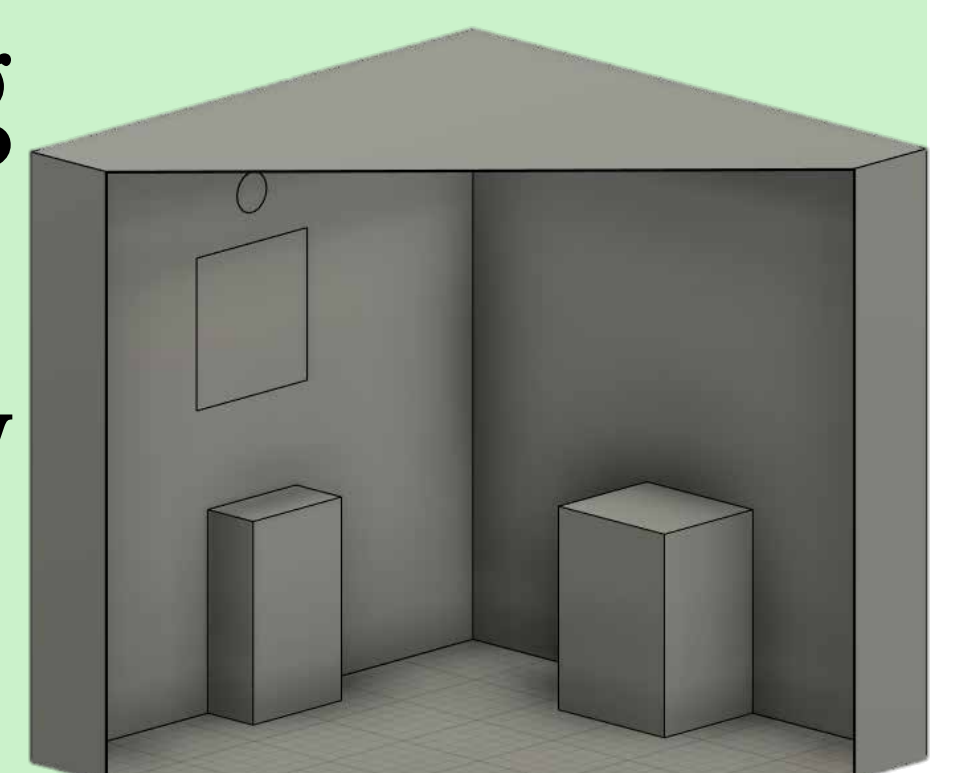
Indoor Air Quality (IAQ) directly impacts both the mental well-being and physical health of building occupants. Long-term exposure to poor indoor air can be tremendously hazard to health, such as suffering cystic fibrosis and cardiac sarcoma. However, limited research has focused on the effectiveness of ventilation in residential bathrooms.

This project focused on the air flow patterns of bathrooms and evaluated the performance of bathroom fans and windows using the software Computational Fluid Dynamics and provides recommendations for optimized bathroom ventilation approaches for the future development of bathrooms in building design.

METHODOLOGY

Create 6 types of bathroom models, with exhaust fan and windows on the wall, and basin and water closet on the ground in Autodesk Fusion 360

Set up boundary conditions and properties of outdoor, exhaust fan and windows. Simulate each model in configurations of (i) operating the fan and having the window opened, (ii) only having the window opened, and (iii) only operating the fan



RESULTS & FINDINGS

The most effective method to ensure sufficient ventilation is by operating the exhaust fan and opening the windows in the bathroom at the same time

Opening bathroom windows can achieve overall ventilation in the bathroom; operating the exhaust fan can achieve ventilation with higher air velocity but limited spaces

Avoid installing furniture on the same side of the fan if installed on the middle-top section of the wall; avoid installing furniture on the nearest perpendicular wall if the fan is installed on the left- or right-top sections of the wall

Rectangular windows perform greater ventilation regardless of the preference in ventilation approach by building occupants

