



## 1. Introduction

Ventilation of buildings is essential to ensure the health and comfort of its inhabitants. Efficient ventilation helps to improve energy efficiency, contain airborne diseases, and limit the concentrations of fine particulates. Many buildings in Scotland still rely on passive ventilation, which significantly increases the energy burden of heating and cooling buildings. Modern buildings, including private dwellings, increasingly adopt active ventilation. However, for this to work effectively, an efficient ventilation arrangement is required to ensure sufficient airflow in all parts of the building. In this project, the influence of different vent positions and flow rates on air quality in a room is investigated using computational fluid dynamics.

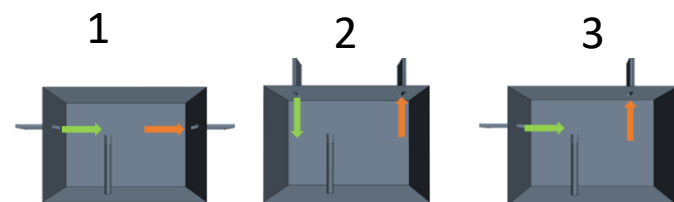


Single-glazed building with passive ventilation



Modern building with active ventilation

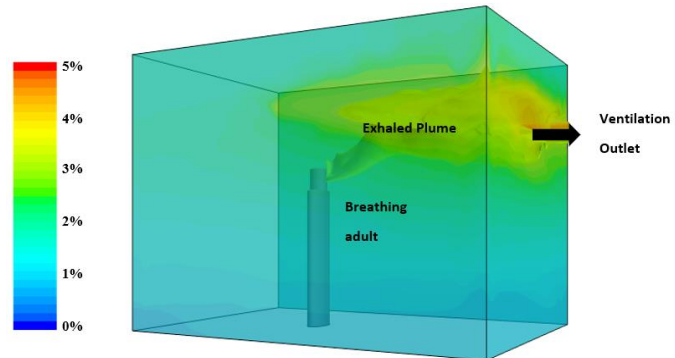
## 2. Computational Model



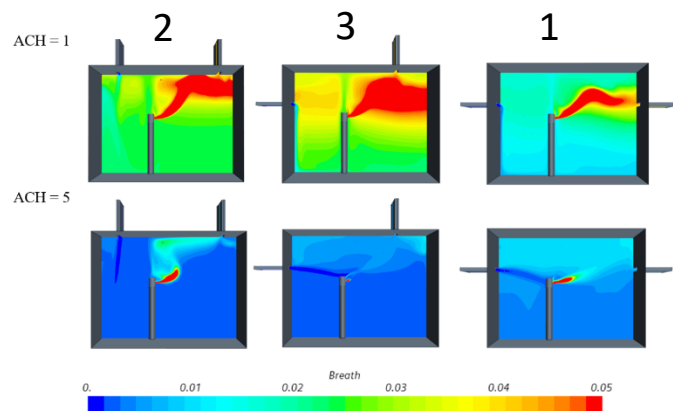
The question of ventilation within an average small office space was addressed by examination of air quality for different:

- tidal volumes – the volume exhaled by an individual
- breaths per minute – the breathing rate of the person
- air changes per hour (ACH) – the flow rate of the ventilation system
- and ventilation positioning within the room – three different arrangements for ventilation positions and flow directions as shown above (1, 2, and 3).

## 3. Results



In low ventilation rates of 1 ACH or less the simulation indicated that almost the entire room contains over 1% exhaled breath. With aerosol viral transmission, this could present a significant health risk. In terms of room air quality, this is also not ideal.



Room ventilation positions at low and high flow rates:

- At low flow rate ventilation position 1 is best
- At high flow rate ventilation position 1 is now worst and ventilation position 3 is best

## 4. Conclusions

Three different ventilation positionings examined under various conditions of flow rate, and room occupant breathing rate.

- At low ventilation rates, the room suffers from low air quality with almost the complete room being over 1% exhaled air.
- The ventilation flow rate is not the only factor to consider. The positioning of the ventilation also plays a significant role
- This study looked at temperature and concentration, but other factors such as human comfort are of importance and will be considered in future studies.