Additional notes on the ventilation of MR4 and MR5

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This note has been prepared to provide lecturers and event organisers using MR4 and MR5 with some additional explanation as to why you are asked to keep the external door shut. Specifically, why having it open for lectures can lead to an increased risk of transmission of COVID-19 and other airborne viruses.

Except in the summer, the temperature outside will be cooler than the temperature inside these two rooms. If the ventilation is not turned on, then it is undoubtedly true that the room will be better ventilated if the external door is open. Indeed, even if the ventilation system is on, the total amount of fresh air entering the room will be greater if the external door is open. The issue is more about how the air of different temperatures and from different sources is distributed within the room.

The mechanical ventilation system introduces fresh external air at high level (unlike many buildings, there is no recirculation of air) through a linear vent that runs front to back in the room. During the summer, this air is cooler than that already in the room, and so buoyancy forces cause it to convect downwards, cooling the occupants.

During the winter, the air introduced through the mechanical system is warmed, meaning it is less dense than the cooler air that will be in the room already (due to heat losses through the windows or an open external door). If the temperature difference between the floor and ceiling is large enough, the air will not descend form the ceiling, but instead spread across it and be short-circuited out the eight extraction ducts, also located in the ceiling. If you look carefully at the inlet ducts, you will see some plastic angle sections running along each side. These were installed during the pandemic to redirect the momentum of the incoming air downwards to allow it to penetrate further into this stratification. (Figure 1 shows the original installation in MR5.) You will also see a large floor fan in the back corner of each room. The purpose of this fan is to mix the air in the room, removing as much of the temperature difference as possible before it is first occupied. (As winter approaches, we might need to have this fan running throughout the day due to the heat loss through the windows. This heat loss cools the air near the windows, causing it to sink to the floor and increase the temperature difference between floor and ceiling.)

Similarly, introducing cold air from outside creates a cold layer at floor level, working against the aims of the the ventilation system and the floor fan. If the door were to be open for *all* lectures, regardless of the numbers in the room and changes in the weather outside, then this would not be problematic other than the occupants being cold and the room wet. However, if the door is only open for some lectures, a cold layer of air will become trapped in the room. When combined with the heat loss through the windows, the ventilation system may not be able to erode this layer away in a reasonable time, if at all. The problem is that the density change between the cold floor-level air and the warm ventilation-supplied air can trap everyone's exhaled breath in the breathing zone within the room. The photo (figure 2) of MR4 last year illustrates this very problem. If the room were fully occupied, then it is likely that this layer would be a little higher and a bit thicker, and it is likely that both the lecturer and attendees would have some exposure to higher levels of previously breathed air.

As secondary benefit of the changes to the inlet duct and installation of the floor fan is likely to be a more comfortable thermal environment than in previous years, although there will be a greater movement of air in the occupied zone which may negate that for those sitting closest to the windows. In contrast, having the external doors open will remove not only he heat in the air, but also the heat stored in the floor and walls, making it even harder for the ventilation system to remove a stratification if one develops.

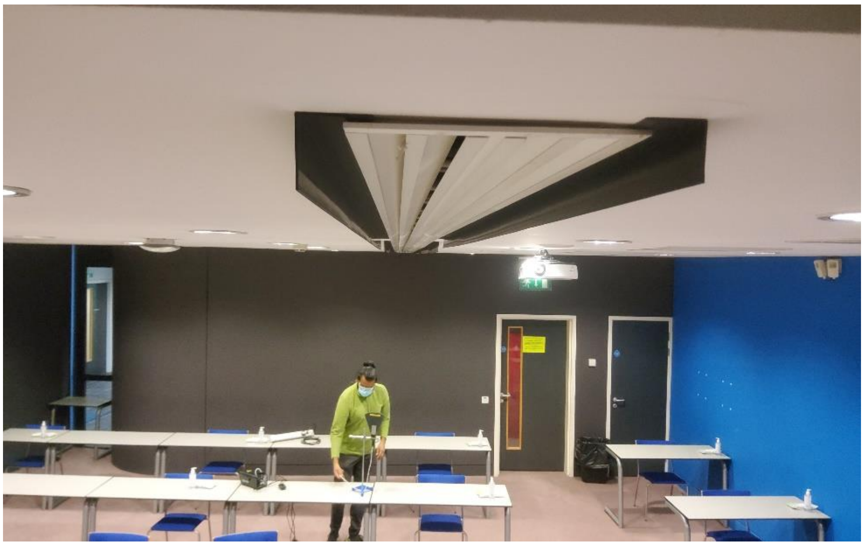

Figure 1: The initial modifications to the inlet duct in MR5 (October 2020). The black angled-plastic strips have since been replaced with while ones. This deflects the incoming air away from the ceiling, providing better ventilation during the winter months.

Figure 2: MR4 in December 2020. The external temperature was 5-8°C and the ventilation system had been running for over an hour. Artificial smoke, with a buoyancy comparable to breath, was released and became trapped in the breathing zone. (The inlet duct had been modified to deflect the airflow downwards.)

We will continue to monitor the temperature profiles that form in the room over the winter months (you may notice small temperature loggers stuck to the walls in the rooms) and make any additional changes that might be necessary to prevent potentially risky stratifications from forming. However, we will not be able to do so if the external doors are left open.

Footnote:

Although less serious, leaving doors open for other meeting rooms connected to cooler spaces (*e.g.* MR2–MR3 and MR12–MR15) introduces some of the same challenges. Hence, the reason you are requested not to prop open any of the doors.