

Coronavirus risks – Air conditioning and ventilation

Preamble

There is evidence that homes are the major source of COVID transmission (up to 80% of cases). Other areas of major concern are situations where people often raise their voice to communicate or sing loudly or fail to keep the desired 2m. To date outbreaks through multiple onward transmission have not been reported within classroom settings from the millions of school children who have returned in the UK to secondary school or Sixth Form College. In the UK school environment the measures put in place seem to have worked very well to stop spread indoors (coupled with the onward transmission rate being lower with age). It should be noted that the safety measures at UCL are more rigorous than in many secondary school environments (e.g. expectation of face coverings, 2m distancing and 25% guide for campus occupancy).

The Covid-19 virus is very small- around 100 nm. A full stop on a printed page would contain about 10,000 viruses if they could be stacked end to end. In human breath the typical size of the exhaled droplets are 5-10 microns (ca 1/10 of the width of a full stop). These droplets tend to have a low buoyancy and subsequently deposit onto surfaces after travelling typically no more than 1-2 metres (unless under great force such as a large cough, shouting or opera singing). This is one of the reasons behind the Government's 2-metre rule, as the droplets are the primary transfer vector for COVID-19, not the individual virus. Touching contaminated surfaces and then touching the mouth, nose and eyes is a key transmission route, hence the huge push for regular hand hygiene, avoiding touching the face, and regular deep cleaning of surfaces.

Under extremely high force and using artificial aerosols that are a lot smaller than from human breath the virus has been detected under lab conditions as airborne for 3 hours. This is not the situation faced in an indoor space with people talking in a socially distanced fashion. Wearing a face covering in classroom settings offers a significant further layer of protection - even a simple cotton face covering and especially if it is made of multiple layers and materials. These face coverings trap the exhaled 5-10 micron aerosols quite effectively and help prevent onward spread. They will offer significant protection to the wearer of the face covering and people around them, if worn properly. The purpose for the vast majority of people wearing face coverings is that they help to protect the whole population in particular by trapping exhaled virus from an asymptomatic or pre-symptomatic host.

I have been involved in a number of discussions with estates about ventilation. I have confidence that the approach taken by UCL Estates is robust, particularly when taken with the other measures that the Institution has put in place to protect us all on campus.

Professor Ivan Parkin

Dean, MAPS

1st October 2020

Risk Level

The Health and Safety Executive state that the risk of air conditioning spreading coronavirus is extremely low¹. No one yet around the world has been able to identify live infectious virus in air samples. The WHO state⁶ there have been reported outbreaks of COVID-19 in some closed settings, such as restaurants, nightclubs, places of worship or places of work where people may be shouting, talking, or singing. In these outbreaks, aerosol transmission, particularly in these indoor locations where there are crowded and inadequately ventilated spaces where infected persons spend long periods of time with others, cannot be ruled out. Current evidence suggests that COVID-19 spreads between people through direct, indirect (through contaminated objects or surfaces), or close contact with infected people via mouth and nose secretions.

Risk mitigations

Recirculating centralised ventilation systems:

For buildings with centralised ventilation systems that remove and circulate air to different rooms, it is recommended that recirculation is turned off and as much fresh air supply introduced as possible. The HSE state that other types of air conditioning systems do not need to be adjusted¹.

UCL Estates estimate that 90% of UCL ventilation systems do not have any recirculation. Where practicable recirculating plant within ventilation systems is being turned off or bypassed, including heat recovery systems.

Recirculating local ventilation systems (split A/Cs or Fan Coil Units [FCUs]):

Within a room/zone these systems provide thermal comfort by warming or cooling the indoor air and the air movement they provide can help prevent stagnant areas. However, they do not provide any outside air into the room/zone and without a dedicated source of outside air they could be responsible for recirculating and spreading contaminants into the path of socially distanced building users⁵.

It is important that in room/zones with more than one occupant that there is a source of outside air provision (either natural or mechanical ventilation) when these units are in operation. If a room/zone has no or very little outside air ventilation provision then the action of a FCU or split unit could create air movement that could spread any airborne contamination throughout the room and the advice is to turn off the fan coil unit fan if there is more than one occupant. However, if there is a good outdoor air ventilation supply (either mechanical or natural) to the room/zone then the action of the fan coil unit fan will help de-stratify the air and reduce the chance of pockets of stagnant air, helping to dilute any airborne contaminants. UCL Estates will be identifying and marking the FCU/Split units in spaces with limited fresh air supply.

Ventilation rates:

Every enclosed workplace should be ventilated by a sufficient quantity of fresh or purified air². The associated Guidance³ states that the fresh air supply rate to your workplace should not normally fall below 5 to 8 litres per second, per occupant. New buildings are generally designed for 10 litres

¹ HSE eBulletin sent at 22-05-2020 03:00 PM BST
(<https://content.govdelivery.com/accounts/UKHSE/bulletins/28ce71a>)

² The Workplace (Health, Safety and Welfare) Regulations 1992 (WHSW), Regulation 6

³ Workplace (Health, Safety and Welfare) Regulations 1992: Approved Code of Practice and guidance L24

per second per occupant (generally 2-3 air changes per hour. The HSE recommend good ventilation is encouraged to help reduce the risk of spreading coronavirus¹.

The general advice is to supply as much outside air as reasonably possible⁴. *The key aspect is the amount of fresh air supplied per person.* When, due to COVID-19 social distancing, the number of occupants in a room is reduced then the available fresh air per person will be increased. Social distancing measures that reduce occupancy to c.25% of normal capacity therefore mean that the amount of fresh air supplied per person is increased fourfold – even without other interventions. UCL Estates will, where practicable through controls and mechanical settings increase fresh air ventilation rates to their maximum. Regular planned preventative maintenance and filter changing will continue to keep systems operating as installed.

In line with the Chartered Institution of Building Services Engineers London (CIBSE) guidance⁵ extended operation times are being implemented. UCL Estates are changing the clock times of system timers to start ventilation at nominal speed at least 3 hours before the building usage time and switch to lower speed 3 hours after the building usage time. In demand-controlled ventilation systems we will change CO₂ set point to lower, 400 ppm value, in order to maintain the operation at nominal speed.

Ventilation Validation Approach to Critical (Teaching) Spaces:

UCL Estates have assessed the ventilation rates (the amount of fresh or outside air provided) to critical areas across the campus, focusing on teaching spaces. The ventilation to these spaces generally consists of either mechanically supplied ventilation (from an air handling unit or supply fan), natural ventilation via openable windows, or occasionally a mixture of the two methods.

The approach adopted to assess the air flow rate to the spaces can be summarised as follows:

Survey of Spaces

The initial step for each space was to survey the area in question and determine whether it was ventilated by natural or mechanical means. Once this was determined it was noted and assigned to an engineer to assess the space and record the air flow rate within it.

Mechanical Ventilation

Where a space has fresh air supplied by mechanical means, the supply fan or air handling unit was enabled and run at full capacity. The air flow into the space was then measured and recorded at every delivery point using a calibrated anemometer (air flow meter) by a commissioning engineer.

The calculated total amount of outside air supplied to space was then compared against the occupancy level assigned to the space to confirm that the air flow rate per person was in line with the HSE and CIBSE guidance (stated above).

Natural Ventilation

Where spaces are ventilated via openable windows, consulting engineers have surveyed the room to assess the room geometry, window arrangement, and maximum safe opening of windows.

⁴ REHVA (The Federation of European Heating, Ventilation and Air Conditioning associations) COVID-19 guidance document, April 3, 2020

⁵ CIBSE COVID-19 Ventilation Guidance version 2 12 May 2020

⁶ WHO Q&A: How is COVID-19 transmitted? <https://www.who.int/news-room/q-a-detail/q-a-how-is-covid-19-transmitted>

Consulting engineers have then performed calculations based on these variables and on average daytime temperatures to determine whether the ventilation expected in these rooms is in line with HSE/CIBSE guidance. The expected ventilation is compared against the assigned occupancy.

In window ventilated spaces suitable ventilation can be provided by using a “pause” technique of having windows open until the temperature drops and then closing them again. This will mean that there has been a total air change in the room and this can be repeated a number of times an hour. There will be periods where the temperature in the space will be sub-optimal and users have been advised to wear additional or their outdoor clothing during these period. All naturally ventilated teaching rooms have signage indicating that windows should be opened during use.

Fans

The HSE recommends consideration to improving the circulation of outside air and prevent pockets of stagnant air in occupied spaces. This can be achieved by using ceiling fans or desk fans for example, provided good ventilation and supply of outside air is maintained. The risk of transmission through the use of ceiling and desk fans is extremely low providing there is good ventilation in the area it is being used, preferably provided by fresh air through a window or from a centralised system.

Remedial action:

A very small number of teaching rooms were identified as requiring remedial ventilation works. These have either:

- (i) been completed prior to room use or
- (ii) where more extensive work is required, the specific room has been withdrawn from the teaching room stock and closed until the necessary work has been completed.

Other Factors:

Ventilation is only part of a very large range of risk reduction measures that have been put in place. Safe transmission mitigation measures depend on multiple factors related to the individuals, their activity and the environment, including viral load, duration of exposure, number of individuals, and distance between them and whether face coverings are worn. We have considered all of these factors and have specific risk reduction measures in place for all of them throughout the UCL campus.

We are following the latest Government and UK Health and Safety Executive (HSE) guidelines, and drawing on the latest research, to ensure safety on campus. This includes:

- Operating at around 25% capacity in most areas
- Teaching room capacities (and other shared spaces such as study spaces) have been reduced in accordance with 2m social distancing and room layouts have been set to ensure social distancing is maintained at all times
- Signage, posters and one-way systems in buildings and around campus have been put in place to facilitate social distancing
- Enhanced cleaning regime (see <https://www.ucl.ac.uk/coronavirus/keeping-safe-campus/reducing-risk-transmission-through-cleaning-and-building-ventilation>)
- It is expected that face coverings will be worn by all (see <https://www.ucl.ac.uk/coronavirus/keeping-safe-campus/wearing-face-coverings-campus>)

- Staff and students have been instructed to remain at home if unwell if they have any coronavirus symptoms
- The UCL Connect to Protect tool (see <https://www.ucl.ac.uk/coronavirus/testing-reporting-and-managing-potential-cases-ucl>).

References

Related references to COVID spread can be found here:

<https://www.jwatch.org/na52094/2020/08/04/household-transmission-sars-cov-2-korea-clue-role-children>

<https://www.japantimes.co.jp/news/2020/06/18/world/coronavirus-spreads-at-home/>

<https://www.ecdc.europa.eu/en/covid-19/latest-evidence/transmission>

<https://hartfordhealthcare.org/about-us/news-press/news-detail?articleid=24686&publicId=395>

<https://www.who.int/news-room/q-a-detail/q-a-how-is-covid-19-transmitted>

<https://www.medrxiv.org/content/10.1101/2020.04.04.20053058v1>