How to deliver adequate, effective, suitable ventilation in a COVID-19 environment?

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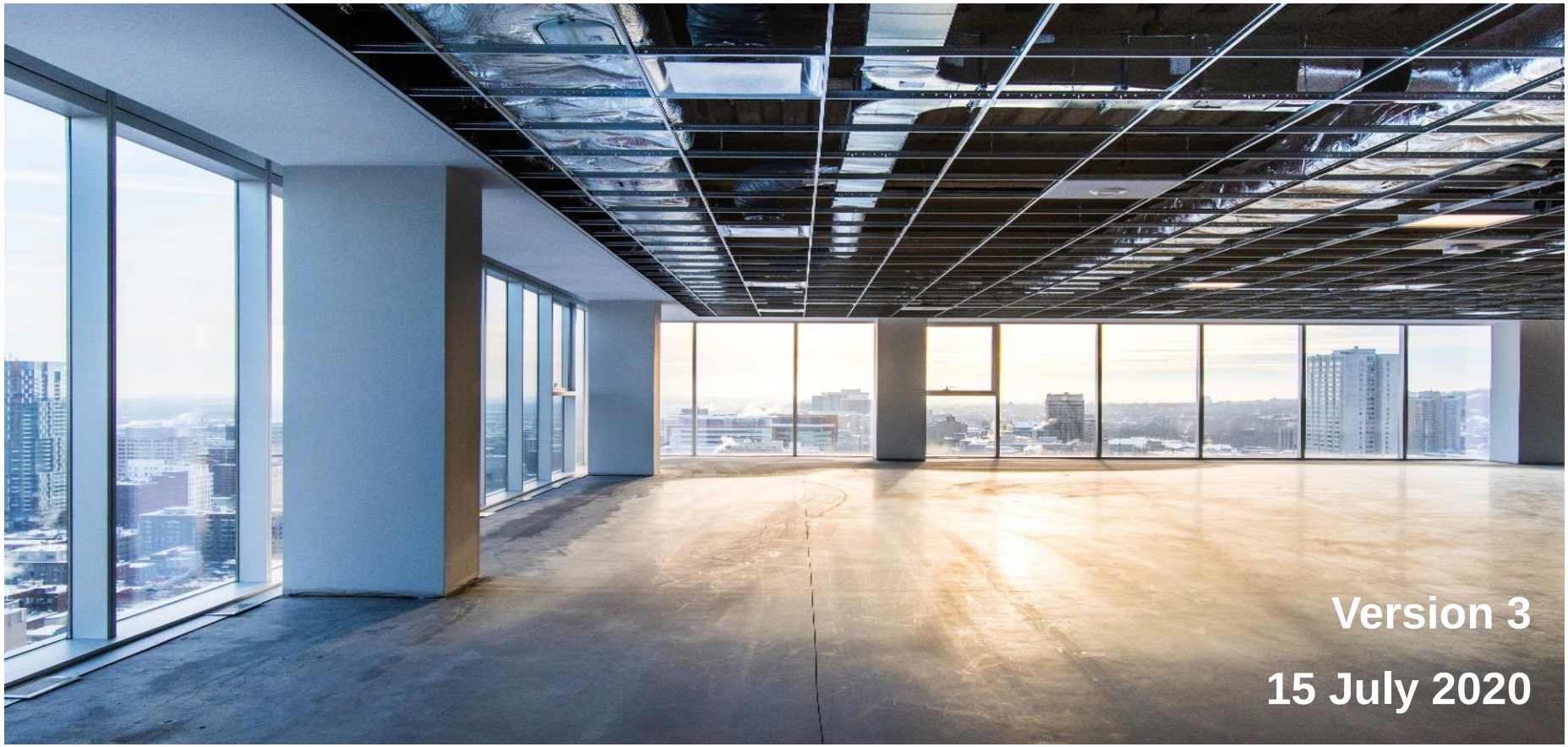
CIBSE COVID-19 VENTILATION GUIDANCE



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Controlling COVID-19

Aerosol transmission is **not** the main concern

Droplets and contact – person to person or via surfaces or common touchpoints appear to be the main transmission pathways

So personal hygiene – hand washing, surface cleaning and distancing are key to reduce transmission by these routes:

Hands – Face - Space

Ventilation **supplements** these measures, it certainly does not replace them

It is about reducing risk and managing probabilities

“There are known knowns. These are things we know that we know. There are known unknowns. That is to say, there are things that we know we don't know. But there are also unknown unknowns. There are things we don't know we don't know.”

Donald Rumsfeld, February 2002

Aerosol transmission

In the early days of the pandemic the WHO considered that the only transmission routes were by contact or droplet transmission.

Early research from Italy indicated that there is a risk of aerosol transmission at distances greater than 2m

A group of over 200 scientists and engineers from around the world, co-ordinated by Lydia Morawska from the University of Queensland published an open letter calling on the WHO to recognise the aerosol transmission route

WHO added aerosol transmission to the infection pathways in July

CIBSE Guidance

Following the early indications that aerosol transmission was an issue, CIBSE produced a statement for the CIBSE website in early May supporting the emerging view

This was supplemented a few days later by the first guidance notes on

- Emerging from Lockdown
- COVID-19 Ventilation Guidance
- Recommissioning Lifts

These have been updated since to reflect emerging findings

A fourth edition of the ventilation guidance is about to be published to address some of the concerns here in the UK as we enter the heating season

The major concern is balancing thermal comfort and reducing aerosol transmission

What are we trying to achieve?

Safer ventilation of existing non domestic buildings – (some 2m in UK)

Ventilation rate is the biggest factor in reducing the risk of aerosol transmission

Dilution

To reduce potential concentration of any viral material in the occupied spaces of a building - dilution is improved by increasing the air supply to a space

Reduced potential exposure

Exposure depends on the number of occupants in a space and the levels of exertion being undertaken – sedentary occupants talking quietly on the phone will generate lower levels of viral material than someone walking around the room talking loudly or people exercising, shouting or singing.

Unknown sources

Traditional source control is based on knowing the location and quantity of contaminant or pollutant to be controlled

In this pandemic we do not know where the source(s) will be located (and they will move around) and possibly behave in ways we don’t expect

Where we have a source we are unlikely to know that they are a source – until after the event

So all our guidance is precautionary

So we may have to think about probability and likelihood much more than we are used to in engineering ventilation systems – we are used to much greater clarity over cooling and heating loads or power demands or hot water requirements in our buildings

The challenges

There are a number of significant unknowns in seeking to manage the risk of aerosol transmission in buildings:

We do not know the location of any source of infection – and the source, or sources, will be moving around

The rate of production of contaminant, or infectious material, is variable in quantity as well as location

The behaviour of any infected material is also influenced by the movement of other building users – corridors and stairways

So what we do has to address all of these unknowns

Ventilation for SARS CoV 2

Identify poorly ventilated spaces – they are the priority

If its stuffy or smelly it is not well ventilated

Its more important to increase ventilation in poorly ventilated multi occupant spaces

Aim for 10 litres per second per person – rather than air changes per hour

If ventilation to a space cannot be improved, limit access or occupancy or both

Remember the law of diminishing returns

Reducing emissions

We know that some things increase the rate at which an infected person will generate aerosol material

Talking quietly < talking loudly < shouting < singing

Exercise increases breathing rates and emission rates

Some settings may be a need to consider the activities being undertaken as well as how spaces are ventilated

Reducing the rate of emission reduces the risk of transmission

Occupancy density

The more people in a space, the higher the risk that an infected person is present

Greatest effect in smaller spaces – a second person in a small room doubles the risk

Reducing the occupancy density reduces the risk of transmission at a set ventilation rate

Smaller spaces at greater risk than larger open plan spaces or classrooms

Ventilation and thermal comfort

Higher ventilation rates reduce the risk of transmission via the aerosol route if an infected person is present

Greatest effect in smaller spaces where there is a limited reservoir of air so it needs changing fast

Increasing the ventilation rate may cause some thermal discomfort

Need to balance the risks of transmission with the potential for uncomfortable occupants to turn the ventilation down or off to keep warm

Recirculation

If an infected person is present then the air may be contaminated.

Avoid recirculation/transfer of air from one room to another unless this is the only way of providing adequately high ventilation to all occupied rooms and keeping them comfortable

Recirculation of air within a single room where this is complemented by an outside air supply is acceptable - this helps enable more outside air to be provided, get more outside air to all occupants, and it can make an environment more comfortable

Recirculation – central systems

If an infected person is present then the exhaust air may be contaminated.

Best not to recirculate that air if there is an adequate supply of outside air that is warm enough to avoid thermal discomfort

If not recirculating some air leads to occupants feeling cold and ‘sabotaging’ the supply of outside air, better to maintain the ventilation rate and temperature – the risk from a small amount of recirculated material is lower than the risk from being in a poorly ventilated space.

Recirculate as much as you need and as little as you can get away with

What about CO2 levels?

CO2 is breathed out – just like viral material. Increasing levels of CO2 suggest that the ventilation rate is not sufficient and that if an infected person is present the level of viral material may also be increasing

Higher CO2 levels are likely to indicate lower ventilation rates

Lower levels of CO2 are desirable but may not indicate good ventilation, depending on the activity

If CO2 levels exceed 1500ppm for an extended period then the ventilation rate to that space is almost certainly insufficient.

Horses for courses

Different locations will need different measures to increase ventilation and reduce risk, taking account of

- Ventilation system
- Activity being undertaken
- Exposure times
- Avoiding thermal discomfort
- The occupancy of the building or space

Education, education, education

User behaviour will have a significant influence on the effectiveness of any measures

It is vital to explain how the building or space is intended to be used and how it is ventilated and to explain to users how they can contribute to reducing the risks of occupying the space

It is also important to listen to user feedback. A set up that works for users will be more effective than one that they feel they need to modify to be comfortable

There is no simple equivalent to “Hands – Face – Space” when it comes to ventilation

Engineering, Engineering, Engineering

There is no better time to be an engineer!

Buildings need engineering expertise to assess their ventilation requirements and reduce the risks of SARS CoV 2 infection to building occupants

Engineers are important to reopening the economy at lower risk and to maintaining safe and healthy working environments

Engineers can help users' understanding of building ventilation systems and how they can best be operated to reduce aerosol transmission of SARS CoV 2

Further Guidance

https://www.cibse.org/coronavirus-covid-19/emerging-from-lockdown

CIBSE ventilation guidance is found in

- CIBSE Guide B2 – Ventilation and Ductwork
- Guide A Section 1.8 – Environmental Design

Also in

- AM10 – Natural Ventilation
- AM13 – Mixed mode ventilation
- TM21 – Minimising pollution at air intakes

All to be found at https://www.cibse.org/knowledge which is available to all our members as a benefit of membership

Not a member? You need to talk to Sharon Pestonji spestonji@cibse.org.au

Summary

Increased ventilation using outside air is the primary means of mitigation of the risks of indoor aerosol transmission of SARS-CoV-2

Recirculation increases the risk of transmission

Winter poses a challenge of balancing outside air supply and thermal comfort

Thank you for listening

Any Questions?

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