

Theatres, Concert Halls and Other Performance Spaces

12 July 2020

Executive Summary

- Good ventilation is a primary mitigation for reducing the risk of transmission of COVID-19 by aerosols. Performance venues should seek to maximise the fresh air ventilation rate while being mindful of thermal comfort.
- Many performance venues have the capability to provide good levels of ventilation. However, the theatre operator may not know whether appropriate levels of ventilation are being provided, especially in smaller venues which use opening windows as a means of ventilation. If the theatre operator is unsure of the level of ventilation being provided, it is recommended that NCID type CO₂ sensors are installed in the occupied space and that the theatre operator checks that levels do not exceed 1000ppm for extended periods.
- The theatre operator should ensure that the facilities manager takes appropriate steps to ensure safe re-commissioning (if necessary) and re-use of equipment that may have been dormant for several months. CIBSE offer guidance to building operators on re-commissioning systems.
- Each performance venue is invariably comprised of different spaces, all of which though are linked by doors and stairwells. Ensuring adequate levels of ventilation in one space does not guarantee appropriate levels of ventilation in another, so due care must be given to each occupied room/space.
- Performance venues should take steps to reduce overcrowding including restricting numbers of people in foyer and bar/café areas as well as in back stage areas.
- Alongside ventilation, performance venues should implement a regular cleaning routine and ensure that surfaces which are touched by performers and audience members are cleaned before the next performance

Overview

Building types

There are a large range of building types for arts performances, including:

- modern purpose-built venues with ventilation provision broadly in line with current building regulations
- older venues which were purpose built but which may not have ventilation systems in line with current standards
- older (and some newer) venues which have been converted from their original form to allow for performances

Ventilation strategies

There are three types of ventilation strategy deployed in all spaces.

- Mechanical ventilation, which uses fans to provide fresh air to the occupied zones, distribute the air, extract stale air, and partially recirculate some of the air at times to help mitigate cold draughts and/or conserve energy.
- Natural ventilation, which uses buoyancy and/or the wind to provide fresh air into the space, distribute the air and extract stale air via openings. This can be as simple as opening windows, although many venues will have more sophisticated vents.
- Hybrid ventilation, which can involve part-natural and part-mechanical simultaneously, or else mechanical ventilation at some points in time and natural ventilation at other points in time.

There are two types of air distribution strategy – displacement ventilation whereby fresh air is typically introduced at low level and stale air exhausted at high level, and mixing ventilation whereby cool fresh air is provided at high level, mixes with air in the space as it descends, and stale air is exhausted at high level.

Typical ventilation rates and variation with occupancy

Ventilation rates in the occupied areas for performance venues which have been built or refurbished in the last 10 or so years are designed for 10l/s/person (8l/s/person prior to this). The ventilation systems installed are designed to cope with maximum occupancy. The ventilation rate can be higher on a per person basis if the provision of fresh air is the mechanism by which internal temperatures are kept within reasonable limits – because the rates of fresh air needed for temperature regulation are usually higher than the minimum fresh air rates in building regulations. It is also possible to provide more ventilation per person during periods of lower occupancy if the CO₂ set points for the building management system are reduced. Theatre operators should work with their facilities management team to establish whether this is possible and if it is, adjust the set points accordingly.

Most of the public areas (auditorium and bar/café areas) are usually well ventilated, however over occupancy in bar/café areas is common which can reduce the effective ventilation. The foyer is sometimes just ventilated with the main doors open. The backstage area and smaller sunken orchestra pits can sometimes be poorly ventilated, especially if the occupancy backstage is higher than the number of performers for which the space is designed and there is no dedicated supply of air to the orchestra pit.

Higher risk areas and specific potential mitigation measures

Areas which might have a higher risk of build-up of airborne pathogens due to lower rates of ventilation (per person) can potentially be tackled with various practical solutions including:

- performers (musicians) arriving at the venue concert-ready (no changing) where possible
- limiting the size of the cast/groups performing so that the sizes of groups are within the design intent of the space

- staff members working within lighting/sound booths working individually or else wearing face masks (to protect themselves and any colleagues in the booth)

Areas which might have a higher risk of build-up of pathogen due to stratification within the space include balconies and lighting gantries where some members of staff may be working. Venues should check whether their ventilation system is a displacement type and hence whether stratification is more likely to occur. Venues should consider not using balconies at the moment, and should consider requiring staff members working in lighting gantries to wear appropriate face masks to protect themselves.

General risk mitigation measures

Risks in the performance space associated with potential aerosol transmission could be reduced further by considering:

- reducing the occupancy levels for audiences in line with social distancing measures, as this will also assist with provision of greater ventilation rates per person especially if the mechanical ventilation system runs with the same fan speeds as for higher occupancy, or if the CO₂ set points are reduced (if these form part of the building management control system inputs)
- greater use of microphones for performers to reduce the volume at which they need to speak/sing
- avoiding performances which involve all the audience talking/singing for a significant period of time
- having limited duration performances/halves
- air flushing of the auditorium using the smoke ventilation system/mode in the interval and before/after a performance
- not using recirculation of air (in line with the CIBSE guidance, but note that this guidance is being reviewed with regards to ventilation in colder weather)
- turning off night-cooling in theatres which are naturally-ventilated and which include thermally massive labyrinths; this is because the pre-cooling function usually used during performances may lead to lower ventilation rates than is otherwise achievable. Note that all theatres should however have the ventilation system running after a performance to ensure a number of air changes, to help flush out any pathogens. If the theatre has a labyrinth then it can be used at this point as it can help flush the building more quickly. It can also be used during the operation of the theatre even though the pre-cooling of inlet air may not be as significant due to the loss of, or reduced, night-cooling effect.
- ensuring that the ventilation systems are operating in line with their original design which may not be the case for many reasons. A full maintenance review is advised prior to re-opening of the building. CO₂ monitoring in the occupied space may offer some indication that spaces are maintaining reasonable ventilation rates, although CO₂ is not as good an indicator of good ventilation when occupancy levels for a space are lower than the intended design.
- Non-ventilation related mitigation measures in general (such as signage for people spacing, hand sanitizer etc.) and some specific to these environments including:
 - regular cleaning of surfaces touched by people [chairs in auditoria]
 - all ticket purchases via online system and to include all customer names and tracing/contact details for each booking to assist with tracing
 - all tickets with electronic devices rather paper
 - if provided, then all interval drinks pre-ordered and distributed before interval – but note that provision of interval refreshments at all might be difficult in some venues owing to potential overcrowding in these areas
 - if offered, then programmes only purchased with contactless payment

- use of face coverings when it might be more difficult to maintain physical distancing such as when entering/leaving the auditorium. However, this could be considered even in the auditorium depending on the distancing between individuals/household groups

Future/research

The use of UV-C irradiation or improved filtration in return air ducts is a potential strategy which could help performance spaces operate with partial recirculation in colder weather. The effectiveness and practicality of these options is currently not known and should be investigated urgently.