

# SinBerBEST Recommendations for Singapore Buildings during COVID-19 Circuit Breaker

## Background

On 13 March 2020 World Health Organization (WHO) declared COVID-19 as a pandemic [1-2]. Individual hygiene, disinfection practice, isolation, and physical distancing measures have been advocated by the WHO and Singapore Ministry of Health as the main means to control the spread of COVID-19 [1-10].

With the intent to reduce the risk of COVID-19 spread further, [SinBerBEST](#) provides this Air Conditioning and Mechanical Ventilation (ACMV) expert recommendations document for Singapore commercial, institutional and residential buildings that are operating during the Circuit Breaker period [11, 12]. It is aimed at:

- Facility managers that operate buildings;
- Managers and Administrators for schools and childcare centers; and
- Homeowners of public and private residences and operators of dormitories.

This document follows the use of the precautionary principle to reduce potential risks associated with plausible routes of COVID-19 spread. This document takes into account the context in Singapore [11-14]. It is based on our professional judgment and evidence collected from studies of other infectious agents [15-22] and limited evidence from studies on COVID-19 [24-26]. These recommendations should come after the recommended primary measures, for example, individual hygiene, disinfection practice, isolation, and physical distancing measures [1-10].

## How COVID-19 spreads

The WHO reports [1] that *“COVID-19 is transmitted via droplets and fomites during close unprotected contact between an infector and infectee. The airborne spread has not been reported for COVID-19 and it is not believed to be a major driver of transmission based on available evidence; however, it can be envisaged if certain aerosol-generating procedures are conducted in health care facilities. Fecal shedding has been demonstrated by some patients, and the viable virus has been identified in a limited number of case reports. However, the fecal-oral route does not appear to be a driver of COVID-19 transmission; its role and significance for COVID-19 remain to be determined.”*

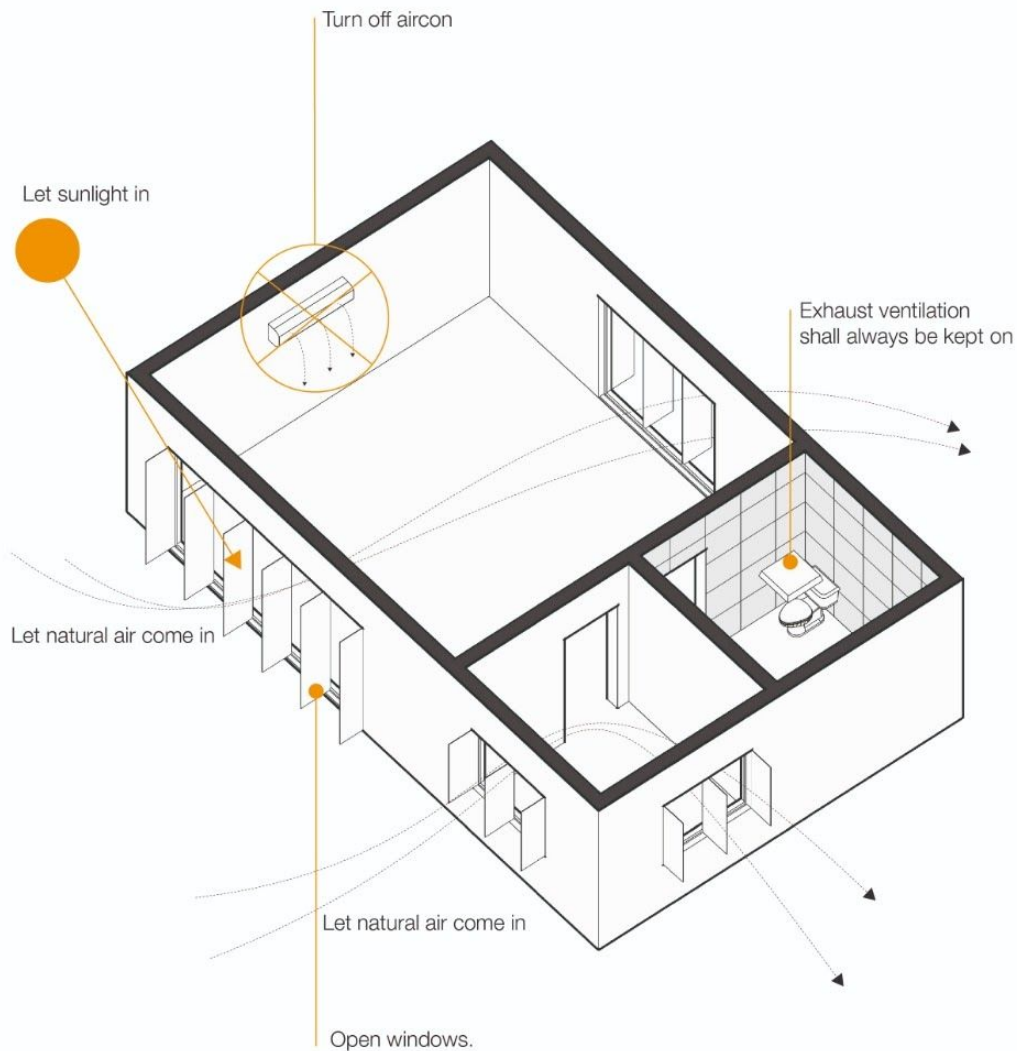
We acknowledge that the airborne transmission route is not the main one. Measures to reduce the potential airborne route are secondary to others but should be applied if only small negative effects are caused by them. Our recommendations are based on increasing ventilation rate [15,16,18, 29-34] and enhancing air cleaning [17,28,35,41] as much as technically, environmentally, and economically feasible.

## General recommendations for buildings

- **Increase to 100% outdoor air intake in air-conditioned buildings.** In buildings with ACMV systems, outdoor air supply shall be set to the maximum setting to enhance dilution indoors. Operation times shall be extended to commence the system at least 2 hours before the first occupant arrives and switch off 2 hours after all occupants have left. Since many office workers are currently on staggered working hours, with staff arriving as early as 7.30 am, leaving late at 7.30 pm, the recommended operation times will be from 5.30 am to 9.30 pm. Demand control ventilation and features that only turn on the supply air when the occupants are in the room shall be disengaged. If a carbon dioxide sensor is present, the closer the indoor carbon dioxide concentration to the outdoor value (410 ppm), the better.
- **Stop recirculation in air-conditioned buildings.** For air-conditioned buildings that have the capacity to operate with 100% outdoor air (no recirculation), they should be operated in such conditions. The return air dampers

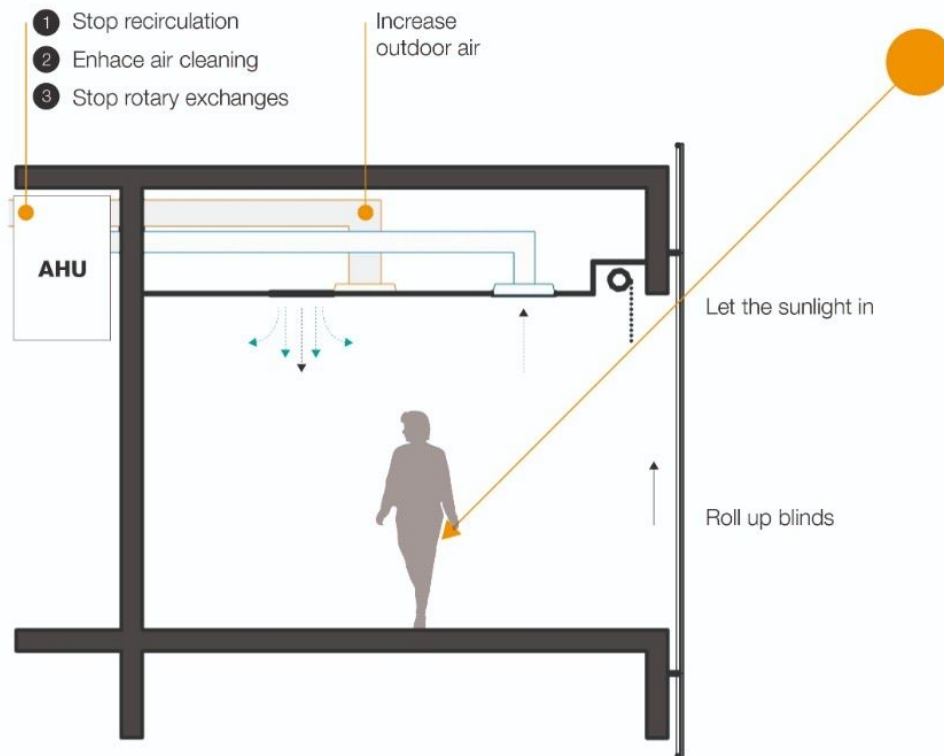
should be closed and the outdoor air intake damper fully open. The operator should verify that acceptable conditions are maintained indoors. If full closing of the recirculation air is not possible for adequate comfort (for example, the air temperature above 27°C), the recirculation air should be kept at a minimum level and shall be treated with high-efficiency media-based filters in place in the AHU and/or localized air cleaning using HEPA-based PACs in the office (see below).

- **Stop rotary exchangers in air-conditioned buildings.** Rotary heat exchangers or heat wheels shall be switched off and leaks identified and sealed to prevent exhaust/recirculated air from getting entrained (bypass) into the supply air.
- **Open windows and turn off or use less often air-conditioning in naturally ventilated buildings.** For naturally ventilated buildings with operable windows, windows shall be fully opened to allow air to flow indoors without obstacles, ideally in the opposite side of a building, to the extent that meets safety requirements and acceptability of outdoor noise and/or air pollution. Increased air motion, such as from a ceiling fan, can be used. If air-conditioning is used in buildings designed to be naturally ventilated (such as residential buildings), it is recommended that sufficient outdoor air be provided by keeping the windows a bit open in every room, air-conditioning can be used to provide comfort but higher energy use is expected.
- **Enhance air cleaning.** High-efficiency media-based filters, preferably MERV 14 (ASHRAE 52.2) [37] or F7 (EN 779 / EN 1822) [38,39] shall be installed and operated in the Air Handling Unit that serves the return and outdoor air. The filters shall be properly installed and well-sealed to prevent filter bypass. The filters shall be regularly inspected to ensure no leakage and that it is not fully loaded. Adequate precaution shall be taken when changing the filters (done while the system is off, wearing personal protection equipment and gloves) and disposing of them.
- **Use Ultra-Violet Germicidal Irradiation (UVGI).** Other physical means of cleaning the air, such as UVGI (portable, upper room, in-room, and in the airstream) may be used [17,28].



**Figure 1.** Diagram showing some of the recommendations given for naturally ventilated buildings.

- **Use Portable Air Cleaners (PACs).** For mechanically ventilated buildings and air-conditioned schools and childcare centers, high efficiency HEPA-based portable air cleaner may be deployed in a small room [35,40,41]. The selection of PACs depends on its performance (clean air delivery rates (CADR)). For larger indoor space, the numbers of PACs to be deployed shall be based on the performance of the PAC (CADR) and the space volume [35,40,41]. The use of PACs will have minimal impact in naturally ventilated buildings.
- **Let the sunlight in.** Where possible and taking into account building safety and acceptability, windows and blinds shall be opened to allow sunlight and thus UV entry indoors.
- **Keep exhaust ventilation always on.** Exhaust ventilation shall always be kept on 24/7, and ensured that the toilet is under-pressure (lower pressure than outdoor) to avoid the fecal-oral transmission [22].
- **Consider the airflow pathway (air distribution) in social distancing.** Singapore Ministry of Manpower is enforcing safe distancing measures in workplaces. As there have been reports on airflow causing spreading of the virus [23], it is recommended the occupancy layout for social distancing take into consideration of airflow patterns and pathways, e.g. staggered layout instead of linear placement of live workstations.



**Figure 2.** Diagram showing some of the recommendations given for mechanically ventilated buildings.

### Specific recommendations for residences with Person of Interest (POI)

- A person of interest in this document is defined as individuals issued with Stay-Home-Notice (SHN) [5], Leave of Absence (LOA) [3,4], or displaying COVID-19 like symptoms and not a confirmed case.
- All the room windows of the POI shall be opened without opening the door that links to the rest of the house. If the toilet attached to the POI room has an exhaust fan, it shall be turned on all the time. The door gaps of the POI room shall be sealed to ensure the air does not leak into the rest of the house.
- If doable, high-efficiency HEPA-based PAC is to be deployed in the room of the POI. Adequate precaution shall be taken when changing the filters (wearing personal protection equipment and gloves) and disposing of them. Additionally, portable UVGI (portable or upper room) may be installed in the room of the POI.

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