

ASHRAE EPIDEMIC TASK FORCE

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PRE RE-OPENING
FACILITY CLOSED, ESSENTIAL ONLY



RE-OPENING
FACILITY OPEN, LIMITED OCCUPANCY



NEW NORMAL
BUSINESS AS USUAL FULL OCCUPANCY



Resources and Links



The recommendations contained here within are based the expertise and experiences of collected individuals on this committee in the HVAC&R related fields. Building Owners, Engineers should also consult CDC, EPA and other cognizant Guidelines not specifically discussed to complete a preparedness plan. Such items include, but not limited to cleaning and disinfecting, social distancing and engineered controls to limit the transmission of airborne infectious diseases.

[CDC Information](#)

[OSHA](#)

[EPA](#)

[REHVA](#)

[AICARR](#)

[ASHRAE Glossary](#)



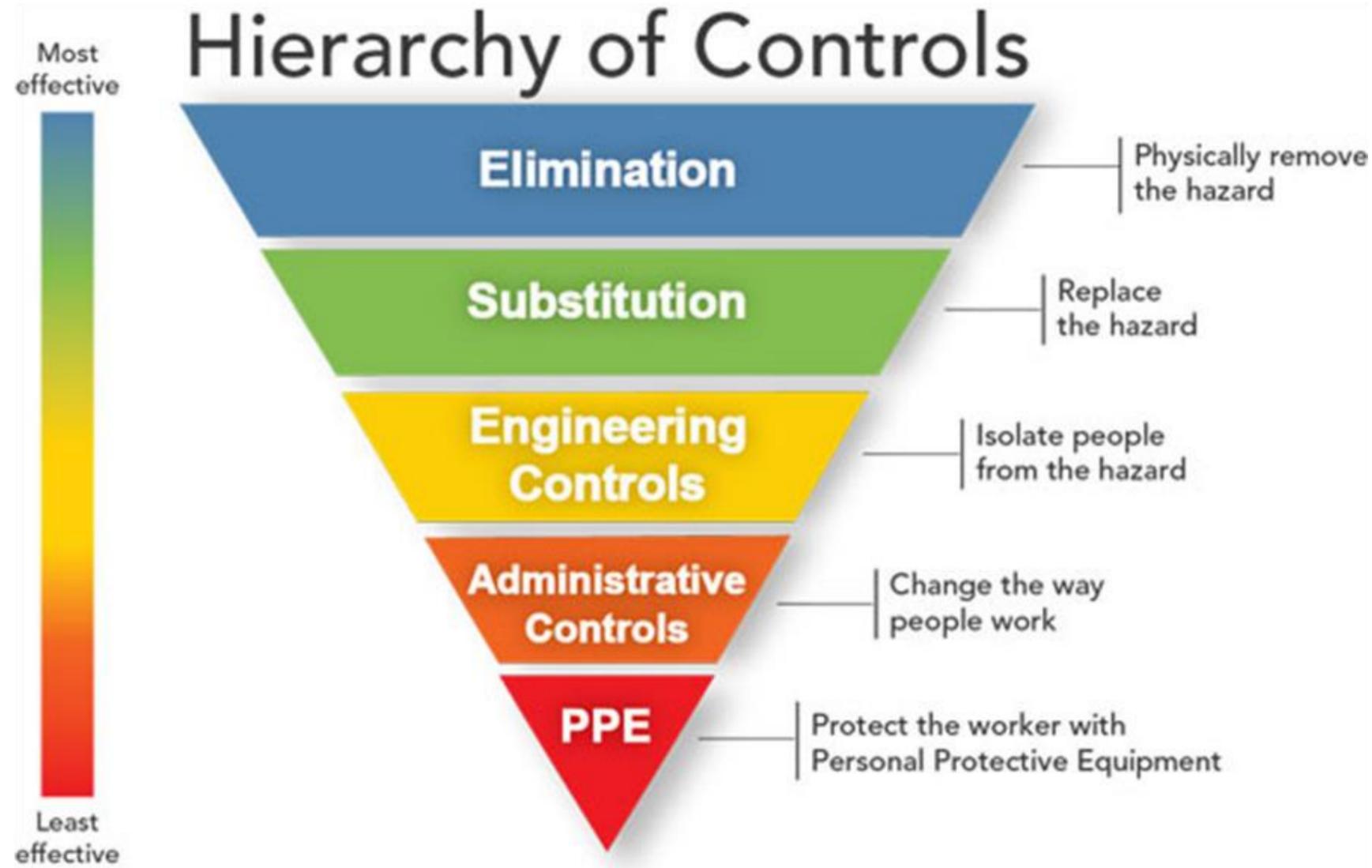
General Recommendations

Operating commercial office buildings under epidemic conditions requires a holistic framework during the crisis and the restoration to potentially a new “normal” after the public health emergency has ended.

This section describes seven basic elements that can be taken in commercial buildings to reduce exposure to SARS-CoV-2, the virus that causes COVID-19. This document is based on the information available prior to the week of August 16th, 2020. It is possible the document content will change pending on future information.



General Recommendations



Example of an Office Outbreak



A great example is the outbreak in a call center (see Figure). A single infected employee came to work on the 11th floor of a building. That floor had 216 employees. Over the period of a week, 94 of those people became infected (43.5%: the blue chairs). 92 of those 94 people became sick (only 2 remained asymptomatic). Notice how one side of the office is primarily infected, while there are very few people infected on the other side. While exact number of people infected by respiratory droplets / respiratory exposure versus fomite transmission (door handles, shared water coolers, elevator buttons etc.) is unknown. It serves to highlight that being in an enclosed space, sharing the same air for a prolonged period increases your chances of exposure and infection. Another 3 people on other floors of the building were infected, but the authors were not able to trace the infection to the primary cluster on the 11th floor. Interestingly, even though there were considerable interaction between workers on different floors of the building in elevators and the lobby, the outbreak was mostly limited to a single floor ([ref](#)). This highlights the importance of exposure and time in the spreading of SARS-CoV2.



Figure 2. Floor plan of the 11th floor of building X, site of a coronavirus disease outbreak, Seoul, South Korea, 2020. Blue coloring indicates the seating places of persons with confirmed cases.

1: Building Readiness:



Refer to [ASHRAE Building Readiness for COVID-19 Reopening](#), to make sure the building is ready.

2: Infectious Diseases Preparedness and Response Plan:



Develop an epidemic plan that can help guide protective actions against COVID-19. This plan should be reviewed and update regularly.

- Follow relevant CDC, EPA, OSHA, city, state, and federal guidelines in developing the plan.
- Establish goals, consider:
 - Reduce the spread of infection among building occupants.
 - Maintain HVAC and building service systems in safe and healthy conditions.
 - Minimizing impact on building occupants and visitors.
 - Communicate risks and precautions being taken with occupants.

2: Infectious Diseases Preparedness and Response Plan (Continued):



In addition, because stay-at-home orders can disrupt supply chains, ensure the continuity of critical suppliers and have backup plans in place to secure supplies and equipment.

- Identify essential vendors who could negatively impact operations.
- Review current service provider agreements to see if alternate suppliers can be engaged in the event of a supply disruption.
- Ask critical suppliers to share their infectious disease preparedness and response plans.
- Set boundaries with suppliers of equipment and services – for example, ask that they not send staff who may be showing signs of illness to your buildings.

Access

- Post signage and communicate to employees, tenants, and post visitors' procedures for entering and leaving the building that will minimize the time spent in public spaces.
- Use touchless access control system if available and where possible.
- Require and enforce social distancing within public spaces using signage.

2: Infectious Diseases Preparedness and Response Plan (Continued):



- Establish a communication protocol and continuity of operations plan.
 - Identify key contacts and publish normal and emergency contact information.
 - Document the chain of command, communication requirements, provide instructions, and outline expectations for how all responses are to be documented. Evaluate which records shall be maintained and distributed.
- Ensure physical distancing for all spaces. Provide staff with:
 - PPE per CDC and OSHA requirements.
 - Training on the proper use and disposal of PPE and waste.
 - Training on infection prevention and control measures.
 - Cross training to ensure critical building functions are maintained in an emergency.
 - Instruction to staff to stay at home if they are feeling sick.

2: Infectious Diseases Preparedness and Response Plan (Continued):



- Establish a cleaning and maintenance plan after hours.
 - Vacuuming, sweeping, curtain cleaning, brooms, could potentially re-suspend infectious particles. Since these are close range self-exposures for the person doing the cleaning that are not affected by HVAC system operation, proper PPE, including N95 masks, should be worn. Please refer to [CDC guidance Frequently Asked Question: “Is it safe to vacuum in a school, business, or community facility after someone with suspected or confirmed COVID-19 has been present?”](#)

3: Review Indoor and Outdoor Environment



- Maintain dry bulb temperatures within the comfort ranges indicated in [ANSI/ASHRAE Standard 55-2017](#).
- If possible, since that can reduce the half-life decay time of the virus. Maintain relative humidity between 40% and 60%, where possible.
 - Review issues regarding indoor condensation possibilities.
- Review outdoor conditions:
 - If outdoor air quality is not healthy per Section 4 of [ANSI/ASHRAE Standards 62.1-2019](#), especially high particulate matters, do not open windows or increase ventilation without using the proper filters.
- Check outside air intake regularly for any potential risk
 - Air intake location; any obstruction or less than 10' above ground
 - Nearby exhaust or other contaminants

4: Review Spaces Inside the Building



For spaces below, note the supply and return outlet locations, ensure no prolonged exposure of air flow from the face of a person onto the others.

- **Lobby:**
 - Pressurized lobby to outside.
 - Consider installing a thermal sensor at building entrances to screen visitors for elevated body temperatures. Note that infected individuals may show no signs of being ill, including having no fever, and can be responsible for much transmission. In such cases, temperature measurements may not be effective.
 - Label entrance and exit doors to provide one-way traffic.



Examples
of Thermal
Sensing



4: Review Spaces Inside the Building



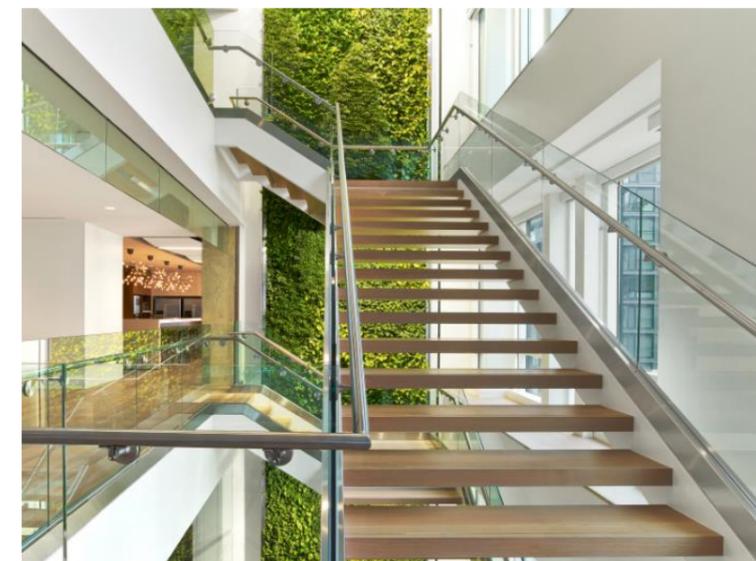
- **Elevator:**
 - Advice riders should wear masks and minimize talking.
 - Limit riders with social distancing and facing away from each other.
 - For low rise buildings, consider allowing elevators to stop at every floor.
 - Turn on elevator cab (lift) ventilation fans, where possible.
 - Encourage occupants to take stairs, where possible, especially when elevator lobbies are crowded. Provide signage to encourage physical distancing.
 - Allow elevators to run at high speed to minimize time in elevators.
 - Consider touchless call button retrofit.
 - Consider portable air cleaner with HEPA filter in lift for vulnerable riders. (e.g. senior population)



Example of
Air Cleaner
in Elevator

<https://www.alibaba.com/showroom/elevator-air-purifier.html>

Use Stair
Where
Possible



<https://www.chargespot.com/workspaces/office-staircase/>

4: Review Spaces Inside the Building (Continued)



- **Stairs:**
 - If two stairs or more are present, consider one-way traffic.
 - Turn on fans (e.g. stairwell pressurization), if available.
 - Open windows to outside, where possible and outside conditions allowed.
 - Consider portable air cleaners.
- **Toilet:**
 - Consider occupancy sensor to inform toilet occupancy where possible.
 - Adding lid to the toilet and encourage occupants to put the lids on before flushing.
- **Conference room or private office:**
 - Keep open doors to allow air movement.
 - If doors must be closed, consider a portable air cleaner or return fan to ceiling plenum.
- **Atrium:**
 - All air handling systems connect to an atrium should have similar measures.
 - Review impact of stack effect.

5: HVAC Systems



- **General:**
 - Identify HVAC System characteristics, review As-Built and Design. Compile and review O&M Manuals.
 - Verify HVAC controls are operable. Ensure that when remote, monitoring and alarm capabilities exist and that they are functioning.
 - Verify and commission the HVAC systems to ensure at least minimum outside air are delivered to each space per ASHRAE Standards 62.1 and outdoor air dampers are properly controlled.
 - Continued operation of all systems is recommended during occupied hours.
 - Use minimum outside air as required by Std 62.1. Use combinations of filters and air cleaners that achieve MERV 13 or better levels of performance for air recirculated by HVAC systems.
 - Evaluate building occupied hours, adjust as necessary (have building hours been extended to encourage physical distancing).
 - Flushing sequence or mode should be implemented to operate the HVAC system to provide three equivalent clean air changes, or two (2) hours, by recirculation through MERV-13 minimum, or air cleaners, or use outdoor air if there is no energy penalty and the system can accommodate the additional air flow, prior to occupancy. Run exhaust fans during flushing.
 - Consider UVC light as an enhancement where spaces require additional measures, e.g. spaces serve vulnerable occupants, or, MERV-13 filter not possible, etc.

5: HVAC Systems (Continued)



- Consider opening windows as an enhancement for outside air, especially when the system can not accommodate MERV-13 filter or minimum outside air.
- Post warning signs if exhaust outlets are near pedestrian areas; consider diverting to avoid them.
- Cooling coils, heating coils, condensate drain pans and humidifiers inside air handling equipment can become contaminated.
 - Consider adding UVGI for coil surface and drain pan disinfection. If coils are fouled or mechanical cleaning is still required, consider cleaning coils and drain pans using a foaming agent to ensure breakthrough through the coil (avoid using pressure washing to not re-aerosolize particles on the surface).
 - These devices and systems should be monitored often, and regular and emergency maintenance should continue.
 - Provide PPE protection for building operators, maintenance technicians and anyone else who must inspect or come in contact with the device or equipment.

5: HVAC Systems (Continued)



- Heat recovery devices
 - Some energy wheels have the potential of cross contamination between the intake and exhaust air stream.
 - When heat or energy recovery devices (heat wheels or enthalpy wheels) used in air handling systems and DOAS serve more than one space, consider whether the energy recovery device should remain in operation.
 - Refer to ASHRAE specific guidance on energy recovery device operation during epidemics and pandemics for further guidance.
 - Other heat recovery devices that decouple the intake and exhaust air streams such as run around coils, plate heat exchanges, and heat pipes can continue to operate.

5: HVAC Systems (Continued)



- Unoccupied Hours

–If a space has occupants after hours (e.g. cleaning crew, maintenance workers, construction workers etc.), the space should be operated in the occupied mode ensuring the operation of both supply and exhausts systems. Toilet and other relevant exhaust systems should be on, if the space is occupied. Consider only operating necessary spaces after hours by limiting the occupied areas of the building. This can be accomplished by restricting the areas staff, maintenance works, janitorial staff, etc. can access during these times. Strategies can be employed to designate toilets for people present in the buildings during this time of operation to further limit occupied areas. When toilets are expected to be used or cleaned, the toilet exhaust fans should be on, and should remain on for 20 minutes (or 3 air changes of the toilet room) after the usage. The relevant makeup system should run accordingly.

5: HVAC Systems (Continued)



- Operate and Maintain HVAC System: Building owners and service professionals should follow the requirements of [ASHRAE Standard 180-2018, Standard Practice for the Inspection and Maintenance of Commercial HVAC Systems](#) which has tables with the typical maintenance required for equipment that has been in operation. Consider PPE when maintaining ventilation materials including filters, condensate. Consult additional guidance before duct cleaning. Check specifically:
 - Dampers, filter, and economizers seals and frames should be intact and clean, are functional and are responding to control signals. Verify setting of manual dampers (i.e. outside air damper is 100% open, all supply registers, diffusers open).
 - Evaluate RA and EA grille/register placement. If possible, modify space/furniture so air passageway avoids occupants.
 - Zone and air temperature, humidity, CO₂, PM_{2.5}, PM₁₀, etc. system sensors, as applicable, should be calibrated and accurately reporting environmental conditions to the BAS or local controllers.
 - Air Handling systems should be providing adequate airflow with no blockages in the duct system (for example – closed fire/smoke dampers) and air from the air handling system should be reaching each occupied space.
 - Exhaust fans are functional and venting to the outdoors.
 - Update or replace existing HVAC air filtration to a minimum of MERV 13 or the highest compatible with the filter rack, and seal edges of the filter to limit by-pass. Make sure the air handling systems and fans can overcome the additional pressure drop of the new filters and still maintain air flow at acceptable levels.

5: HVAC Systems (Continued)



- **System Treatments:**

- Operable window:

- In buildings with operable windows, when outside air thermal and humidity conditions and outdoor air quality are acceptable, open windows where appropriate during occupied hours.
- Disabling the interlock between opening windows and air conditioning system lockout or shut down if this feature is provided for in the Building Automation System.
- Monitor indoor spaces for possible contaminants entering through the windows such as toilets exhaust located nearby or for windows accessible to public and high traffic on adjacent streets and walkways.
- Exposure to seasonal and other outdoor allergens (pollen and mold spores) may occur with windows opened.

- Unitary fans: Different configurations:

- For ceiling fans, if possible, reverse the flow direction to blow upward.
- For pedestal and horizontal fans, beware of the nature of air flow and avoid prolonged cascades of air flow from the face of a person onto others.
- If the space has good filtration efficiency (\geq MERV 13) but poor air mixing or low air change rate, then run fans to promote good mixing.
- If there is good ventilation air and poor air mixing, then run the fans to promote good mixing.
- If there is poor filtration efficiency and poor ventilation, then run the fans and put in portable air cleaner with HEPA filter units.
- If fans are the only HVAC in the room then either open a window, provide portable air cleaner with HEPA filter units or avoid using the room.

5: HVAC Systems (Continued)



- Unitary Through-The-Wall System
 - Provide code required outside air.
 - Provide maximum filter efficiency that the unit can handle, prefers MERV-13 or above filter.
 - Beware of the nature of horizontal air flow and avoid prolonged cascades of air flow from the face of a person onto others.
 - If the room has insufficient outside air per code requirements and filtration is below MERV-13, consider portable air cleaner with HEPA filter units.
- Dedicated Outdoor Air System (DOAS) - maximize the amount of outside air possible to the space. For different types of DOAS:
 - With no local recirculation (e.g. radiant ceiling) - review outside air flow in space for good distribution.
 - With local recirculation but no filter (e.g. wall mounted VRF, selected chilled beam) - consider the air flow carefully and ensure outside air is mixed with recirculation.
 - With local filtration (e.g. fan coil) - provide the maximum efficiency filter, preferred MERV-13 or above, that the system can accommodate.
 - If the room has insufficient outside air per code requirements and filtration is below MERV-13, consider portable air cleaner with HEPA filter units.

5: HVAC Systems (Continued)



- VAV system:
 - VAV system with minimum outside air - provide minimum MERV-13 filter at the mixed air location of AHU.
 - VAV system with economizer cycle - provide required minimum amount of outside air and MERV-13 filter minimum for recirculation. Engage economizer where beneficial to energy savings.
 - For fan powered boxes, where ventilation air per [ASHRAE 62.1](#) is available, provide the highest-grade filter the units can accommodate, and the units should continue to operate.
- Series fan powered box:
 - Consider adjusting setpoint to ensure maximum primary air during heating. This could be done through raising supply air temperature setpoint, so it is warmer – thereby having the space call for more air.

5: HVAC Systems (Continued)



- **Parallel fan powered box**

- Modify the programming to leave the fans on during occupied mode to increase air movement in the space.
- Adjust the heating temperature setpoint to engage the fan, but not at a point where the heat would get engaged.
- Consider adjusting setpoint to ensure maximum primary air even when the fan is off during cooling. This could be done through raising supply air temperature setpoint, so it is warmer – thereby having the space call for more air.

- **Heating Water Systems**

- Keep heating water systems circulating and maintain temperatures above 140°F to avoid microbial incursion. Do not let water temperature drop below 120°F.

5: HVAC Systems (Continued)



- **Exhaust system:**

- See “Unoccupied Hours” in Section 5 regarding toilet exhaust.
- Garage exhaust systems should run 30 minutes before occupancy. It is preferred to run garage exhaust systems continuously during occupied hours. Continue to operate garage exhaust systems 30 minutes after the building becomes unoccupied. These measures may require disengage the demand ventilation controlled by carbon monoxide.
- Other exhaust systems should continue to run as normal.
- If there are exhaust outlets located in pedestrian areas outside, provide warning signs and consider diverting or rearranging the exhaust air discharge locations so that they would pose no opportunity to cause harm.
- Temporary and Special exhaust systems: Particulates or aerosols should be captured and filtered or disinfected as close to the source as possible. Particulates can possibly be a means where viruses can adhere to become aerosol.

6: Pressure Control



- Cascading pressure from clean to less clean spaces.
- Maintain equal pressures on all the floors in multi-floor buildings. Maintain slightly positive pressure as compared to outside in both single story and multistory buildings.
- Shut off return air to the central air conditioning systems in the spaces where infected people may be present and use exhaust fans discharging air directly to the outside away from outdoor public gathering spaces, outdoor air intakes and operable windows. Consider HEPA filter, or, UVGI lamps with exhaust fan if exhaust can cause harm to the public. Provide extra outside air, if required, to make up for the additional exhaust.
- In tall buildings, pressurizing the building will need to take into consideration stack effect and wind effects. Stack effect direction can be reversed between summer and winter; therefore, settings likely will need to be adjusted throughout the year to maintain the above recommended conditions. To help mitigate stack effect:
 - Close all the doors in public areas along the path of least resistance where stack effect is strongest such as at elevator shafts connecting all floors, atriums, open stairs, escalators, etc. to isolate air transfer between floors.
 - Consider providing signage to inform occupants to keep these spaces closed off.
 - Avoid any permanent openings to outside.

6: Pressure Control (Continued)



- Tenants and visitors should use revolving doors and properly designed vestibules in buildings that have these types of entrance and exit ways rather than using single swinging doors to enter the building. Caution should be taken when going through air-locks by allowing social distance to “air” the space after the passage of a person. Consider providing signage to inform and direct occupants as to what entrances and exits to use.
- Wind speed and pressure in the upper part of a tall building can be significantly higher than lower levels. Pressure control, especially the upper part of a tall building, needs to consider the wind pressure. Buildings with operable window in mild weather can increase the air changes more in the higher levels.

7: Building Automation and Control System:



- Automate the control sequences in this document as an "Epidemic Mode" operation that can be turned on, shut down or override, if needed, by manual selection of the operator.
- Monitor the measures as described in this document and set alerts and notification to provide real time feedback to building operators and maintenance personnel where possible.
- If the building system has sensors for $PM_{2.5}$ and PM_{10} particulate monitoring setup alerts and notifications to notify tenants when high particulate counts occur.
- Provide remote BAS access to staff and trusted service providers who are responsible for operating and maintaining BAS, security, access control, information technology, fire alarm and life safety systems. Have written procedures and test remote access and secure access levels and permissions for all individuals prior to an emergency, if possible.

7: Building Automation and Control System (Continued)



- Monitor and trend indoor humidity if the system has the capability and setup alerts and notifications to building operators and maintenance personnel when conditions occur beyond the recommended range of 40%-60% RH.
 - Consider adding humidity sensors and monitoring if the system can accommodate adding this feature. Consider using local data loggers that monitor temperature and humidity if the BAS cannot. Place loggers in high occupancy spaces such as lobbies, atriums, conference rooms, and spaces deemed critical by facility managers to building function and safety etc.
- For HVAC systems that use Demand-controlled ventilation sequences, consider disabling this feature for the duration of the crisis.
- Regularly check battery backup and generator backup power supplies for BAS, Security, Fire Alarm, Life Safety, Lighting Control, and IT systems and IOT devices that must remain in operation.

Commercial Buildings Subcommittee



Shanti Pless – NREL

Amy Jiron – DOE

Brian Gilligan – GSA

Paul Torcellini – NREL

Marcus Bianchi – NREL

Bill Livingood - NREL

Marwa Zaatari – SSPC 62.1, TRG.4IAQP, BlueBox Air

Josephine Lau – University of Nebraska - Lincoln

Christian Callaghan – Wework.com

Peter Simmonds – Building and Systems Analytics

Jennifer Isenbeck – SSPC 62.1, Sodexo – University of Tampa

Charles Funk– BOMA, Jacobs Engineering Group

Nicholas Rajkovich – University at Buffalo

Luke Leung – ASHRAE EHC, Skidmore Ownings & Merrill (SOM)



Disclaimer



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