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OPTIMIZING ENGINEERED BUILDING SYSTEMS

A CHECKLIST FOR MAINTAINING A SAFE WORK PLACE IN THE COVID ENVIRONMENT

We understand your need to continue to deliver services while there is still a risk of COVID-19 transmission. It will be necessary for building operators to take the precautions to provide a safe and healthy work environment and address the concerns and anxieties of the public and staff.

The most recent CDC update states that the primary mode of transmission for COVID-19 is through close person-to-person contact mainly through respiratory droplets produced when an infected person coughs, sneezes or talks. Some evidence suggests aerosol transmission over greater distances. Studies also suggest that it is also possible for transmission to occur from touching contaminated surfaces. We recommend that building owners take a holistic approach and re-evaluate their operations and procedures in each of the following areas that are known to be effective in reducing the risk of spreading the virus.

- Policy related to prevention practices and social distancing
- Cleaning and sanitary procedures
- Optimizing engineered building systems

The following document focuses on engineered building systems and considerations to improve their ability to provide a healthy school environment. The attributes of the engineered building systems that would mitigate the risk of air borne particle transmission is wide ranging and includes the following:

- Diluting air in a space with cleaner outside air
- Filtering and/or sanitizing recirculated air
- Containing contaminated air and/or exhausting it outside
- Maintaining ideal temperature and humidity conditions
- Delivering clean air within the occupant breathing zone

Each building site and system is unique and the specific site conditions will inform how practical it is to address all of the attributes in each condition. Some of the considerations should be part of normal maintenance procedures and do not require additional funding to complete. Some of the considerations will take a range of funding, affect the on-going operational cost, or require hiring specialized service. The following separates the wide range of considerations into categories to aid in determining the right approach.

ASHRAE Statements

1. Airborne Transmission:

Transmission of the COVID-19 virus through the air is sufficiently likely that airborne exposure to the virus should be controlled. Changes to building operations, including the operation of heating, ventilating and air-conditioning systems can reduce airborne exposures.

2. Operation of HVAC Systems

Ventilation and filtration provided by heating, ventilating, and air-conditioning systems can reduce the airborne concentration of the COVID-19 virus and thus the risk of transmission through the air. Unconditioned spaces can cause thermal stress to people that may be directly life-threatening and that may also lower resistance to infection. In general, disabling of heating, ventilating, and air-conditioning systems is not a recommended measure to reduce the transmission of the virus.

Ventilation Maintenance Procedures: Ensure existing systems are operating at peak efficiency. We recommend completing the following on all building ventilation systems. Building maintenance staff can typically perform these items.

- ☐ Replace air handling unit filters. Consider upgrading filters as described in the detailed filter discussion of this document.
- ☐ Visually inspect filter racks to ensure a tight seal to limit air by-pass.
- ☐ Visually inspect the operation of outside air dampers to ensure they are functional.
- ☐ Visually inspect the outside air path to ensure it is unobstructed.
- ☐ Visually inspect interior of air handling units and coil surfaces for cleanliness
- ☐ Review air delivery in each room to ensure diffusers and grilles are open and not physically obstructed.
- ☐ Modify time of day scheduling of systems to flush building areas before and after occupancy for a minimum of 2 hours. Consider operating systems 24/7 during times of high use. The practicality of continuous operation may be determined with consideration of outside air conditions to minimize the impact to operating costs.
- ☐ If a building has been idle, operate the systems for a minimum of 1 week prior to the staff returning to the building. The systems operation may be concurrent with staff in the building.
- ☐ Where systems have de-humidification capability, verify they are operating to maintain humidity below 60%.
- ☐ Regularly monitor key trend data as is available through the building automation system i.e. outside airflow rates, CO2, temperatures, and humidity.

Additional Considerations for Increasing Ventilation Air: Increasing outside air ventilation rates will further dilute indoor air and help mitigate the risk of virus transmission in enclosed indoor environments. Consider the following with the awareness that increased outside air ventilation rates will have an impact on the system operating cost.

- ☐ Disable or override ventilation demand-control strategies that reduce ventilation airflow rates. Modern systems may include CO2 measurement as a method to adjust the quantity of outside air based on the level of occupancy.
- ☐ Disable or override stand-by mode control strategies that limit the capacity of air handling systems. Modern systems may have controls tied to an occupancy sensor to indicate occupancy.
- ☐ Increase outside ventilation air beyond code minimum (up to 100%) to reduce the air re-circulated within the system. Implement with careful consideration of the system capacity limits and the outside air conditions.
- ☐ For variable air volume systems, provide discharge air temperature reset based on space temperature demand. Allowing for a higher discharge air temperature (while still maintain the space temperature set point) will increase the total airflow. Modern control systems are capable of automating this control.

Re-commissioning Ventilation Systems: Provide methodical testing of the controls and systems related to delivering outside air for ventilation. Testing through a certified third party will certify that the systems are operating in accordance with the design criteria. The scope of re-commissioning can be scaled to work within a budget.

- ☐ Functionally test ventilation controls over the full range of operation.
- ☐ Measure outside ventilation air quantities and adjust to maintain minimum ventilation rates over the full range of operating conditions.
- ☐ If present, service and re-calibrate airflow-measuring stations.
- ☐ If present, calibrate and service CO2 sensors.

Designate an Isolation Area: If a building occupant displays symptoms indicating a possible COVID-19 infection, it will be necessary to have a policy for isolation to protect other building occupants until safely removing the individual from the site. Consider designating a safe room with the following features:

- ☐ Verify adequate ventilation air is provided.
- ☐ Verify exhaust systems are present and are functioning to maintain a negative pressure relative to the adjacent spaces.
- ☐ Eliminate the return air path such that room air does not cross contaminate adjacent spaces.

Ventilation System Enhancements: Add features to the existing building systems to improve the effectiveness in removing virus contaminants. Each instance would need to be studied by a design professional to determine the practicality and budget to complete the work.

- ☐ Install controls and systems to maintain relative humidity less than the recommended maximum of 60%. Evidence suggests that viruses survive better in high humidity environments. Consider the impact to operating costs associated with these systems.
- ☐ Install controls and systems to maintain relative humidity greater than the recommended minimum of 40%. Evidence suggests that viruses survive better in low humidity environments. Consider the impact to operating costs associated with these systems
- ☐ Install UV sanitizing lights in the air-handling units. UV sanitizing lights have been shown to deactivate microbes on surfaces and suspended in the air. Most applications to date have been directed to cooling coil surfaces. UV systems can be configure for disinfecting filter surfaces or within the airstream. Careful consideration should be given to the cost / benefit of these systems. We recommend consulting a design professional to review specific applications.
- ☐ Install BiPolar ionization technology to continuously disinfect both the breathing space and surfaces of the indoor environment. Systems can typically be retrofit into the existing duct distribution system or installed directly in a space. Carefully consider the potential unintended health risks sometimes associated with these systems. To date, there is not an independent study to validate the safety and effectiveness of these applications. We recommend consulting a design professional to review specific applications

New Design Considerations: It is impractical to fully isolate each individual within the building, however, in a new systems design, consideration can be given to minimize the cross contamination between occupants. In addition to the items above, consider the following additional strategies.

- ☐ Displacement ventilation systems design better directs the ventilation air to the breathing zone of the building occupants. Air movement is vertical within the space to sweep contaminates from the breathing zone to the ceiling to be returned to the air handling system.
- ☐ Displacement systems can be designed as dedicated outside air units to fully eliminate re-circulated air from the building.

Detailed Filter Discussion: The filter MERV rating (Minimum Efficiency Reporting Values) identifies the effectiveness of an air filter. The higher the MERV rating the smaller the particle the filter is able to capture. The COVID virus is 0.125-micron in size, but may be spread as a biological aerosol with sizes of 0.5-3.0 micron. A filter that is effective in removing airborne particulates within this size range will have a benefit in mitigating the risk of COVID-19 transmission.

We recommend consulting with your filter supplier to install the highest efficiency filter within the constraints of each system. The target filter efficiency rating for office environments is recommended to be a minimum MERV 13 or higher if possible. A MERV 13 filter on average will remove a minimum of 75% of airborne particle in the size range from 0.3 to 1.0 microns. If the existing system filters are MERV 13 rated or higher, then the filters should be replaced on a regular schedule starting prior to building occupancy. If the existing filters are not MERV 13 or higher, consider upgrading these filters

The higher the filter MERV rating the greater the air pressure drop. The challenge with installing higher MERV rated filters than originally designed is that they need to work within the constraints of the existing system capabilities. When upgrading the filter efficiency rating, we recommend consulting a design professional to determine the effect on the system air delivery.

Additional Considerations for Idled Building: The long isolation period will also have an adverse effect on the building domestic water systems. The domestic water systems likely have stood idle for a longer time than usual. Water served from the utility typically has chlorine biocide as an additive. An idle system will have reduced chlorine levels and may be at risk of microbial growth. We recommend completing the following on all domestic water systems prior to staff returning. The building maintenance staff can typically perform these items.

- ☐ Fully flush both hot and cold systems at all fixtures. Determine if the line has been adequately flushed by measuring the free chlorine content and comparing the value to the utility source. It is recommended to start the flushing process from the most remote fixture.
- ☐ Inspect the hot water recirculation pump for proper operation. If the pump had been disabled, enable the pump prior to starting the flushing procedure.
- ☐ For showers, it is recommended to remove the heads prior to flushing to minimize the risk of aerosolizing contaminants.
- ☐ Functionally test all flush valves and hand washing stations to ensure full operation.

Additional Considerations for Toilet Rooms: Studies have shown that toilets can be a risk of generating airborne droplets and droplet residues that could contribute to the transmission of pathogens. The following are strategies to mitigate these risks.

- ☐ Close toilet room doors even when not in use.
- ☐ Close toilet seat lids (if present) before flushing.
- ☐ Verify the operation of toilet room exhaust fans.
- ☐ Operate toilet room exhaust fans continuously.
- ☐ Close operable windows (if present). Open windows could result in pressurizing the toilet room and migrating air borne particle to the adjacent building.

Engineering Consultation: The Wold Engineering team can provide assistance as needed to determine the right approach. Evaluation of the existing systems is necessary when considering upgrades or modifications

Additional References:

https://www.ashrae.org/COVID19
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