Schnackel University

Schnackel engineers

ENHANCED HVAC INFECTION CONTROL:

SENIOR LIVING

WHITE PAPER DECEMBER 2020

Introduction

Continuing our look into occupancy specific building types this paper examines the unique characteristics and challenges of mitigating the spread of airborne diseases in senior living facilities.

Our primary objective will be to answer the question:

> *What should I do to my facility to improve the safety and comfort of its occupants?*

We will review the common systems types found in senior living facilities and make recommendations for improving the infection control potential of these systems. We will also examine how well these systems can be adapted to meet the latest infection control standards and recommendations.

Agency Recommendations

The latest recommendations from the ASHRAE Epidemic Task Force for Commercial Buildings (updated 08/17/2020) include the following improvements related to any building's HVAC system:

- Maintain temperatures in accordance with ANSI/ASHRAE Standard 55-2017.
- Maintain relative humidity between 40% and 60%.
- Verify minimum ventilation requirements per Standard 62.1 are maintained. Increase ventilation rate as allowed per installed equipment and still maintain comfort levels.
- Increase filter rating to MERV-13 if equipment can handle the additional pressure loss.

(https://www.ashrae.org/technical-resources/resources)

The Centers for Disease Control and Prevention's Resuming Business TOOLKIT includes the following general recommendations for all ventilation systems:

- Increase ventilation rates or percentage of outdoor air.
- Disable demand-controlled ventilation (DCV).
- Improve filtration to MERV-13.

(https://www.cdc.gov/coronavirus/2019-ncov/community/resuming-business-toolkit.html)

Typical HVAC System Types at Senior Living Facilities

Senior living facilities may be served by a wide variety of system types including, but not limited to, the following:

- Terminal units: Fan coil, WSHP, GSHP, VRF, PTACS, split systems.
- Commercial packaged roof top units – Common areas.
- Central air handlers – Common areas.

The central air handling systems (indoor modular, indoor self-contained and outdoor packaged types) handle the introduction of fresh outside air in the equipment itself, through various forms of dampers and intake hoods. The terminal unit systems are usually provided with through wall louvers to obtain fresh air directly from the outdoors.

The system types associated with senior living facilities offer many options for improving indoor air quality and reducing the risk of the spread of contaminants and pathogens. The key is selecting the right combination of measures to achieve the optimum result for each system, within the budget constraints of the project, while maintaining acceptable comfort levels for the occupants.

Temperature Control

ANSI/ASHRAE Standard 55-2017 does not directly specify temperature requirements for various occupancies. This is due to the fact that occupant comfort is a very subjective matter. Different individuals have different expectations with respect to temperature and humidity in order to

determine if a space is considered "comfortable". This is particularly true with seniors, who often prefer higher indoor temperatures throughout the year.

Any modifications to the HVAC systems should be carefully coordinated to ensure that the end result still provides acceptable human comfort, effective infection control and satisfied seniors.

Facilities personnel or qualified service contractors should verify that the temperature and humidity sensors in all areas are calibrated and operating properly, prior to embarking on an upgrade program to improve infection control.

Ventilation Systems

Ventilation requirements for the living quarters are dictated by ANSI/ASHRAE Standard 62.2. The living quarters, regardless of configuration, will likely have an air change rate of outdoor air of less 1 air change per hour.

The common areas ventilation requirements are dictated by ANSI/ASHRAE Standard 62.1. The typical air change rate of outdoor air can range from as high as 5.5 air changes per hour in cafeterias to as low as 0.4 air changes per hour in the corridors.

While these rates would meet minimum code requirements, the air change rates of the living quarters and corridors, for example, are not considered sufficient for the purpose of an effective dilution ventilation strategy for virus control. The cafeteria and dining areas required air change rate is considered sufficient, however many of these spaces are likely not performing to these levels due to energy conservation efforts and/or deferred maintenance. Therefore, even the cafeteria and dining areas should be tested and balanced as part of any upgrade plans.

Air changes per hour	Minutes required for removal efficiency	
	99%	99.9%
2	138	207
4	69	104
6	46	69
12	23	35
15	18	28
20	14	21
50	6	8
400	<1	1

Time required for infectious agent removal based on the number of air changes per hour (adapted from CDC guideline [28])

Infectious Agent Dilution Ventilation Performance

The goal should be to achieve the maximum outdoor air ventilation rate possible at any given time without overloading the HVAC's system ability to properly condition the air. See our white paper on Dilution Ventilation for further details and energy conservation recommendations.

Demand Controlled Ventilation Systems

Demand controlled ventilation (DCV) systems are rare in senior living facilities due to the need for constant ventilation of the facility. The CDC has recommended *disabling* DCV systems, and it is Schnackel Engineers' recommendation to do so in any senior living facility. DCV is not appropriate in a senior living facility where infection control is tantamount to maintaining a safe and healthy living environment for seniors.

Ventilation System Maintenance

All HVAC systems, regardless of type, should be checked to ensure that the ventilation rates delivered to the occupied spaces are as high possible without compromising comfort levels or causing undue loading on the system equipment. All dampers, motors, controls and accessories associated with the ventilation systems should be checked to ensure they are working properly, and meeting at least the minimum code requirements, if not higher.

Filtration

Our Filtration White Paper took an in-depth look at the available filtration technologies that can be applied to almost any HVAC system. Please refer to that white paper for more specific information about MERV ratings, filter efficiencies and the associated pressure drop considerations. The primary objective of increasing filtration with respect to infection control, is to install as high-efficiency of filters as is possible, subject to the static pressure limitations of the HVAC system.

Central air handling units and commercial package roof top units should be capable of overcoming the additional static pressure associated with the higher MERV ratings recommended for infection control. Whenever possible, install filters of a MERV-13 rating, or higher, to achieve maximum viral droplet capture. Sometimes increasing the MERV rating of the filters will require either no modifications to the HVAC equipment or minor changes to the belts, pulleys and possibly the supply fan motor, all of which can be accomplished at a relatively minor cost.

Terminal Unit systems can be more challenging when it comes to filtration. Since terminal units are relatively small in size and therefore have smaller fans and motors, most will not be capable of handling an upgrade to a MERV-13 rating. However, the filters should still be upgraded the highest MERV rating that each unit can safely handle. Even an upgrade to MERV-8 or MERV-10 can provide a meaningful reduction in the concentration of airborne infectious particles, particularly the larger droplets that are associated with SARS-CoV-2 spread. Each system should be evaluated by an HVAC design professional to determine the optimum replacement filter efficiency. In room filtration systems may be an option for areas where reasonable filtration cannot be achieved with the HVAC systems installed.

Humidity Control

As we learned in our Humidity Control White Paper, maintaining the optimum humidity level of 40%-60% RH may be the single most effective way to mitigate the spread of viruses in buildings. This is due to both the human body's adverse reaction to low humidity and the viruses' ability to thrive and spread under low and high humidity conditions. Most senior living facilities have a reasonable capacity to dehumidify the air in the building using the air conditioning systems, however not all senior living facilities may be equipped with any type of humidification equipment to keep viral spread low during the winter months.

Central air handling units and commercial package roof top units lacking a humidification system should be *immediately* fitted with central "clean-steam" humidification systems with in-duct steam distributors for each unit. Evaporative type humidifiers should be avoided unless they are coupled with UV light sterilization systems to ensure no mold or bacterial growth can occur.

Facilities served entirely by terminal units that are not equipped with a humidification system will need to be evaluated on a case-by-case basis. Individual "clean-steam" humidifiers featuring in-duct steam distribution might work in some instances. However, in most cases a different approach is warranted. Steam humidifiers with wall-mounted distributors, floor type single room humidifiers and countertop personal humidifiers are some of the options available.

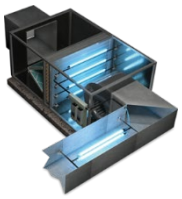
All existing humidification systems should be checked to ensure they are working properly and are capable of maintaining the humidity level within the desired range. It is not possible to overemphasize the importance of maintaining humidity levels in the 40% - 60% range to reduce the possible spread of viral contaminants.

Additional Prevention Measures

In addition to the recommendations discussed above, there are several other options available to provide

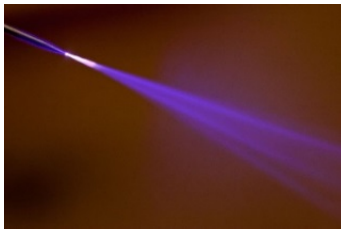
additional layers of infection control and prevention. Often a multi-layered approach is the best strategy to bring a building up to its maximum infection control potential. These measures can include the following:

- In-Duct UV disinfection systems can be installed to disinfect the air as it passes through the HVAC unit and to keep the coils and drain pans free of any type of pathogen, including viruses, bacteria and mold. However, sufficiently high lamp power and quantities are necessary to effectively kill any airborne viruses.



- In large areas with high ceilings Upper Room GUV can be installed for added protection, killing the airborne viruses as they circulate within the rooms. These systems are extremely effective at killing airborne virus droplets and aerosols very near to their source. They can only be installed in areas where there is no possibility of human exposure to the UV radiation, generally above 7'-0" above the floor.

- High exposure risk areas like public bathrooms, dining rooms, fitness/therapy rooms and elevators can be fitted with ionization purification systems, either bi-polar or photocatalytic oxidation type, as additional measures to control potential viral spread in these critical locations.
- Small HVAC systems that are not capable of handling the added static pressure of increased filtration could be fitted with Needle Point Bipolar Ionization technology to enhance the viral protection of the area served, although these systems require routine cleaning and maintenance to maintain their effectiveness.



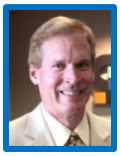
Summary

Schnackel Engineers can assist you with a thorough evaluation of your building to ensure you are doing everything possible to prevent the spread of viruses within your facility. Please give us a call at 800-581-0963 or email us at info@schnackel.com for a consultation.

About Pedro:

Pedro Ferrer, P.E. has been involved in the design of mechanical systems for malls, mixed-use developments, corporate offices, national retail roll-outs, commercial and institutional buildings for over 26 years with Schnackel Engineers. Email Pedro at pferrer@schnackel.com

About Greg:



Gregory Schnackel, P.E., LEED AP has been involved in the design of mechanical, electrical, plumbing, fire protections and information technology systems for malls, mixed-use developments, corporate offices, national retail roll-outs, schools, hospitals, medical facilities, commercial and institutional buildings for over 40 years with Schnackel Engineers. Email Greg at gschnackel@schnackel.com

RESOURCES	
ASHRAE	https://www.ashrae.org/
Centers for Disease Control	https://www.cdc.gov/coronavirus/2019-nCoV/index.html
ASHRAE Journal	https://www.ashrae.org/technical-resources/ashrae-journal
Schnackel Engineers White Paper Series – Enhanced HVAC Infection Control.	http://www.schnackel.com/firm/white-papers/enhanced-hvac-infection-control-white-papers