Building Solutions

Clean-Air: Ventilation is the Foundation

COVID-19 has brought to light that most schools have inadequate ventilation, marked by insufficient levels of Outside Air (OA). Increased amounts of OA are required in education spaces by recent codes, but except for the newest buildings, spaces are typically performing below current standards. Environments in buildings that are 'grandfathered' under old codes are tolerated by building officials but are unhealthy, especially in pandemic conditions.

The American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) 62.1: Ventilation for Acceptable Indoor Air Quality (IAQ) is the industry standard for introducing fresh air into buildings, which is a major factor in achieving the healthiest possible indoor air. The 62.1 standard was first published in 1973 and applied to highly populated and transient occupancy facilities. Shortly after, cities began adopting it in their mechanical codes for large facilities with very high occupancy loads. It has only been required for smaller residential type units in education facilities the last decade by most cities.

Building Solutions has had numerous internal discussions to arrive at a reasonable and achievable approach to healthy indoor air which we can recommend to our school clients. Our underlying premise is that schools now place a premium on health, even at some cost of comfort and efficiency if necessary, to meet changing public health scenarios. We are finding that most schools want to at least move toward the highest standards of healthy indoor air, even if it must be done incrementally. They also need to demonstrate to their constituents that they are taking positive action, based on science and engineering, with minimal investment in 'theatrical' gestures or expensive gadgets. If they must invest in visible appliances or equipment that demonstrate they are taking "action", they want those solutions to be effective.

Achieving this balance of health, comfort, and economy is sometimes at odds with the "easy" solutions, sometimes involving exotic technologies. Some are appropriate under the right circumstances, while others not so much. While we want to be sensitive to a school's choice to engage in these, our recommendation is to begin with the existing built-in HVAC systems currently in the facilities. Ensuring HVAC systems are compliant with current codes and ASHRAE 62.1 is the best starting point for aerosol infectious disease prevention in education facilities.

The basic scope of ASHRAE 62.1 from the Standard itself below is simple:

2. SCOPE

2.1 This standard applies to spaces intended for human occupancy within buildings except those within dwelling units in residential occupancies in which occupants are non-transient.

2.2 This standard defines requirements for ventilation and air-cleaning system design, installation, commissioning, and operation and maintenance.

2.3 In addition to ventilation, this standard contains requirements related to certain contaminants and contaminant sources, including outdoor air, construction processes,

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moisture, and biological growth.

Here is where most education facilities have problems. Small to medium size institutions often use Roof Top Package Units (RTUs). These are required to have exterior fresh air dampers built into them that are fixed in place at the percentage required by law (62.1) for mixing fresh air into the space it is providing ventilation. However, these types of facilities also supplement their RTUs with residential type split systems that do not have the fresh air dampers built in and without this are no longer complaint with the mechanical code for education facilities. Some split systems may have been added after the building was built or remodeled when building inspections were not involved.

A complication associated with 62.1 is that it requires special sizing of the HVAC unit so it can properly treat the unconditioned outside air. In many climates, outside air is humid and requires air conditioning capacity to dehumidify the air for comfort. Larger facilities have special controls to monitor people loads so it can automatically modulate the outside damper controlling an adjustable amount of fresh air into the space as needed. In those facilities, outside air is minimized if there are fewer occupants in the spaces. All the facility HVAC systems are designed to work as one system, building-wide and symbiotically, to meet the ASHRAE Standard.

Most RTUs do not have the special controls onboard and the residential split system units are almost never sized properly to add the ducting or have the controls. As a result there are often comfort complaints and/or they are running inefficiently, so maintenance or contractor technicians have been known to close the fresh air dampers to resolve the discomfort complaint because everything else with the unit seemed to be operating as designed. Or it may have been a maintenance issue that required temporary closure of the damper until resolved, then they forgot to open it back to proper setting. Now the unit is no longer providing the required fresh air.

We understand that if education institutions are not ASHRAE 62.1 compliant, it could potentially be expensive to catch up. Recognizing this, Building Solutions created a three phased approach that maps out an affordable and well-reasoned process for achieving a healthy environment, without undue sacrifice of comfort and economy.

First, assessment:

1. In depth maintenance assessment of the HVAC units, especially the air handlers
2. High level design review of the various coordinated systems serving each building, to determine if fresh air volumes are in the "ballpark" of ASHRAE 62.1.

Second, implementation:

3. Recommend immediate steps to address Covid-19, including fresh air dilution, filtration, and maintenance. Many times, this could simply require adding appropriately sized outside air ducts and perform past-due maintenance.
4. While managing the near-term tweaks described above, we map out a longer-term plan as necessary to meet or exceed minimum standards. The additional steps may involve larger expenditures or disruption of spaces that have to be delayed until the summer or holidays. It could involve postponing replacement of equipment that is not yet at the end of its useful life. You may work at your own pace, knowing that you've taken first steps that are a foundation for an optimal balance of health, comfort, and economy. (as a reference, see EPA webinar recorded segment from Minute 6:30 -22:00).

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5. In connection with the longer term and more strategic plan, you may choose to enhance the basic building operating systems with disinfection or special scrubbing systems, like those found in hospital settings. But we recommend consideration of these in the context of the overall system capacities and when the building system is verified and operating properly.

ASHRAE 62.1 has a prescribed maintenance schedule that is broken down into various tasks that starts over every five years. The most reliable verification of appropriate maintenance is a visual inspection by a third-party consulting engineer, who is not affiliated with the maintenance company. This inspection should take place every five years. (see the same **EPA webinar recorded segment** Minute 51 to 1:07)

Finally, one of the important criteria in 62.1 is "air changes" for the purpose of virus dilution with OA (outside air) and filtration of air entering or recycled into the space. The number of air changes is determined by room size and the proposed type of use(s) (e.g. classroom, auditorium, gym, etc.). The size of the HVAC system is determined by how many times all the air inside a room needs to be treated by the HVAC system.

So, how about higher-grade filters, like Merv 13's? In less sophisticated systems these much more air restricted filters will cause a pressure drop in the ducts resulting in less air flow and fewer air changes. In addition, the air flow restriction will put a strain on the HVAC system, increase electricity cost, and shorten the lifecycle of the unit. Thus, it may do more harm than good. But it's not guesswork; the feasibility of upgrading filters in your system can be determined by a qualified engineer in the first few steps above. It's reasonable for a hospital with active Covid-19 cases present and with HVAC systems designed for this, but less so for schools.

In the meantime, I recommend that schools not install filters higher than Merv 10 in small air handlers (that are not the whole building type centralized air handlers) until you have had the assessment engineer determine what is overall best for each unit. Although, face masks are much more effective than increased HVAC filtration.

Pointing up the value of simply addressing ventilation, the California Department of Health has stated: "If there was no ventilation and no filtration, the risk of long-range airborne infection would be over six times as high as that for a classroom with code-required ventilation and a MERV 8 filter (I.e. ASHRAE 62.1)."

Resources and additional reading:
EPA Indoor Air Quality Tools for Schools: Guidance Documents [read more]

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