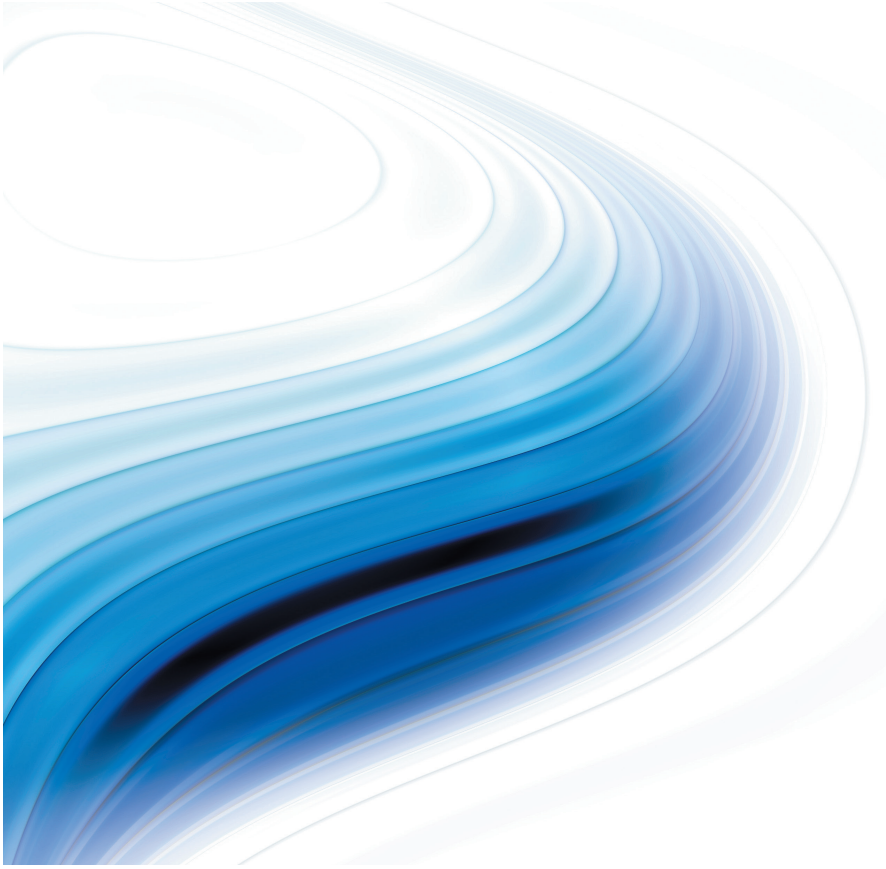
The Importance of Controlled Ventilation in Schools

Now more than ever, schools need to ensure healthy indoor air quality.

By Darryl DeAngelis, LEED, AP



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Maintaining air quality can be challenge for facility managers, whether a building is newly built or 50 years old. Maintenance is deferred, equipment operates past its planned life expectancy, and then there is an unexpected event such as a pandemic—a disruption unlike any we've seen in recent times. Yet districts must continue to provide the most productive and healthiest environment for the students and staff.

Regardless whether district schools are open or closed to students this year due to the pandemic, indoor air quality is important to maintain a healthy environment, and ventilation is a critical factor—especially as many educators in 100% virtual districts are opting to teach from their school building classrooms.

The EPA estimates that approximately 46% of U.S. public schools have environmental conditions that contribute to poor indoor environmental quality and that the concentration of indoor pollutants can be up to five times higher than outdoor concentrations. Ventilation reduces indoor pollutants and leads to a healthy indoor environment

The level of "freshness" of indoor air is difficult to perceive—it's not something that you can see or smell, necessarily. The consequences of inadequate ventilation usually are not readily apparent, and when they are noticed, either by damage to the building or an increase in illness, they are quickly elevated to an unexpected expense. However, this does not have to be the case if the ventilation is accurately monitored and controlled.

Minimum ventilation rates are directed by the American Society of Heating, Refrigerating and Air-Conditioning Engineers; enhanced ventilation rates are promoted by building certification systems such as WELL™ and LEED™. The failure of an HVAC system to provide the proper amount of outdoor air can be caused by, but not limited to, changes in fan speed to meet heating or cooling requirements, direction and speed of wind and associated wind gusts, temperature changes from summer to winter, dirty filters, damper and actuator failures, and improper control sequences.

An imbalance of ventilation and exhaust can lead to pressurization problems. When the indoors is not adequately pressurized, more air is

exhausted out then ventilated in. The air from outdoors is sucked into the building—infiltrated—through doors, windows, walls, and the roof. This brings unconditioned and unfiltered air into the building and can lead to wasted energy, an uncomfortable space, damage to the building envelope, or mold growth. The latter can lead to building degradation and has the potential to cause occupants to have allergic reactions or other upper respiratory ailments.

ADDITIONAL RESOURCES

Indoor air quality is directly tied to ventilation. The following resources and tools address this important topic:

- Energy Savings Plus Health: Indoor Air Quality Guidelines for Schools—EPA
- Schools for Heath: Foundations for Student Success—Harvard University T.H. Chan School for Public Health
- Impact of School Buildings on Student Health and Performance—The Center for Green Schools
- Indoor Air Quality Scientific Findings Resource Bank—Lawrence Berkley National Laboratory

COVID-19 and IAQ

COVID-19 has caused us to rethink the environment in which we educate our students. Research indicates that poor air circulation and inadequate ventilation can increase the chances of COVID spread

Relative humidity levels of 40%–60% have been effective in deactivating virus particles.

Consequently, in addition to focusing on maintaining social distance, modifying schedules, reducing class size, and wearing PPE, schools should also focus on the HVAC systems and ventilation — bringing more of the outdoors indoors. Ventilation combined with enhanced filtration and in-room ultraviolet lamps are recognized as effective facility enhancements to help mitigate super-spread.

But combating COVID spread is not a matter of simply adjusting ventilation and humidity. The outdoor air may be colder, hotter, or of higher humidity levels than the indoor air, thus compromising the HVAC equipment's ability to adequately cool, heat, or remove the excess humidity. Increased ventilation also may lead to over-pressurization problems that can affect the operation of doors or damage the envelope.

Levels of carbon dioxide inside the space can also be a factor in healthy indoor air quality. Each human generates a quantity of CO_2, although different amounts by sex, age, body weight, and activity. Concentrations of CO_2 within a building are used as a proxy to indicate ventilation, with the idea to bring indoor CO_2 levels closer to outdoor levels (~400ppm).

However, CO_2 control is often incorporated incorrectly into control systems to maintain optimal ventilation and is typically used as an energy savings measure to reduce ventilation. It can also cause systems to ventilate more than the equipment can handle if setpoints are too aggressive.

Correct Controls

The only accurate way to determine whether ventilation rates are sufficient is to actively measure and control the outdoor airflow rate. When HVAC systems use measured outdoor air to control the rate of air in and out of the building, the process will not only establish the correct ventilation rates, when coupled with exhaust airflow measurement tracking, it will ensure the correct pressure relationship from indoors to outdoors.

By constant airflow measurement and control integration, the amount of outdoor air can be adjusted to suit dynamic operational changes, changes in schedule or occupancy levels, and trigger alarms when problems are detected. It may be set to adjust the ventilation rate to the capacity of the HVAC equipment relative to outdoor weather conditions providing maximum outdoor air while controlling efficiency and comfort.

Bottom Line

Outdoor air ventilation is necessary for the health and wellbeing of a building's occupants. It is even more important during the pandemic. Maintaining the appropriate ventilation rate requires real-time measurement and control.

Measurement, control, and fault alerts should be the foundation of any mechanical system upgrade or the basis of a new school HVAC system. Incorporation of airflow control will not only provide means to meet today's unique challenges, it is investment in education in the future. The initial cost of incorporating airflow control in an HVAC system is minimal compared to the risks associated with over-ventilation, inadequate ventilation, and infiltration.

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