

Safe School Design Task Force OBJECTIVE, RESEARCH, & TRENDS FRAMEWORK

Healthy Schools: Air Quality and Ventilation

A. Objective Statement

Our AIA NJ Safe School Design Task Force is focusing attention on the timely and important topic of “**Air Quality and Ventilation**” and how it relates to the overall framework of designing safe and secure schools in New Jersey. Our Task Force objective is to share national best practices in K-12 school designs and to show how to apply these practices to local New Jersey communities to help meet our schools’ health, safety, welfare, and wellness needs. The strategies used by NJ Architects to design and renovate schools shall not only protect building occupants but also create highly successful learning environments by applying innovative design solutions to integrate facility management and physical security with spaces supporting mental health and wellness practices.

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GOAL: Providing Healthy Environments by promoting better Indoor Air Quality and Ventilation

What is Indoor Air Quality, and why is it important for schools?

When we spend most of our day inside buildings, we live and breathe in a microclimate made of materials that might off-gas, surfaces that may or may not inhibit bacterial growth, and mechanical systems that may continually re-circulate the same air. We can ensure good air quality and ventilation if we choose the suitable systems and make informed decisions.

Studies have shown that poor indoor air quality in classrooms can be associated with headaches, dizziness, asthma, absenteeism, poor student attendance, and low test scores.

There are more variables to good indoor air quality than one might think. Indoor Air Quality (IAQ) is not only about mechanical units, filtration, and ventilation but is also related to contaminants and pollutants brought into or occur inside a building. Additionally, when air is continuously refreshed with clean air, people are less likely to get sick from airborne pathogens, such as COVID-19.

When speaking of the air system, several components affect indoor air quality:

Ventilation, which is outdoor air that is intentionally brought into the building naturally or mechanically.

Filtration, which uses filters in the heating, ventilation, and air conditioning (HVAC) systems to capture airborne particles.

Air Cleaners, which are similar to filtration, but are independent from the HVAC system and are within the room.

Germicidal Ultraviolet, which can be used to inactivate viruses, bacteria, and fungi and can be installed inside the HVAC unit, in the duct, or independently of the central HVAC system.

Outside the air system, air quality is affected by material choices, moisture, mold, and outside contaminants brought in by building occupants.

Taking all this together is what will impact the building’s IAQ and impact students, teachers, and staff.

B. Design Innovations & Creative Solutions

When we look at all the air system components mentioned above as a complete system, there are several building systems that you may be aware of, which are often seen in classrooms. The USGBC put together a guide to evaluating Building System Types for the classroom, linked in the Resource links. Below is the overall evaluation.

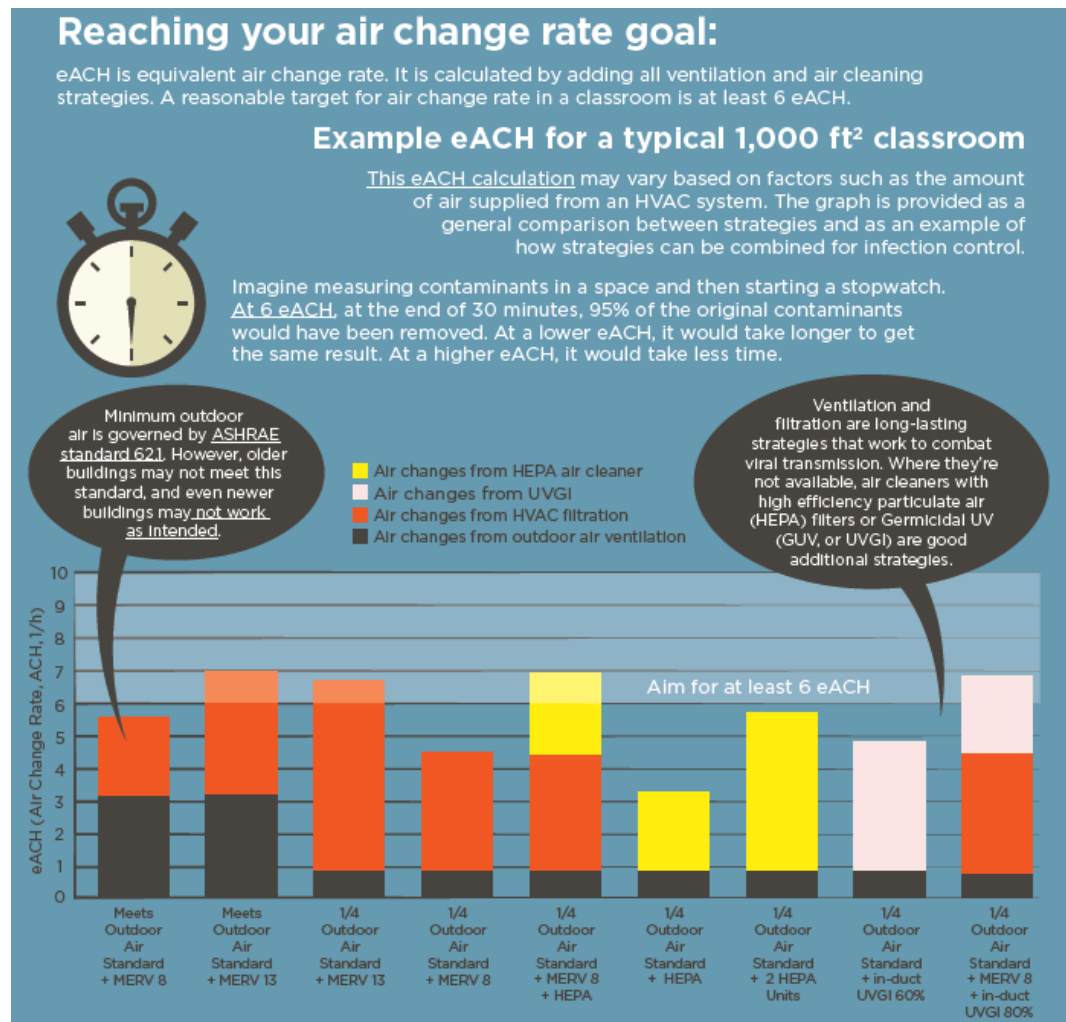
Topic	Building System Type				
	Window Units, radiator, or no space conditioning	Unit ventilator or univent	Decentralized heating /cooling systems	Central System serving one or multiple rooms / zones	
				100% recirculation	Recirculation + ventilation
Ventilation: Mechanical		✓	Depending on system		✓
Ventilation: Natural	✓		✓	✓	
HVAC Filtration		Depending on pressure drop	Depending on pressure drop	Depending on pressure drop	Depending on pressure drop
Air Cleaners	✓	✓	✓	✓	✓

In-room Germicidal UV	✓	✓	✓	✓	✓
In-duct Germicidal UV				✓	✓

As you can see, there are various ways to accomplish the majority of the needs. One of the components that can vary is Filtration. Filtration is a critical component that must be considered during design as the filter type most likely can not be exceeded later on, such as placing a MERV 13 filter in a system that can only support MERV8, as doing so will impact the amount of air volume output, damage the equipment, and or void warranties.

Focusing our attention again on the overall system of components, one of the overall goals is to bring in fresh air continually. Replacing the air with new air through filters, air cleaners, and other means removes pathogens and other contaminants. Certain combinations do this task better than others. Recommendations for the amount of air changes per hour have changed over time. With the recent COVID-19 Pandemic, the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) has re-evaluated its recommendations. Their COVID Epidemic Task Force recommends (6) equivalent air changes per hour (eACH) or higher.

To help evaluate this, the USBC released a graphic showing several combinations of the components mentioned throughout this paper with an eACH rating.



As you can see above, using the baseline ASHRAE standards from years past will not achieve the recommended 6 eACH. However, the recommendation is achievable by either adding HEPA filters, Ultraviolet Germicide, switching to MERV 13 filters or by using some combination of these options.

As we began this topic, additional categories were outside the air system components that will impact the IAQ.

Material choices will determine if more chemicals are off-gassed into the indoor environment or if *Mold* growth occurs. These are discussed in more detail in our Hygienic Materials topic, but to make the point brief, you don't want to ignore the impact these choices have on indoor air quality and building occupants. Select materials that do not or will inhibit mold growth, have zero VOCs, and reduce or eliminate other harmful properties.

Lastly, as we touch upon above, outside contaminants are brought in by building occupants, such as from their shoes or clothing. Using walk-off mats can help reduce this with proper care and maintenance. Recessed walk-off mats with drainage are recommended. Additionally, you want to avoid depositing these outside contaminants inside the building. This can occur while using a plenum air return system. This type of air return system will continually draw from a potential deposit of mold, bacteria, or other contaminants. A ducted return is recommended.

C. Resource Reference Links

Resource Information on Daylight and Lighting and excerpts taken from:

[The 9 Foundations of a Healthy Building, Healthy Buildings for Health](#), 2017

Harvard T.H. Chan School of Public Health by Joseph G. Allen, Ari Bernstein, Xiadong Cao, Erika Sita Eitland, Sky Flanigan, Maia Gokhale, Julie M. Goodman, Skylar Klager, Lacey Klingensmith, Jose Guillermo Cedeno Laurent, Steven W. Lockley, Piers Macnaughton, Sepideh Pakpour, Jack D. Spengler, Jose Vallarino, Augusta Williams, Anna Young, and Jie Yin.

“The 9 Foundations of a Healthy Building” was created by a multidisciplinary team of experts from the Healthy Buildings Program at the Harvard T.H. Chan School of Public Health. You can learn more about the team and our research at www.ForHealth.org. The 9 Foundations curated summaries are designed to be a clear and actionable distillation of the core elements of healthy indoor environments. For each, we created a 2-page summary of the underlying science, fully cited back to the primary literature. These summaries are included in the following pages, along with a short guide for how to achieve each foundation. The 9 Foundations apply universally to all building types, including homes, but the supporting text focuses mainly on commercial office environments.

[Foundation For Student Success How School Buildings Influence Student Health, Thinking and Performance](#)

Harvard T.H. Chan School for Public Health by Erika Eitland, Lacey Klignesmith, Piers MacNaughton, Jose Cedeno Laurent, Jack Spengler, Ari Bernstein, and Joseph G. Allen

Schools for Health: Foundations for Student Success was researched and produced by the Healthy Buildings program at the Harvard T.H. Chan School of Public Health under the direction of Dr. Joseph Allen. Our goal is to improve the lives of all people, in all buildings, everywhere, every day. The Schools for Health program is a platform to discuss, research, and disseminate information on how school buildings affect the health and productivity of students, teachers, and staff every day. Our team works to answer critical questions related to the

environmental and contextual factors that influence chronic absenteeism, academic performance, and short- and long-term health performance indicators. Schools for Health: Foundations for Student Success is intended to serve as an evidence-based decision-making tool for key school stakeholders.

Educational Facilities, N.J.A.C. 6A:26

The rules are adopted by the New Jersey State Board of Education to implement the Educational Facilities Construction and Financing Act (EFCFA), P.L. 2000, c.72, as amended and as defined in N.J.S.A. 18A:7G-1, as well as to consolidate, conform, and update other rules relating to educational facilities in this State. The rules are adopted to ensure that the educational facilities in the State are safe, healthy, and educationally adequate to support the delivery of the thorough and efficient education to which all students are entitled, as defined by the New Jersey Student Learning Standards. The rules apply to all district boards of education in the State. To the extent these rules are inconsistent with other rules in Titles 6 and 6A of the New Jersey Administrative Code, the rules in this chapter shall take precedence.

2022 Research White Paper “Healthy Schools by Design - Classrooms” - A study on classrooms by Perkins&Will

- *Of the 15,000 hours spent in school by the time they graduate 12th grade, children spend most of that time in their classrooms. This exposure to classroom environments can impact both academic and biological growth.*
- *According to a National Center for Education Statistics Survey, on average teachers have 14 years of experience and work approximately 53 hours a week. Therefore, teachers are susceptible to classroom conditions as well.*
- *Older school buildings may contain harmful substances and features that are not optimized for student health and performance including, windowless classrooms, high levels of background noise, lead in paint and drinking fountains, and asbestos.*

Indoor Air Quality Tools for Schools Action Kit, Environmental Protection Agency (EPA)

IAQ Tools for Schools Action Kit shows schools how to carry out a practical plan to improve indoor air problems at little- or no-cost using straightforward activities and in-house staff. The Action Kit provides best practices, industry guidelines, sample policies, and a sample IAQ management plan.

School IAQ Fact Sheets, U.S. GreenBuilding Council

The IAQ Fact Sheet Series is designed to help people without a technical background understand details about indoor air quality (IAQ) so that they can make important decisions for their schools.