

HETI Horizons

The Impact of Ventilation On Indoor Air Quality In Schools

School indoor air quality (IAQ) affects the health, performance and comfort of school staff and students. Routine classroom and school activities – such as art, biology and chemistry – can contribute to indoor pollutants. Normal cleaning and sanitizing of school buildings can release particulates and hydrocarbons. In newly-constructed school facilities, exposure to indoor air pollutants has increased due to a variety of factors – including construction of tightly-sealed buildings; reduced ventilation rates to save energy; off-gassing from synthetic building materials and furnishings, such as medium density fiberboard; use of personal care products; and increased use of vehicles and power equipment within and around the buildings. Aging and poorly-maintained school facilities are also affected by some of these issues, as building materials decay and water infiltration can lead to fungal growth.



Managing IAQ in schools presents different challenges than commercial facilities. The population density and building use differ – with schools housing a larger number of people per square foot of building space than commercial facilities. A typical school has approximately four times as many occupants as an office building for the same amount of floor space. Due to the increasing number of occupants, schools look for additional areas to host students, sometimes using portable classrooms or rooms/buildings that

were not originally designed to serve as classrooms. To support these new “classrooms”, schools frequently re-assign existing heating, ventilation, and air-conditioning (HVAC) equipment, or add small package systems. Buildings that are intended for short-term use often find longer life spans. The end result for the schools are buildings, which are near or at their occupancy limits, being supported by modified HVAC systems that were not designed for these new requirements. So, it should be no surprise when schools have IAQ issues. Unfortunately, these issues are often the lead story for local news reports and parent-teacher organization meetings.

Common Indoor Air Pollutants

Pollutants to indoor air can come from building materials, cleaning products, operating equipment, existing moisture issues, or from outside the facility. IAQ pollutants often identified in schools include biological contaminants (mold, dust mites, pet dander, pollen, etc.), carbon dioxide (CO₂), carbon monoxide, fine particulate matter, lead, nitrogen oxides, pesticides, radon, and volatile organic compounds (formaldehyde, solvents, cleaning agents, etc.). Elimination of contaminant sources is the primary goal of school facilitators and ventilation is the method frequently used to control indoor contaminant concentrations.

Ventilation Issues

Resolving IAQ problems involves diagnosing the cause and applying practical actions that either reduce emissions from pollutant sources or remove pollutants from the air (e.g., increasing ventilation or air cleaning) ...or both. Problems related to sources can stem from improper material selection or application, allowing conditions that can increase biological contamination and dust accumulation, or source location. Ventilation issues stem from:

- ◆ Improper design
- ◆ Incorrect installation
- ◆ Lack of operation & maintenance of HVAC systems

Improper Design

HVAC systems in school buildings are frequently not operated according to the original design specifications and needs. Systems may be under- or over-sized. When designed, fresh air intakes should be located away from vehicle traffic, bathroom and kitchen exhaust vents, and locations where birds may roost. Changes in the facility use and layout require system modifications to operate properly within the new parameters; however budget constraints may not allow for these changes. As long as the HVAC systems keep the spaces relatively comfortable, then even if the IAQ is not ideal, modifications may be postponed until a later date.

Incorrect Installation

After designing and selecting the proper HVAC system for a school building, proper installation is next. In newly-constructed buildings, field changes are often made to accommodate issues that occur during the construction process. These modifications can affect the HVAC system installation causing changes in duct diameter, duct length, and duct pathway that reduce the effectiveness of the system. Testing the system after the building is occupied provides a baseline to make certain the system operates as designed.

Renovation of existing facilities may also occur due to restrictions present within the facility. Testing should be conducted after system modifications and throughout the lifetime of the building to maintain proper performance.

Operation and Maintenance



Once the HVAC system is installed within a school building, proper operation and maintenance (O&M) of the system is the next challenge. A good O&M program will help maintain the performance of the system over its lifetime, protect employees and occupants, comply with national guidelines, increase the service life, reduce operating costs, maintain the value of the system, and lessen the impact of unexpected shutdowns and repair costs.

Here are some critical components of an O&M Program:

- ◆ Facilities should have a written O&M Program that is specific for each facility
- ◆ O&M Program training of the responsible personnel should be conducted periodically
- ◆ HVAC inspections should be conducted on a regular basis and documented
- ◆ Inspection findings should be addressed, and any repairs documented
- ◆ Preventative maintenance should be scheduled, conducted, and documented on a regular basis

Operation of HVAC Systems during School Closures and Temperate Periods

A challenge with which many schools are currently dealing is the operation of their HVAC systems in the summer and temperate months. During the summer months when school occupancy is low, the HVAC systems are often turned off or adjusted to limit operation and reduce costs. This may result in increased temperature and relative humidity inside the facility, which facilitates mold growth on classroom walls, carpeting, contents and furnishings.

Solutions

So how do schools reduce the risks associated with ventilation systems and the potential for IAQ problems? The first step is to make sure the HVAC design is consistent with both the short- and long-term needs of the facility. Written, facility-specific programs for IAQ and HVAC systems consistent with EPA "Tools for Schools" should be developed – requiring an assessment of the facility and review of existing facility procedures and O&M Programs. Personnel responsible for building maintenance should be adequately trained. HVAC systems should be regularly inspected and serviced – with proper filter change and drip pan/coil cleaning to add to service life and reduce operating cost. Schools should also evaluate the existing HVAC systems to determine if they are supporting the current facility layout requirements. Finally, schools should implement IAQ and HVAC plans, and conduct required O&M activities to assist in reducing the occurrence of future IAQ issues. Deferring needed maintenance may reduce short-term operating costs but lead to long-term operational issues.

HETI...Experienced IAQ Professionals



HETI can assist schools in the management of operational issues and response to the challenges addressed in this issue of *HETI Horizon*. We can provide ventilation and IAQ assessments, along with cost-effective and feasible solutions. HETI can also assist in the development and implementation of written IAQ and O&M Programs, and conduct employee training.

To find out more about this and other HETI IAQ and industrial hygiene services, please contact us.

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