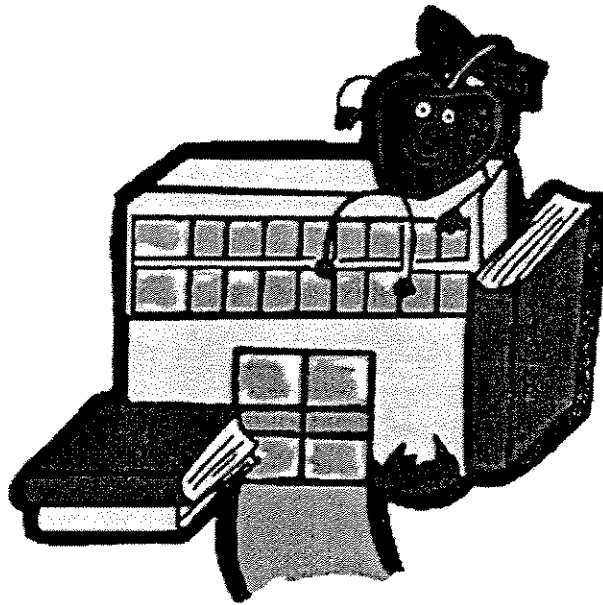


INDOOR ENVIRONMENTAL QUALITY INVESTIGATION

**PORTA Elementary School
514 West Monroe Street
Petersburg, Illinois
IDPH File No. 910150201**



**Illinois Department of Public Health
Division of Environmental Health
Toxicology Program
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PURPOSE

The Illinois Department of Public Health (IDPH) has performed an indoor environmental quality (IEQ) investigation of the PORTA Elementary School in response to concerns of parents about mold contamination and a reported inordinate number of students experiencing respiratory problems while at school. Our investigation included a visual inspection of the school building and its heating, ventilating, and air conditioning (HVAC) system, environmental monitoring, and an evaluation of health and attendance records maintained by the school.

BACKGROUND AND STATEMENT OF ISSUES

On Thursday, October 17, 2002, staff from the IDPH Toxicology Section conducted a preliminary inspection of the Petersburg Elementary School. The inspection was initiated after receiving a request for assistance from the Menard County Health Department and several telephone inquiries from concerned parents.

During the preliminary inspection, the District Superintendent stated that the school has had an ongoing moisture problem since its renovation several years ago that is being addressed. The HVAC contractor who renovated the system and BBA Engineering, P.C. (BBA), a mechanical and electrical engineering firm, have been trying to determine the cause of the moisture problem and have experimented with operational modifications to correct it.

The preliminary inspection consisted of visually inspecting the HVAC system as well as 17 of 20 classrooms and other areas within the building for visible signs of moisture damage and/or mold growth. A small amount of mold was observed on pipe insulation in the ceiling plenum above Room 107 and no mold growth was observed on either side of any water-stained ceiling tiles in other parts of the school.

Based on this preliminary inspection, we issued recommendations to District Superintendent in a letter dated October 24, 2002. Those recommendations included:

- Continuing efforts to determine the source of moisture in the school and correct the problem.
- Replacing water-stained or damaged ceiling tiles in all of the classrooms and hallways.
- Conducting a more thorough inspection of the building including in-depth evaluation of the HVAC system and the unit ventilators in each classroom.
- Repairing the skylights in the west hallway and fixing any water leaks near these units.
- Properly remediating the mold detected in room 107 and any future mold contamination according to appropriate guidelines.
- Conducting mold remediation and/or replacing water-damaged materials at night or on weekends when the building is unoccupied.

On October 21, 2002, the District Superintendent and School Principal met with BBA to discuss the findings from BBA's site visit on October 4. BBA summarized several items they discovered during their site visit that may contribute to moisture problems at the school. They include:

- The school building has never been "dried out" post construction to remove humidity that may be trapped within it.
- The chilled water supply temperature was too high to maximize dehumidification.
- The outdoor air dampers on the unit ventilators were in a closed position.
- The unit ventilator fan speed had been set too high on all units.
- The exhaust fans in the corridors were set up for on/off control.

BBA also presented a list of recommendations to address these specific problems. Of those recommendations, BBA's solution for drying out the building has yet to be implemented since it requires that the building be unoccupied.

On November 6, 2002, staff met with Jim Smith, Head of Maintenance for the PORTA School District, to discuss the basic operations of the school's HVAC system and visually inspect its major components. According to Mr. Smith, each classroom and the library are served by unit ventilators. The office area, which includes the reception area, principal's office, and rooms 115 through 118, is served by a separate and distinct air handling system. Exhaust fans are located in each of the corridors on the main level. In order to maintain positive pressurization in the building, only one exhaust fan is currently operated (pursuant to a recommendation by BBA Engineering, P.C.).

During our visual inspection of the HVAC system, we looked at 1) the outdoor air intakes to verify they were open and unobstructed, 2) the condition of the filters, cooling coils, and condensate drain pans in each unit ventilator, 3) the condition of supply air diffusers and return air vents, and 4) the overall cleanliness of each unit ventilator. We also looked at the exterior of the school and the general indoor environment in each classroom taking note of items that might contribute to the respiratory problems reported by parents.

We completed our visual inspection of the HVAC system, school exterior, and general classroom environment using a School Indoor Environmental Quality Assessment Checklist. The checklist was adapted, with permission, from the U.S. Environmental Protection Agency's *Indoor Air Quality Tools for Schools* Program (Attachment 1).

On November 8, 2002, staff returned to the school to conduct 1) environmental sampling for temperature and relative humidity in every classroom, 2) a moisture survey of visibly water-stained building materials, and 3) a qualitative evaluation of the pressure relationships between individual classrooms and the ceiling plenum as well as the corridors.

In order to address parental concerns about the number of students experiencing respiratory problems while at the school, we reviewed a variety of health and attendance records maintained by the school. Prior to our preliminary inspection on October 17, we obtained the school's

Illinois School Report Card from 2000 and 2001 and reviewed its attendance rate for those years relative to District and Statewide averages. We also reviewed several other records, including information from the Annual Health Update, the number of school nurse referrals and health room visits, the number of students with inhalers at school, and the school's attendance log book. The attendance log book includes the number of absences for each student as well as the reasons reported for the absence.

RESULTS

HVAC System Inspection

On November 6, we completed a visual inspection of the unit ventilators in 19 of 20 classrooms. We did not inspect the unit ventilator in room 004 because it was blocked by a computer workstation. In general, the unit ventilators were running, the outdoor air intakes were open and unobstructed, the filters were properly installed and appeared to be on a regular maintenance schedule (they were due for replacement on or around November 24), and the condensate pans, although dirty, contained no standing water or slimy debris. However, we observed that the airflow control louvers, air diffusers on top of each unit ventilator, return air grilles near the bottom of each unit ventilator, and the inner face of the access panels on ceiling mounted unit ventilators were typically dusty or laden with debris. This is not unexpected, especially in the case of the air diffusers. Debris and office supplies normally found in classrooms, such as paperclips and staples, can easily fall through the diffusers and land inside the unit ventilators.

We also observed that the cooling coils in some classrooms (rooms 101, 102, 103, 104, 113, and 114) were dustier than in other classrooms. In most of the same classrooms, as well as room 005, 106, and 111, the outdoor air side of the filters was also much dirtier than filters in other classrooms.

Building Exterior Inspection

On November 6, we completed a visual inspection of the building exterior with Jim Smith. Our inspection was unremarkable, with the exception of two observations. We observed a bird nest on the exterior of an outdoor air intake on the south side of the school. This outdoor air intake serves the cafeteria and the multi-purpose room. We also observed a significant amount of standing water on the roof over several older sections of the school. According to Jim Smith, there are currently no active leaks in the older part of the school.

General Classroom Environment

On November 6 and 8, we took note of the general environment in each classroom while paying particular attention to items that might contribute to the respiratory problems reported by parents, such as water stains on carpet or ceiling tiles, classroom activities, and the presence of plants, animals, and chemicals. We made several observations, including the following:

- The unit ventilators were partially blocked or used for storage in eleven classrooms (004, 005, 006, 102, 103, 104, 105, 111, 112, 114, and 201).
- Rust-colored water stains were present on the carpet near the unit ventilator in seven classrooms (005, 006, 103, 105, 106, 113, and 114). Typically we observed these stains on the chilled water side of the unit ventilator.
- Houseplants were present in five classrooms (005, 006, 102, 111, and 201). They appeared to be healthy and well maintained.
- Teachers in five classrooms (006, 103, 104, 111, and 112) were using pumpkins, dead tree leaves, “gumballs,” and other plant materials for either decoration or class projects. In fact, a hollowed-out pumpkin in room 006 was covered with a significant amount of fungal growth. We did not see these items in any of the classrooms when we visited the school on November 8.
- Animals were present in four classrooms including a small rodent in room 004 and fish in rooms 103, 105, and 114.
- An ozone-generating air cleaner (Living Air Model XL15) was present on a shelf above the unit ventilator in room 004.
- Water stains were present on all four corridor skylights. According to Jim Smith, these are not active leaks and are typically a problem only when it snows.
- Barrier mats were present at all school entrances.

Environmental Monitoring

On November 8, we collected environmental readings for temperature and relative humidity using a TSI Velocicalc Plus Ventilation Meter Model 8360. Readings were collected in two outdoor locations and twenty three indoor locations, including every classroom. The data collected during this visit are attached in Table 1.

Temperature

Temperature is frequently identified in indoor air complaints because it is directly linked to occupant comfort. Excessively high or low temperatures can lead to general thermal discomfort and occupant dissatisfaction. The American Society of Heating, Refrigeration, and Air Conditioning Engineers, Inc. (ASHRAE) (Standard 55-1992 section 5.1.2) recommends that office temperatures be maintained between 68 degrees and 75 degrees (71 degrees is optimal) during the winter months and between 73 degrees and 79 degrees (76 degrees is optimal) during the summer months. Because of individual differences, it is impossible to recommend a thermal

environment that will satisfy everyone. The purpose of this standard is to recommend a thermal environment that is acceptable to approximately 80% of the occupants.

The temperatures we recorded inside the school ranged from approximately 68 degrees to 75 degrees, which is consistent with the range recommended by ASHRAE for winter months. The outdoor temperatures recorded were 67 degrees and 71 degrees.

Relative Humidity

Relative humidity (RH) is an important factor in indoor air quality because moisture levels are linked to occupant comfort and other considerations. High moisture levels impair the body's ability to lose heat, and can lead to microbial growth. This growth may lead to irritating odors, cause permanent damage to building components, and result in a variety of infectious or allergic illnesses for building occupants. Excessively low moisture levels result in dry air that can irritate the lungs, eyes, nose and throat. ASHRAE (Standard 55-1992) recommends that RH be maintained between 30% and 60%.

Relative humidity levels recorded inside the school ranged from approximately 29% to 43%, and the levels recorded outdoors ranged from 31% to 33%. This range is consistent with ASHRAE's standard; however, the relative humidity levels recorded in rooms 111 through 114 are greater than the typical levels recorded in other classrooms. The relative humidity in room 103 also exceeded 40%.

Moisture Survey

On November 8, we performed a moisture survey using a Delmhorst Moisture Tester Model BD-9 and a Tramex Moisture Encounter. We used the BD-9 to measure moisture content of visibly water-stained materials in nine separate locations, including rooms 004, 005, 106, 113, 114, and four corridor skylights. The BD-9 registered "0" for each measurement recorded in the classrooms (for non-wood materials, a comparative scale of 0-100 is used), including measurements from carpet and ceiling tiles. The BD-9 registered 10% moisture content or less for each measurement recorded from the wood framing materials that form the corridor skylights.

Since moisture infiltration had been a problem in room 101, we used a Tramex Moisture Encounter (Scale 3) to measure the relative moisture content of the cinder block wall on the east side of the room. The Tramex registered a "100" near the bottom of the wall (as with the BD-9, a comparative scale of 0-100 is used for non-wood materials), but gradually decreased as successive measurements were collected up the wall. We also observed a slight amount of efflorescence near the bottom of the wall. At the time of our first visit on November 6, improvements to the exterior side of this wall had been completed in order to prevent further moisture infiltration along this wall.

Building Pressure Relationships

On November 8, we performed a qualitative evaluation of the pressure relationships within the school in order to determine if the building is positively pressurized and establish the presence of potential exposure pathways between the ceiling plenum and individual classrooms. We used smoke tubes to complete this evaluation. In general, the building was positively pressurized, and the classrooms were positively pressurized relative to the corridors.

Because we had seen mold in the ceiling plenum above room 003 (on an insulated chilled water pipe) and previously in room 107, we determined it was necessary to evaluate the potential for air in the ceiling plenum to migrate into the classroom. In most cases (rooms 107 through 110 and the library excluded), two ceiling tiles had been removed from each classroom and replaced with air grilles. In those classrooms, one grille was placed above the unit ventilator and one was placed near the corridor side of the classroom. The velocity of the air blowing out of the unit ventilators forced air into the ceiling plenum in all classrooms. For the ceiling grille near the corridor, air typically remained stagnant near the grille; however, in a few cases we noticed a flow of air into the classroom.

Health and Attendance Records

In order to address parental concerns about the number of students experiencing respiratory problems while at the school, we reviewed a variety of health and attendance records maintained by the school. Our observations are as follows:

- According to its Illinois School Report Cards, Petersburg Elementary School had an attendance rate of 95.7% in 2000 and 95.3% in 2001. These attendance rates exceed the corresponding rates for the District (95.2% in 2000 and 95.0% in 2001) and State (93.9% in 2000 and 93.7% in 2001).
- According to information from the school's Annual Health Update, 26 students have reported having asthma. According to the school nurse, three students keep inhalers at the school. Two of the children have used their inhalers once this school year.
- According to the attendance logbook from the first day of school to November 1, 2002, 19 children with asthma as reported on the Annual Health Update have been absent on at least one occasion for either a full or half day. Forty-one full day and 22 half day absences were recorded for these children as follows: planned out of town trips (16 days, 1 half day), the lack of a birth certificate and unexcused absences for one student (9 days), dental appointments (2 half days), and ear infection and pink eye (1 day). Other reasons given for absences were "illness" (9 days), doctor appointments (2 days and 13 half days), appointments (5 half days), coughing and wheezing (1 day), upset stomach (1 day and 1 half day), and no reason (2 days).

- According to the attendance logbook from the first day of school to November 1, 2002, eight students not known to have asthma or allergies have had respiratory-related absences. These students are from seven classrooms, including rooms 004 (1), 005 (1), 006 (2), 102 (1), 103 (1), 104 (1), and 114 (1). Parents of these eight students reported twelve reasons for the absences, but the most frequently reported reason was “croup.” Croup was reported by four of the students’ parents on seven occasions.
- According to the school nurse, students have visited the Health Room and reported respiratory symptoms twelve times this school year. The reported symptoms include sore throats (9), shortness of breath (1, per a parent’s request), and coughing. Four of these students are in kindergarten, four are first graders, and three are second graders.

CONCLUSIONS & RECOMMENDATIONS

Based the information gathered during a review of engineering reports written by BBA, a visual inspection of the school building and its HVAC system, environmental monitoring for temperature and relative humidity, a moisture survey, an assessment of pressure relationships within the school building, and an evaluation of health and attendance records maintained by the school, we have the following conclusions:

1. The amount of dust and debris on individual components of the unit ventilators warrants cleaning. Specifically, the cooling coils, condensate pans, airflow control louvers, air diffusers, return air grilles, and the access panels on ceiling mounted unit ventilators should be cleaned. Dust inside the unit ventilators can be a reservoir for a variety of allergens and asthma triggers, including dust mites and mold spores.
2. The bird’s nest on the exterior of the outdoor air intake for the cafeteria and multi-purpose room should be removed.
3. Standing water is not an unusual observation for a flat-roofed building, but the water can contribute to fungal growth if roof leaks develop. The school should be regularly inspected for signs of roof leaks, such as water-stained or visibly moldy ceiling tiles. When leaks are identified, they should be addressed immediately and visibly moldy ceiling tiles should be removed according to appropriate mold cleanup and remediation guidelines.
4. Unit ventilators should not be blocked with desks or workstations. The use of the unit ventilators for storage should also be discouraged.
5. If not well maintained, houseplants can be a source of fungal growth and contribute to the overall level of fungi inside the classrooms. Moreover, pumpkins, dead tree leaves, and other plant materials we found in certain classrooms are natural substrates for fungal growth. The potential for them to contribute to the overall level of fungi in the classrooms and affect sensitive students should not be ignored, especially if mold is a concern.

6. The rodent in room 004 should be removed from the school if possible. Exposure to allergens in the dander, urine, or saliva of furry mammals can cause allergic reactions or trigger asthmatic episodes in sensitive students.
7. The use of an ozone-generating air cleaner in the school can contribute to respiratory problems experienced by students or teachers and should be prohibited. Ozone is a known respiratory irritant that can cause coughing, shortness of breath, and throat irritation. It may also aggravate chronic respiratory conditions such as asthma and compromise the ability of the body to fight respiratory infections. For your information, we have attached the U.S. Environmental Protection Agency's fact sheet "*Ozone Generators that are Sold as Air Cleaners: An Assessment of Effectiveness and Health Consequences*" to this report in Appendix 2.
8. The temperature and RH levels recorded inside the school on November 8 were consistent with ASHRAE standards. However, RH may increase with the arrival of spring and summer, and should continue to be monitored until the problems described by BBA are resolved.
9. Visibly water-stained materials in rooms 004, 005, 106, 113, 114, and four corridor skylights did not contain excess moisture relative to building materials which had not been subjected to water leaks, condensation, or other types of water damage. In addition, visible fungal growth was not evident on any of these materials. However, if leaks around the skylight are a problem when it snows, we suggest consulting with an architect or a general contractor to find a solution to this problem.
10. The relative moisture content of the cinder block wall on the east side of room 101 was high compared to other areas of the wall. The use of a portable dehumidifier should help dry out the wall since efforts have been taken to waterproof the exterior side and prevent further moisture from building up. In addition, the small amount of efflorescence we observed on the wall can be cleaned by maintenance staff with a solution of soap and water.
11. Some fungal growth is present in the ceiling plenum above at least two classrooms; however, the pressure relationships we observed suggest that this is not a significant source of fungal exposure in classroom air. Nevertheless, the mold should be cleaned using appropriate guidelines.
12. Concerns that an inordinate number of students have been experiencing respiratory problems do not appear to be supported by a review of the Illinois School Report Cards and the health and attendance records kept by the school for the time frame evaluated. Attendance rates as recorded on the Illinois School Report Cards for 2000 and 2001 demonstrate an above average school attendance by PORTA Elementary students compared to other schools in the district and state. Records from the attendance logbook

and information from the school nurse do not indicate an inordinate number of absences or health room visits by asthmatic children. "Croup," indicated as the primary reported reason for absences of at least four children with no history of asthma, is due to a viral infection and not associated with moisture or mold in the school. Furthermore, the records do not suggest that absences or health room visits have a building-related cause as there does not appear to be a clustering of illness associated with a specific class room or area in the building. While these records may contain some erroneous information because of self-reporting by students or diagnoses by parents, they do provide valuable information and should be occasionally reviewed to determine changes in attendance patterns. Information on childhood asthma and managing asthma and respiratory problems in the school environment is provided in Appendix 3.

Preparers of Report

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TABLE 1 - Porta Elementary School, Site Visit 11/8/02

Location	Temperature (degrees °F)	% Humidity	Room Pressurization	Comments
Outside (near east door)	67.4	33.3	Positive	At approx. 2:15 PM
Outside (near west door)	71.1	31.4	Positive	At approx. 3:45 PM
Gym	74.5	33.1	NA	
Cafeteria	74.3	33.4	NA	
Room 201 (Music Room)	71.6 72.0	34.0 34.5	Positive	
Room 202 (Art Room)	70.0 69.5	33.4 34.0	Positive	
Room 101	71.2 71.4	32.8 32.6	Positive	Positive moisture readings on lower cinder block wall at east end of room
Room 102	73.1 73.5	32.1 33.2	Positive	
Room 103	70.0 71.3	41.1 40.0	Positive	In plenum: Temp: 73.5 °F Humidity: 35.1%
Room 104	74.6 75.2	32.0 32.3	Positive	
Room 105	74.8 74.8	35.5 35.4	Positive	
Room 106	74.0 74.5	32.0 32.0	Positive	Moisture readings on carpet near ventilator: <10% Exhaust in bathroom ceiling vent: positive
Room 107	72.2 71.2	30.2 28.7	Positive	No vents present in ceiling
Room 108	74.0 74.0	29.5 28.5	Positive	Ventilator located on ceiling near door. Second set of readings taken at opposite end of room.
Room 109 (Computer Room)	69.9	30.5	Positive	Readings recorded at east end of room

Location	Temperature (degrees °F)	% Humidity	Room Pressurization	Comments
Room 110	70.4 70.8	31.8 31.7	Positive	No vents present in ceiling. First set of readings are from the west end of room, second set are from east end of room near door.
Room 111	68.2 68.8	41.6 43.0	Positive	
Room 112	71.6 73.6	40.6 37.1	Positive	
Room 113	70.6 71.5	36.5 37.0	Positive	Moisture readings on carpet near ventilator: <10%
Room 114	69.7 70.5	41.3 40.5	Positive	Moisture readings at rust spots on carpet near ventilator <10%
Room 003 (Storage)	72.3	31.7	Positive	
Room 004	71.6	32.2	NA	Moisture readings on stained ceiling tile near ventilator: <10% Ozone generator on shelf near vent. Gerbil kept in classroom.
Room 005	72.2	36.1	NA	Moisture readings on stained ceiling tile near ventilator <10%
Room 006	71.2	36.6	NA	
Library	73.1 72.9	32.5 29.5	Positive to hall At south door into office: + at top - at middle + at bottom From office into Room 108: stagnant	Ventilator located on ceiling near north end of room.
Skylight in hall				Moisture readings: <10%

Note: Unless otherwise noted, in rooms where 2 temperature and humidity readings are recorded, the first reading is from an area close to the ventilator and the second reading is from the area close to the room exit to the hall. In rooms where only one set of readings was recorded, the readings were taken in the area close to the ventilator.