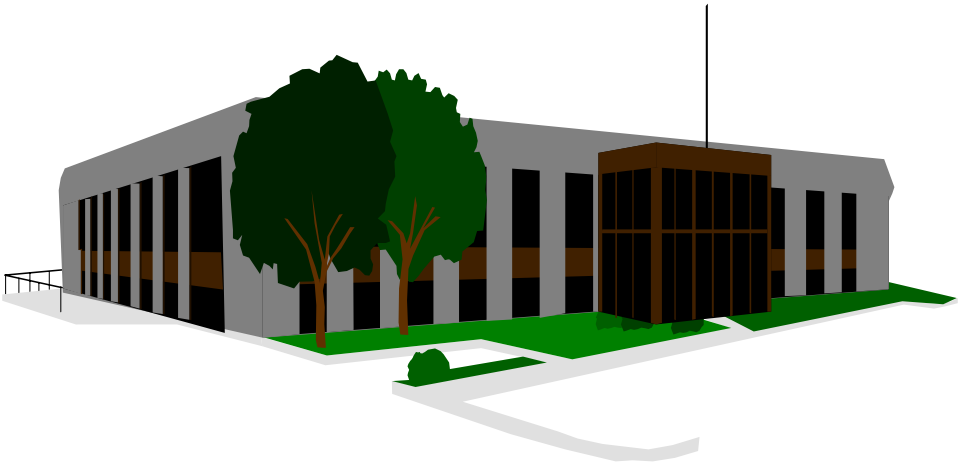
INDOOR AIR QUALITY ASSESSMENT

Garfield Magnet School
168 Garfield Ave
Revere, Massachusetts



Prepared by:
Massachusetts Department of Public Health
Bureau of Environmental Health Assessment
April, 2000

Background/Introduction

Upon referral from the Massachusetts Department of Public Health Occupational Surveillance Program, an indoor air quality assessment was conducted at the Garfield Magnet School in Revere, Massachusetts. This assessment was conducted by the Massachusetts Department of Public Health (MDPH), Bureau of Environmental Health Assessment (BEHA).

On February 9, 2000, a visit was made to this school by Michael Feeney, Chief of Emergency Response/Indoor Air Quality (ER/IAQ), BEHA, to conduct an indoor air quality assessment. Mr. Feeney was accompanied by Cory Holmes, Environmental Analyst, BEHA, and by Bill Niedzwiecki, Head Custodian, Steve Mitten of Honeywell Home and Building Control and Francis Hyland of the Revere Board of Health. This request was prompted by indoor air quality complaints believed to be associated with water penetration problems in the building.

The school is a four-story brick building built in 1991 located within an eighth of a mile from Revere Beach. A rooftop penthouse contains various components of the building's heating, ventilating and air-conditioning (HVAC) system. Among these components is a large chiller that is used to provide air-conditioning for the interior of the building during warm weather. The fourth floor contains general classrooms and the media center. The third and second floors house general classrooms, kitchens, cafeterias and a play area. The first floor consists of general classrooms, gymnasium, auditorium, music room and a pool area with locker rooms. An underground-parking garage is located beneath the building. An elevator shaft connects the parking garage to each floor.

The building has had a history of water penetration through the building envelope. As reported by school officials, the exterior wall facing Revere Beach has experienced extensive water penetration. ATC Associates Inc. (ATC) performed a

microbiological survey on June 8, 1999 that noted significant mold contamination within the interior of the building, most notably on gypsum board and fiberglass insulation. ATC recommended disinfection of materials and removal of water damaged porous materials (ATC, 1999). As part of remediation efforts, the contractor that built the school installed an exterior wall over the original to eliminate water penetration (see Picture 1). School officials report that the remediation efforts have reduced/eliminated water penetration on the ocean side of the building.

Methods

Air tests for carbon dioxide were taken with the Telaire, Carbon Dioxide Monitor and tests for temperature and relative humidity were taken with a Mannix, TH Pen PTH 8708 Thermo-Hygrometer. Wind speed and direction were measured with a Davis, Wind Wizard, Wind Speed Indicator.

Results

This school houses grades pre-kindergarten through eighth grade, consisting of a student population of approximately 1400 and a staff of approximately 220. The tests were taken under normal operating conditions. Test results appear in Tables 1-10.

Discussion

Ventilation

It can be seen from the tables that the carbon dioxide levels were elevated above 800 ppm (parts per million) in forty-six of ninety-one areas surveyed, indicating a ventilation problem in these areas of the school. It should be noted in a number of areas with carbon dioxide levels above 800 ppm, the exhaust system and/or univents were obstructed and/or not operating (see Tables).

Two separate ventilation systems exist in the school. Offices and common areas are ventilated by rooftop air handling units (AHUs), which are ducted to ceiling-mounted air diffusers and wall-mounted exhaust vents. It is important to note that all areas ventilated by AHUs had carbon dioxide levels below 800 ppm.

Fresh air in classrooms is supplied by a unit ventilator (univent) system in most classrooms in the school (see Figure 1). The univents were found off in a number of classrooms. Many of these univents appeared to have been deactivated. School maintenance staff re-activated several of these units to observe function, which BEHA staff verified. Obstructions to airflow, such as books, papers and posters on top of univents, and bookcases, tables and desks in front of univent returns were also seen in a number of classrooms. To function as designed, univents and univent returns must remain free of obstructions. It is important that these units must be activated and allowed to operate.

The second floor cafeteria contained four univents, all of which were deactivated. Carbon dioxide levels were above 800 ppm while the room was at approximately one-third of its capacity. Carbon dioxide levels would be expected to elevate during periods of peak occupancy. The carbon dioxide level for classroom 115 was slightly elevated above 800 ppm, however the classroom was occupied by three separate classes of

children during the assessment. Classroom 115 carbon dioxide levels would be expected to drop according to normal occupancy.

Exhaust ventilation in classrooms is provided by a mechanical exhaust system. The exhaust vents are located on the walls at floor level (see Picture 2). This design allows for the vents to be easily blocked by stored materials and occluded by floor dust. In a number of classrooms, these vents were blocked with books, book bags, boxes and other obstructions. In several areas, exhaust vents were not operating; indicating the motor is turned off or non-functional. BEHA staff examined exhaust motors on the roof. Mr. Mitten reported that several exhaust motors were not functioning. The school department has reportedly placed orders for parts to repair exhaust fan motors EF-14, EF-32, the library exhaust fan and one unlabelled fan. As with the univents, in order to function properly these vents must be activated, cleared of obstructions and allowed to operate.

To maximize air exchange, the BEHA recommends that both supply and exhaust ventilation operate continuously during periods of school occupancy. In order to have proper ventilation with a univent and exhaust system, the systems must also be balanced to provide an adequate amount of fresh air to the interior of a room while removing stale air from the room. The date of the last balancing of these systems was believed to have occurred in 1991 upon completion of construction.

The Massachusetts Building Code requires a minimum ventilation rate of 15 cubic feet per minute (cfm) per occupant of fresh outside air or have openable windows in each room (BOCA, 1993, SBBRS, 1997). The ventilation must be on at all times that the room is occupied. Providing adequate fresh air ventilation with open windows and maintaining the temperature in the comfort range during the cold weather season is

impractical. Mechanical ventilation is usually required to provide adequate fresh air ventilation.

Carbon dioxide is not a problem in and of itself. It is used as an indicator of the adequacy of the fresh air ventilation. As carbon dioxide levels rise, it indicates that the ventilating system is malfunctioning or the design occupancy of the room is being exceeded. When this happens, a buildup of common indoor air pollutants can occur, leading to discomfort or health complaints. The Occupational Safety and Health Administration (OSHA) standard for carbon dioxide is 5,000 parts per million parts of air (ppm). Workers may be exposed to this level for 40 hours/week based on a time-weighted average (OSHA, 1997).

The Department of Public Health uses a guideline of 800 ppm for publicly occupied buildings. A guideline of 600 ppm or less is preferred in schools due to the fact that the majority of occupants are young and considered to be a more sensitive population in the evaluation of environmental health status. Inadequate ventilation and/or elevated temperatures are major causes of complaints such as respiratory, eye, nose and throat irritation, lethargy and headaches.

Temperature readings were within a range of 70^{o} F to 81^{o} F, which was close to the BEHA guidelines. The BEHA recommends that indoor air temperatures be maintained in a range of 70^{o} F to 78^{o} F in order to provide for the comfort of building occupants. With the exception of the pool and classroom 424, all temperatures were within BEHA's comfort range. In many cases concerning indoor air quality, fluctuations of temperature in occupied spaces are typically experienced, even in a building with an adequate fresh air supply. It was reported that the pool water is heated and maintained to be equal to room temperature to provide thermal comfort. Also affecting thermal comfort were drafts noted around broken windows throughout the school.

The relative humidity in this building was below the BEHA recommended comfort range in all areas sampled, with the exception of the pool area. Relative humidity measurements ranged from 7 to 24 percent. The BEHA recommends that indoor air relative humidity is comfortable in a range of 40 to 60 percent. Relative humidity levels in the building would be expected to drop during the winter months due to heating. The sensation of dryness and irritation is common in a low relative humidity environment. Low relative humidity is a common problem during the heating season in the northeast part of the United States.

Microbial/Moisture Concerns

Since its construction, school officials reported that this building has a history of water penetration through the building envelope (e.g., through walls, window frames, etc.), particularly on the seaward side of the building. As reported by school officials, the building contractor constructed a new exterior wall over the original to create a barrier that would seal the building from further water penetration during the 1999 summer months. The outside of the building was re-paneled, re-caulked and a vapor barrier was installed. According to school officials the overall the remediation efforts appear to be successful. One exception is an active leak present in the front foyer.

A number of classrooms had water damaged ceiling tiles around the exterior windows. Several of these ceiling tiles were removed, which revealed rusted pipe hangers (see Picture 3). This condition can be a sign that moisture is being introduced into the building resulting in condensate on metal fixtures in the unconditioned ceiling plenum.

It is also important to note that the top floor of this building appears to be unaffected by the water condensation problem, even though this floor is outfitted with

univents connected to the air-conditioning system. All of the chilled water pipes that supply chilled water to the univents throughout the building are located above the suspended ceiling in floors below univents. Since no chilled water pipes exist above the suspended ceiling on the top floor, it appears that a primary source of moisture resulting in wet ceiling tiles is the air-conditioning system. The chilled water pipes can reduce the temperature of nearby metallic materials, such as pipe hangers. This may make pipe hangers prone to generating condensation. When moist air comes in contact with the metal of the pipe hangers, condensation can be created.

Moisture resulting in condensation appears to be several sources. The primary source appears to be the introduction of moisture into the building through the univents. Condensation is generated under the following conditions. When warm, moist air passes over a surface that is colder than the air, water condensation can collect on the cold surface. Over time, water droplets can form, which can then drip from a suspended cold surface. For this reason, HVAC systems are equipped with drainage systems beneath cooling coils to drain condensate as moist outdoor air is cooled.

Contributing to this problem may be moisture sources related to the plumbing system. School maintenance staff reported a problem with the expansion and contraction of hot water pipe valves above ceiling tiles. As reported by school maintenance personnel, valve leaks are isolated and repaired by the Honeywell representative and water-damaged ceiling tiles are replaced as needed. Water-damaged ceiling tiles, wallboard and other porous building materials can provide a source of mold and mildew and should be repaired/replaced after a water leak is discovered and repaired. Mold can be an eye and respiratory irritant to certain sensitive individuals.

Plants were noted in several classrooms. Plants can be a source of pollen and mold, which can be a respiratory irritant to some individuals. A number of plants were

noted on top of univents (see Picture 4). Plants should be properly maintained and equipped with drip pans. Plants should also be located away from univents to prevent the aerosolization of dirt, pollen or mold.

Throughout the school, windowpanes were cracked or broken and air infiltration was noted around windows. In several rooms the window seals appeared to be failing (see Picture 5). Repairs of window leaks are necessary to prevent water penetration. Water penetration through window frames can lead to mold growth under certain conditions. Repeated water damage can result in mold colonization of window frames, curtains and items stored on or near windowsills.

A bucket overflowing with water was noted in the HVAC penthouse (see Picture 6). The bucket was placed beneath a water leak from the HVAC equipment. If left unattended, overflow can spill onto the floor of the penthouse and saturate porous materials, which can lead to potential mold growth. In addition, standing water can become stagnant and provide a medium for bacteria, mold and unpleasant odors. A cup of standing water was noted on the univent in classroom 220. The cup appeared to be stationed on top of the univent to provide added moisture to the air. Although no odors were detected, the water had a cloudy, white- milky appearance. A pungent odor was noted upon entry into the 236 mechanical room. Water-damaged ceiling tiles and cardboard boxes were noted on the floor. These materials should be removed and discarded. A humidifier was noted in classroom 119. Humidifiers should be emptied and cleaned as per the manufacturer's instructions to prevent bacterial and mold growth. The American Conference of Governmental Industrial Hygienists (ACGIH) recommends that porous materials be dried with fans and heating within 24 hours of becoming wet (ACGIH, 1989). If porous materials are not dried within this time frame, mold growth

may occur. Mold colonized gypsum wallboard cannot be adequately cleaned to remove mold growth.

Other Concerns

A number of other conditions were noted during this assessment which can effect indoor air quality. A pungent garbage odor was noted in elevators. The elevators terminate in the basement, in a hallway that is connected to a garage area where the school's trash dumpsters are located. When closed, the hallway doors to the trash dumpster room have spaces through which air and odors can freely pass (see Pictures 7 and 8). These doors should be rendered air tight to prevent trash and vehicle exhaust emissions from entering the elevator lobby. Once in the basement hallway, odors can be drawn from the basement and distributed to the occupied areas of the school by the operations of the elevator. This piston effect can serve to place the lobby area under negative pressure as cars move upwards, which can then enhance the penetration of odors into occupied areas. In addition the garage door to the dumpster room should remain shut to avoid over-pressurization, which can also force trash odors into the elevator lobby.

The installation of the exterior wall over the original seaward-facing surface of the school required the removal of the original univent fresh air supply vent exterior louvers. A number of these louvers were installed, but a number of the openings to the univents remain open to the air. The vents that remain open appear to have sections of the new interior wall installed over the fresh air intake vents (see Picture 9). This installation resulted in reduction of the size of openings to some univents, over an estimated 50 percent in one case (see Picture 10). These univents were designed to have the entire fresh air intake vent free of obstruction, except for the fresh air intake louver.

The obstructions may reduce the ability of univents to provide fresh air for classrooms on the seaward side of the building. The alteration of these vents may require that the univents fresh air louvers be opened to a wider fresh air intake setting than other univents in the building to overcome the resistance to airflow the new exterior wall may have created.

Accumulated chalk dust was noted in several classrooms. Several rooms had missing and/or dislodged ceiling tiles (see Picture 11). Missing ceiling tiles can provide a pathway for the movement of drafts, dusts and particulate matter between rooms and floors. Chalk dust is a fine particulate, which can be easily aerosolized and is an eye and respiratory irritant.

Photocopiers were noted in a few areas of the school. A mimeograph machine was noted in room 326A. Mimeograph duplicating fluid contains methanol (methyl alcohol), which is a volatile organic compound (VOC) that readily evaporates at room temperature. Methanol is also a highly flammable material, which can be ignited by either flame or electrical source. VOCs and ozone can be produced by photocopiers, particularly if the equipment is older and in frequent use. Ozone is a respiratory irritant (Schmidt Etkin, D., 1992). The off-gassing of VOCs can be irritating to the eyes, nose and throat. School personnel should ensure that local exhaust ventilation is activated while equipment is in use to help reduce these materials.

Several classrooms contained dry erase boards and dry erase board markers. Materials such as dry erase markers and dry erase board cleaners may contain volatile organic compounds (VOCs), such as methyl isobutyl ketone, n-butyl acetate and butyl-cellusolve (Sanford, 1999). Cleaning products were found on counter tops and underneath sinks in a number of classrooms. These items should be stored properly and

out of reach of students. Cleaning products, dry erase markers and dry erase board cleaners can contain chemicals, which can be irritating to the eyes, nose and throat.

Conclusions/Recommendations

In view of the findings at the time of our inspection, the following recommendations are made:

1. Examine each univent for function. Survey all areas with univents for proper function to ascertain if an adequate air supply exists for each room; an increase of fresh air intake may be necessary. Operate univents while classrooms are occupied.
2. Consider consulting a ventilation engineer concerning the best option available to ensure appropriate operation of univents with new exterior wall-obstructed fresh air intake vents.
3. Install weather stripping around the trash dumpster room hallway doors. Consider increasing the number of trash removals weekly to reduce odor.
4. Activate exhaust ventilation in occupied areas. Repair and/or replace exhaust ventilation motors where necessary.
5. Remove all blockages from univents and exhaust vents to facilitate airflow.
6. Once both the fresh air supply and the exhaust ventilation are functioning properly, the system should be balanced by a ventilation engineer.
7. For buildings in New England, periods of low relative humidity during the winter are often unavoidable. Therefore, scrupulous cleaning practices should be adopted to minimize common indoor air contaminants whose irritant effects can be enhanced when the relative humidity is low. To control for dusts, a HEPA filter equipped vacuum cleaner in conjunction with wet wiping of all non-porous

surfaces is recommended. Drinking water during the day can help ease some symptoms associated with a dry environment (throat and sinus irritations).

8. Repair any water leaks and replace any remaining water-stained or missing ceiling tiles. Examine the areas above and behind these tiles for mold growth. Disinfect areas of water leaks with an appropriate antimicrobial.

9. Ensure all water damaged wallboard, insulation and building materials have been removed and disinfect areas of water leaks with an appropriate antimicrobial.

10. Repair broken windows and replace missing or damaged window caulking to prevent water penetration.

11. Keep plants away from univents in classrooms. Ensure plants have drip pans and examine drip pans for mold growth. Disinfect areas with an appropriate antimicrobial where necessary.

12. Repair HVAC pipe leak in penthouse to prevent water damage and potential mold growth of stored/building materials.

13. Discard milky water in cup on the univent in classroom 220.

14. Clean and maintain humidifiers as per the manufacturer's instructions.

15. Remove and discard water-damaged cardboard boxes and ceiling tiles in mechanical room 236. Disinfect areas with an appropriate antimicrobial where necessary.

16. Clean humidifiers and dehumidifiers regularly and maintain as per the manufacturer's instructions to prevent microbial growth.

17. Clean chalk boards and chalk trays regularly to avoid the excessive build-up of chalk dust.

18. Replace missing or dislodged ceiling tiles to prevent the egress of particulate matter into classrooms.

19. Ensure local exhaust ventilation is activated whenever office (i.e., photocopiers, and mimeographs) is in use to help reduce odors and excess heat. Consider discontinuing the use of mimeograph machines.

20. Seal spaces beneath and around elevator lobby doors to the parking garage and dumpster room to prevent odors from migrating into occupied areas. Keep exterior garage-doors to dumpster room closed to avoid over-pressurization.

21. Store chemicals and cleaning products properly and out of the reach of students. Ensure all containers are properly labeled for identification in the event of an emergency.

References

ACGIH. 1989. Guidelines for the Assessment of Bioaerosols in the Indoor Environment. American Conference of Governmental Industrial Hygienists, Cincinnati, OH.

ATC. 1999. Letter to Tom Hill, Revere Public Schools from Mark Goldman, Senior Air Quality Scientist, ATC Associates, Inc. Concerning Indoor Air Quality Report, Investigation of James A. Garfield School ATC Project No.: 15032.00006, Dated June 23, 1999. ATC Associates, Inc., Woburn, MA.

BOCA. 1993. The BOCA National Mechanical Code-1993. 8th ed. Building Officials & Code Administrators International, Inc., Country Club Hills, IL. M-308.1

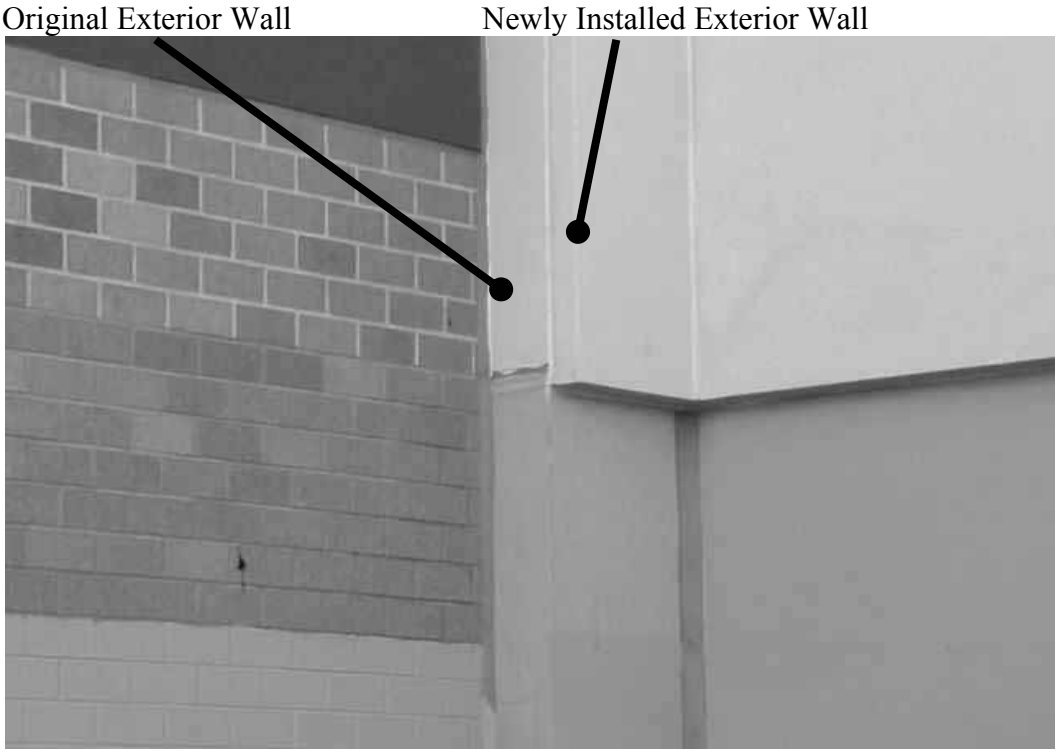
OSHA. 1997. Limits for Air Contaminants. Occupational Safety and Health Administration. Code of Federal Regulations. 29 C.F.R 1910.1000 Table Z-1-A.

Sanford. 1999. Material Safety Data Sheet (MSDS No: 198-17). Expo® Dry Erase Markers Bullet, Chisel, and Ultra Fine Tip. Sanford Corporation. Bellwood, IL.

SBBRS. 1997. Mechanical Ventilation. State Board of Building Regulations and Standards. Code of Massachusetts Regulations. 780 CMR 1209.0

Schmidt Etkin, D. 1992. Office Furnishings/Equipment & IAQ Health Impacts, Prevention & Mitigation. Cutter Information Corporation, Indoor Air Quality Update, Arlington, MA.

Picture 1



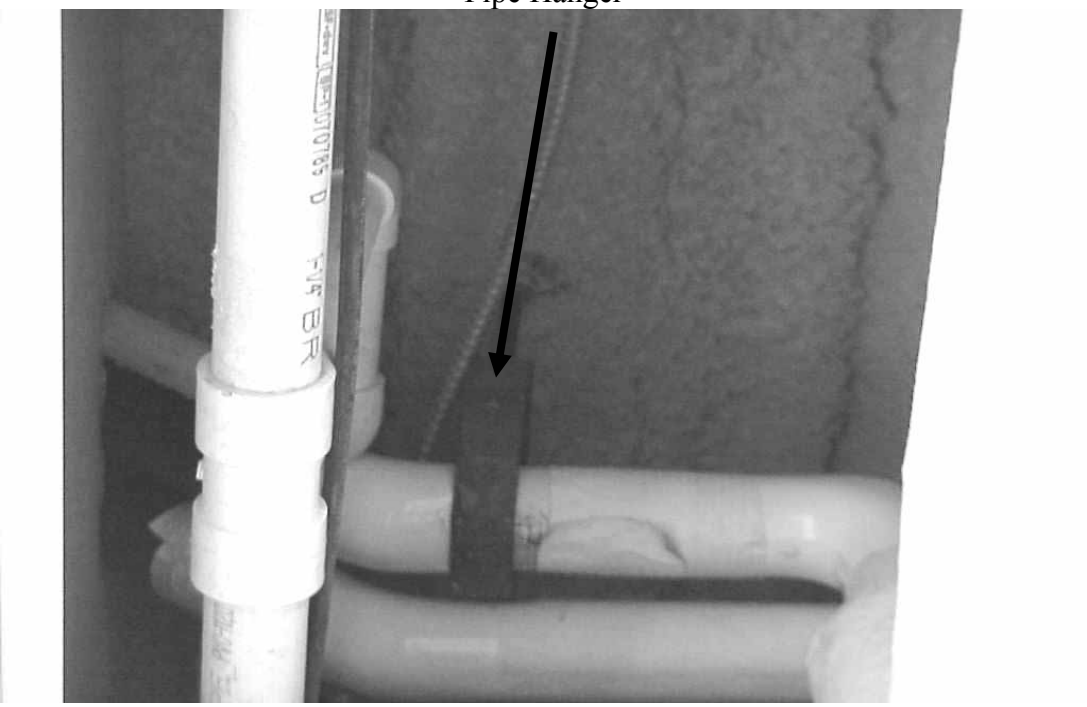
Seaward exterior wall of school that was retrofitted with a new exterior skin

Picture 2

Exhaust Vent Located at Floor Level in Classroom

Picture 3

Pipe Hanger

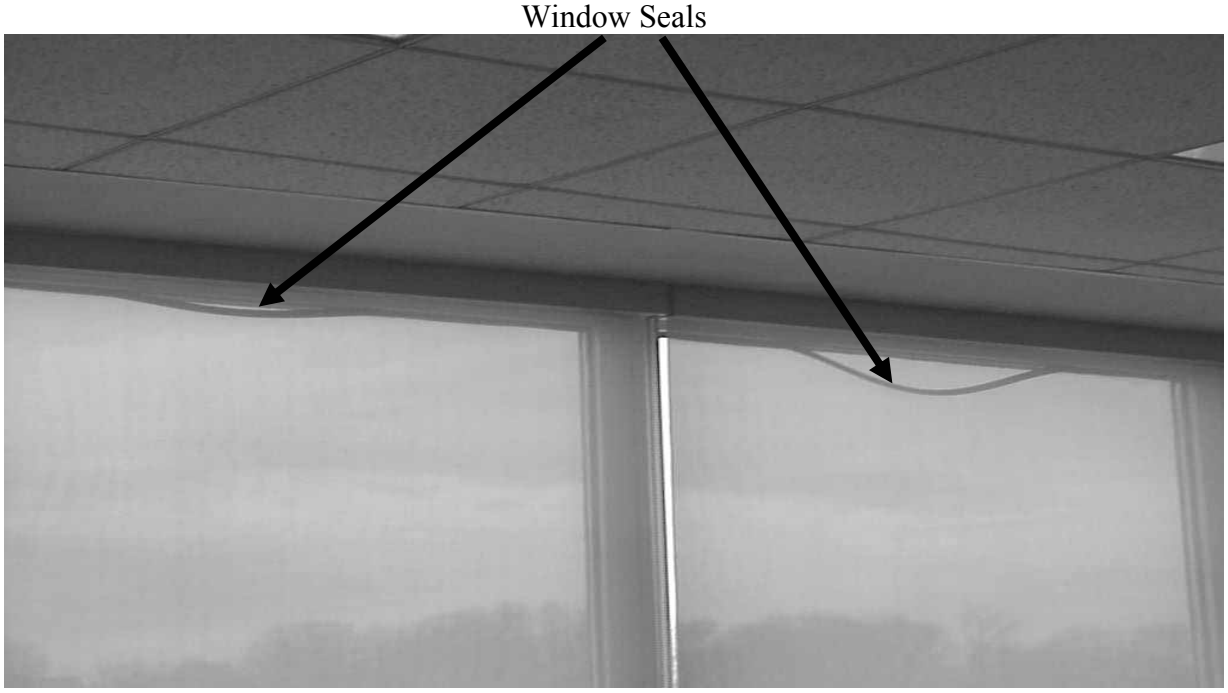


Rusted Pipe Hanger

Picture 4

Plants Noted on Classroom Univent Air Diffuser

Picture 5

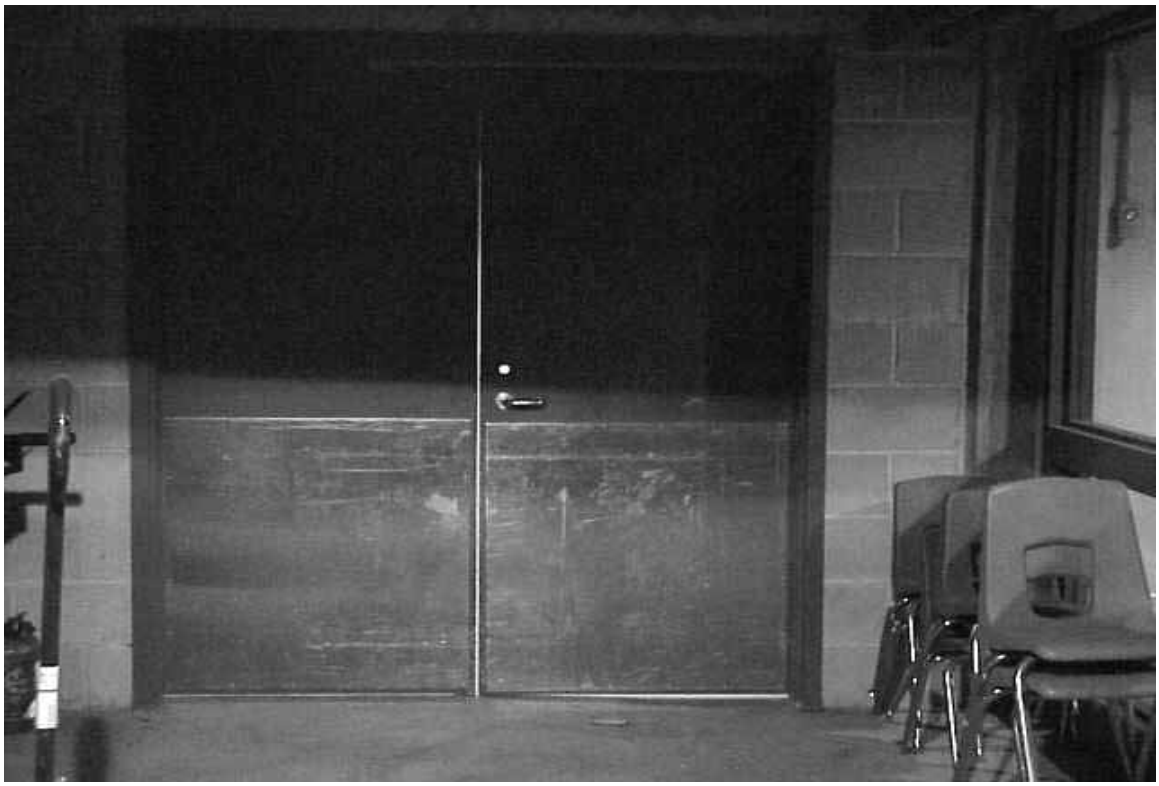


Failing Caulking Noted around Classroom Window

Picture 6

Bucket Stationed below Leak in HVAC Penthouse
Note Overflow on Floor

Picture 7



Double Doors Leading to Dumpster Room Note Spaces between and beneath Doors

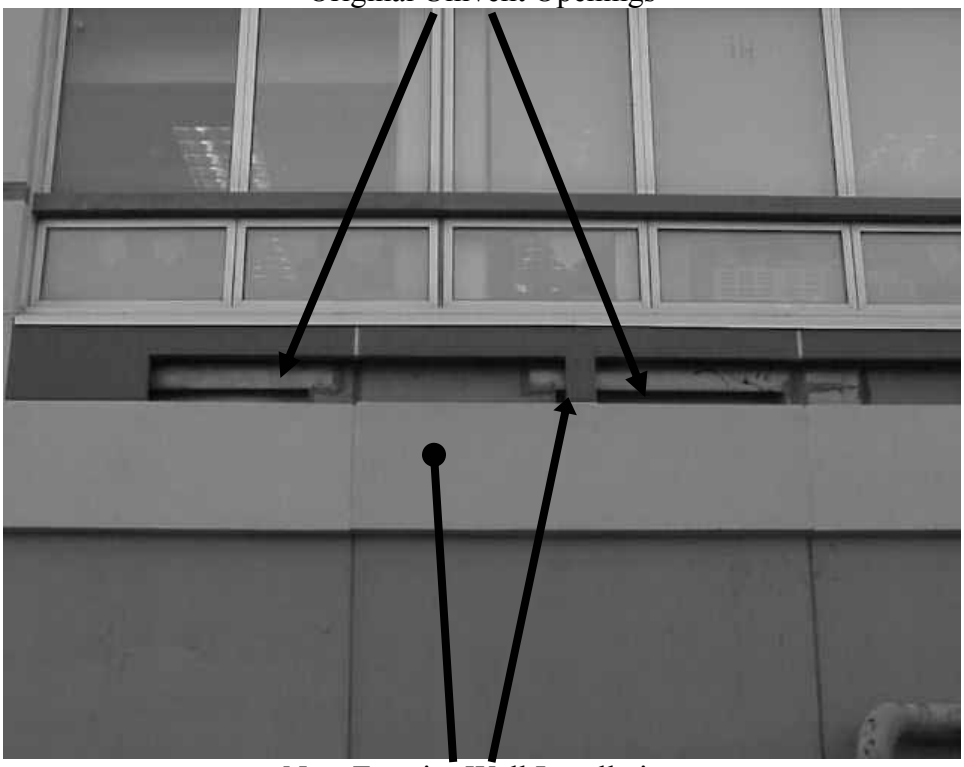
Picture 8

Doors to Elevator Hallway

Trash Dumpster Store Room

Picture 9

Original Univent Openings



New Exterior Wall Installation

Exterior Wall Installed over Sections of Classroom Univent Fresh Air Intake Vents

Picture 10

Exterior Wall Sealing over Fifty Percent of a Classroom Univent Fresh Air Intake Vents

Picture 11

Missing Ceiling Tiles

TABLE 1

Indoor Air Test Results –Garfield Magnet Elementary School, Revere, MA – February 9, 2000

Remarks	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
Outside (Background)	411	42	35					weather conditions: cloudy, wind NW 5-10 mph, gusts of 15-20 mph
Kitchen	560	70	24	10	no	yes	yes	hood exhaust-on, no exhaust in dish room, heat complaint in summer-no a/c
Kitchen Restroom							yes	exhaust off
2nd Floor Boy's Restroom						yes	yes	passive supply,
2nd Floor Girl's Restroom							yes	1 out of 2 exhausts off
Room 230	592	76	8	2	no	yes	yes	2 exhaust vents, door open
Room 229	625	75	10	20	yes	yes	yes	3 CT
Room 228	627	76	8	30	yes	yes	yes	~30 computers, 20+ plants, door open
Room 226 Teachers' Workrm.	566	74	7	1	yes	yes	yes	photocopier, door open
Faculty Restroom							yes	
Room 226B	525	72	7	0	yes	yes	yes	chalk dust

*** ppm = parts per million parts of air**
CT = water-damaged ceiling tiles

Comfort Guidelines

Carbon Dioxide -	< 600 ppm = preferred
	600 - 800 ppm = acceptable
	> 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%

TABLE 2

Indoor Air Test Results –Garfield Magnet Elementary School, Revere, MA – February 9, 2000

Remarks	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
Room 212	1714	76	12	22	yes	yes	yes	5 CT, univent deactivated, boxes in front of exhaust-moved by maintenance staff, cleaning products and unlabeled products under sink
Room 213	1300	77	8	18	yes	yes	yes	1 CT, missing ceiling tile, univent deactivated, cleaning products under sink, door open, exhaust vent blocked by crates & various items
Room 225	1092	72	10	22	yes	yes	yes	exhaust blocked by storage crates, cleaning products under sink
Room 224	796	72	9	20	yes	yes	yes	door open
Room 214	848	77	7	22	yes	yes	yes	cleaning products under sink
Room 215	900	78	9	23	yes	yes	yes	univent off-air diffuser covered with books & storage crates, cleaning products under sink, door open
Room 223	700	75	7	19	yes	yes	yes	cleaning products under sink, door open
Room 222	687	74	11	17	yes	yes	yes	window open, 3 broken windows-drafts, chalk dust, 1 CT
Room 221	667	73	9	20	yes	yes	yes	univent return blocked by bookcases, 5 broken windows, cleaning products

*** ppm = parts per million parts of air**
CT = water-damaged ceiling tiles

Comfort Guidelines

Carbon Dioxide -	< 600 ppm = preferred
	600 - 800 ppm = acceptable
	> 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%

TABLE 3

Indoor Air Test Results –Garfield Magnet Elementary School, Revere, MA – February 9, 2000

Remarks	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
								under sink, 1 plant
Room 220	709	77	8	7	yes	yes	yes	cup of standing water on univent, unknown material, 2 broken windows
Room 218	1300	77	12	26	yes	yes	yes	univent off/deactivated, exhaust blocked by cabinet, cleaning products under sink, 2 CT
Room 217	1000	75	10	22	yes	yes	yes	window open, exhaust blocked by cabinet, univent off, 1 CT, 1 plant, cleaning products under sink
Room 216	790	75	9	11	yes	yes	yes	items on univent diffuser-univent return blocked by storage bin & crates, spray cleaning products under sink, missing ceiling tile
Cafeteria	880	76	18	~70	yes	yes	yes	1/3 capacity @ 11:55 am, 4 univents-off, broken window
Room 111	670	75	10	21	yes	yes	yes	2 univents-1 on/1 off, cleaning products under sink, 7 broken windows
Room 112	600	72	10	23	yes	yes	yes	1 broken window, univent return blocked by chairs, door open
Room 126 Art Room	519	74	7	5	no	yes	yes	pine cleaning product on table, supply off

*** ppm = parts per million parts of air**
CT = water-damaged ceiling tiles

Comfort Guidelines

Carbon Dioxide -	< 600 ppm = preferred
	600 - 800 ppm = acceptable
	> 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%

TABLE 4

Indoor Air Test Results –Garfield Magnet Elementary School, Revere, MA – February 9, 2000

Remarks	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
Room 113B	514	76	10	6	yes	yes	yes	4 broken windows, 1 missing ceiling tile, door open
Room 124	604	77	8	17	yes	yes	yes	exhaust partially blocked, cleaning products under sink, door open
Room 115	820	78	10	~50	yes	yes	yes	univent off-return blocked by cabinet, exhaust blocked by display, classroom triple-occupied, 5 broken windows
Room 116	840	76	8	17	yes	yes	yes	1 broken window
Room 122	945	77	11	21	yes	yes	yes	exhaust blocked, 1 CT, 2 missing ceiling tiles
Room 117	790	75	10	10	yes	yes	yes	cleaning products on counter, toys on univent air diffuser
Room 119	700	76	12	6	yes	yes	yes	1 broken window, 2 CT, plant/items on & around univent, 2 missing ceiling tiles, humidifier
Room 120	620	74	9	3	yes	yes	yes	
Room 121	630	76	9	9	yes	yes	yes	chairs and toys on univent, cleaning products under sink
Health Suite	502	73	8	3	yes	yes	yes	pipe burst-repaired, 5 CT,

*** ppm = parts per million parts of air**
CT = water-damaged ceiling tiles

Comfort Guidelines

Carbon Dioxide -	< 600 ppm = preferred
	600 - 800 ppm = acceptable
	> 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%

TABLE 5

Indoor Air Test Results –Garfield Magnet Elementary School, Revere, MA – February 9, 2000

Remarks	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
Pool Area	630	80	60	12	yes	yes	yes	
Gym	570	75	10	~62	yes	yes	yes	
Room 141 Music Room	580	73	12	23	yes	yes	yes	exhaust off, chalk dust
Auditorium						yes	yes	8+ CT, 8 missing ceiling tiles
Bi-Lingual Office	556	76	9	3	yes	yes	yes	3 CT, photocopier-not near exhaust
Room 323	868	76	10	22	yes	yes	yes	1 missing ceiling tile, rusty hanger
Room 322	1199	73	15	25	yes	yes	yes	3 missing ceiling tiles
Room 321	891	73	14	25	yes	yes	yes	univent blocked by desk
Room 320	787	72	11	3	yes	yes	yes	univent blocked by desk, 2 ceiling tiles ajar
Room 319	651	71	9	0	yes	yes	yes	2 CT
Room 318	1481	73	16	25	yes	yes	yes	univent off-blocked by shelf, exhaust blocked by cart

*** ppm = parts per million parts of air**
CT = water-damaged ceiling tiles

Comfort Guidelines

Carbon Dioxide -	< 600 ppm = preferred
	600 - 800 ppm = acceptable
	> 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%

TABLE 6

Indoor Air Test Results –Garfield Magnet Elementary School, Revere, MA – February 9, 2000

Remarks	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
Room 317	1347	76	12	27	yes	yes	yes	
Room 316	1182	75	11	21	yes	yes	yes	
Room 315	925	74	10	24	yes	yes	yes	
Room 314	923	75	9	20	yes	yes	yes	window open, univent off, exhaust blocked by cart
Room 313	760	74	10	0	yes	yes	yes	univent off
Room 312	1214	74	10	11	yes	yes	yes	univent off
Room 335	816	75	9	30	yes	yes	no	univent off, passive exhaust vent-prep room
Room 334	776	78	8	22	yes	yes	yes	exhaust off, 2 CT
Room 333	1136	77	9	32	yes	yes	yes	univent off, 1 missing ceiling tile
Room 332	779	71	12	21	yes	yes	yes	
Room 331	681	72	9	1	yes	yes	yes	univent off, 3 ceiling tiles ajar

*** ppm = parts per million parts of air**
CT = water-damaged ceiling tiles

Comfort Guidelines

Carbon Dioxide - < 600 ppm = preferred
600 - 800 ppm = acceptable
> 800 ppm = indicative of ventilation problems
Temperature - 70 - 78 °F
Relative Humidity - 40 - 60%

TABLE 7

Indoor Air Test Results –Garfield Magnet Elementary School, Revere, MA – February 9, 2000

Remarks	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
Room 328	768	74	10	1	yes	yes	yes	door open
Room 327	688	74	8	6	yes	yes	yes	
Room 311	1529	76	20	150+	yes	yes (4)	yes	exhaust off, 2 out of 4 univents off
Room 326A	661	71	12	3	yes	yes	yes	mimeograph
Room 325	540	70	9	1	yes	yes	yes	29 computers, ozone odor
Room 324	519	71	10	1	yes	yes	yes	
Room 434	1581	71	13	29	yes	yes	yes	univent and exhaust off, chalk dust, door open
Room 435	1188	70	15	11	yes	yes	yes	univent and exhaust off, chalk dust
Room 436	1424	76	13	23	yes	yes	yes	univent off, door open
Room 437	1932	72	16	23	yes	yes	yes	
Room 438	1551	73	14	20	yes	yes	yes	univent off-blocked by books

*** ppm = parts per million parts of air**
CT = water-damaged ceiling tiles

Comfort Guidelines

Carbon Dioxide -	< 600 ppm = preferred
	600 - 800 ppm = acceptable
	> 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%

TABLE 8

Indoor Air Test Results –Garfield Magnet Elementary School, Revere, MA – February 9, 2000

Remarks	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
Room 439	1378	73	16	18	yes	yes	yes	univent off, chalk dust, door open
Room 339	667	73	11	2	yes	yes	yes	univent off, chalk dust, 3 ceiling tiles ajar
Room 338	881	73	11	21	yes	yes	yes	univent blocked by cart, 6 ceiling tiles ajar
Room 337	1081	73	11	22	yes	yes	yes	univent blocked by cart, 5 CT
Room 336	1660	74	16	11	yes	yes	yes	exhaust off
Room 421	1428	72	13	34	yes	yes	yes	chalk dust
Room 422	1237	71	13	24	yes	yes	yes	univent off-plants on univent
Room 423	1078	71	10	10	yes	yes	yes	univent off
Room 424	904	81	4	11	yes	yes	yes	
Room 425	1097	72	11	33	yes	yes	yes	univent off, window seal-failure
Room 426A	772	72	9	4	yes	yes	yes	

*** ppm = parts per million parts of air**
CT = water-damaged ceiling tiles

Comfort Guidelines

Carbon Dioxide - < 600 ppm = preferred
600 - 800 ppm = acceptable
> 800 ppm = indicative of ventilation problems
Temperature - 70 - 78 °F
Relative Humidity - 40 - 60%

TABLE 9

Indoor Air Test Results –Garfield Magnet Elementary School, Revere, MA – February 9, 2000

Remarks	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
Room 472	788	72	9	13	yes	yes	yes	water damaged window/window seal
Room 430 Nurse's Office	749	73	9	4	yes	yes	yes	door open
Room 431	731	73	8	4	yes	yes	yes	door open
Room 432	806	72	8	17	yes	yes (2)	yes	1 out of 2 univents blocked by computer desk, 17 computers, 10 plants
Room 433	937	71	9	10	yes	yes	yes	univent and exhaust off, missing ceiling tile, door open
Room 412 Upper Library	648	70	8	7	no	yes	yes	ceiling plenum exhaust
Room 412 Lower Library	611	70	7	23	no	yes	yes	17 computers
Room 413	1119	71	12	25	yes	yes	yes	
Room 414	1215	73	12	12	yes	yes	yes	window and door open, univent off, accumulated dust in exhaust vent, chalk dust
Room 415	1050	73	12	22	yes	yes	yes	window and door open, univent off, dust in exhaust vent, chalk dust

*** ppm = parts per million parts of air**
CT = water-damaged ceiling tiles

Comfort Guidelines

Carbon Dioxide -	< 600 ppm = preferred
	600 - 800 ppm = acceptable
	> 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%

TABLE 10

Indoor Air Test Results –Garfield Magnet Elementary School, Revere, MA – February 9, 2000

Remarks	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
Room 416	916	73	8	0	yes	yes	yes	univent off, dust in exhaust vent, chalk dust
Room 447	1238	75	12	17	yes	yes	yes	chalk dust
Room 418	1160	75	12	10	yes	yes	yes	univent off-covered with glass with plants, chalk dust
Room 419	1167	72	10	10	yes	yes	yes	univent off, chalk dust
Room 420		72	9	10	yes	yes	yes	
Conference Room	693	66	13	7	yes	yes	yes	broken window-drafts, dry erase board
Dumpster Room							yes	door open, trash odors in hallway
Parking Garage							yes	exhaust on roof, spaces around door, hole in door
Elevator Lobby								dumpster odors
Room 236 Mechanical Room								water-damaged cardboard boxes and ceiling tiles - musty odors

*** ppm = parts per million parts of air**
CT = water-damaged ceiling tiles

Comfort Guidelines

Carbon Dioxide - < 600 ppm = preferred
600 - 800 ppm = acceptable
> 800 ppm = indicative of ventilation problems
Temperature - 70 - 78 °F
Relative Humidity - 40 - 60%