INDOOR AIR QUALITY REASSESSMENT

James Leo McGuinness Administration Building
Lynn Public Schools
14 Central Street
Lynn, Massachusetts

Prepared by:
Massachusetts Department of Public Health
Bureau of Environmental Health Assessment
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Background/Introduction

In response to a request from Lynn Public School (LPS) personnel, a limited reassessment of indoor air quality in targeted areas was done at the James Leo McGuinness Administration Building (JLMAB), 14 Central Avenue, Lynn, Massachusetts. This reassessment was conducted by the Massachusetts Department of Public Health (MDPH), Bureau of Environmental Health Assessment (BEHA). BEHA staff originally visited the building in December of 2001 and issued a report. The building was most recently visited by Michael Feeney, Director of the BEHA's Emergency Response/Indoor Air Quality (ER/IAQ) Program on March 5, 2002 and May 24, 2002 to conduct an evaluation of the remedial actions instituted by Reit Management. Mr. Feeney examined several areas of the building reported as problem areas, and conducted air sampling in various areas within the building. LPS employees reported that several individuals experienced symptoms that they believe to be attributed to the building. Specifically, they identified offices near the elevator foyer on the fourth floor and the meeting area on the third floor as potential areas of concern.

The JLMAB is a six-story office building located in downtown Lynn. The JLMAB has a wedge-shaped footprint that is bounded by Central Avenue on its north side, Washington Street to the southwest and Oxford Street to the northwest. The east wall joins the west wall of a three-story building. The building was renovated in 1987. Prior to these renovations, the building was reportedly unoccupied for a number of years. The LPS have occupied the building since 1993-1994. Private offices and work areas exist on floors 1, 3, 4, 5 and 6. Floor 2 contains the LPS alternative high school. The basement of the building contains mechanical rooms and is used for record storage. Sash windows in the building are openable. An elevator shaft is installed on the east wall of the building which transverses all floors from the 6^{th} floor to the basement.

Actions on Recommendations Previously Made by MDPH

As previously mentioned, BEHA staff had originally visited the building in December, 2001 and in January, 2002. A report was issued describing conditions observed at that time and recommendations to improve indoor air quality in various sections of the building (MDPH, 2002). A summary of actions taken on previous recommendations is included as Appendix I of this report.

Methods

Air tests for carbon monoxide, carbon dioxide, temperature, and relative humidity were taken with the TSI, Q-Trak ™, IAQ Monitor Model 8551. On March 5, 2002 screening for total volatile organic compounds (TVOCs) was conducted using an HNU Systems, Photo Ionization Detector (PID). Outdoor background TVOC measurements were taken for comparison to indoor levels.

Results

These offices have an employee population of approximately 70. Tests were taken under normal operating conditions and results appear in Tables 1-5. Air samples are listed by office occupant name or by office function (e.g. school committee room).

Discussion

Ventilation

It can be seen from the tables that carbon dioxide levels were below 800 ppm in all areas sampled in the building on March 5, 2002 and May 24, 2002 (see Tables). Please note that areas sampled on May 24, 2002 had few occupants, which would significantly reduce carbon dioxide levels.

Areas in the building are provided with fresh air by a rooftop AHU connected by ductwork to ceiling-mounted fresh air supply diffusers. By design, air diffusers are equipped with fixed louvers, which direct the air supply along the ceiling to flow down the walls, creating airflow.

Air is returned back to the rooftop AHU by a ceiling plenum system. Exhaust ventilation is provided by infiltration of air into an above ceiling open return plenum, which returns air to the AHU. This system has no ductwork, but uses the entire above ceiling space to draw air back to the AHU.

Of note was the condition of the return vent in the east office of the south corner of the first floor. Carbon dioxide levels in this room were approximately 100 ppm higher than adjacent rooms (see Tables). Each office has a hole cut into the gypsum wallboard (GW) above the doorway, which serves as the means for air to return from the office to the ceiling plenum via a plastic ceiling grate (see Picture 1). Almost half of the "return hole" for the east office is blocked by a flexible duct used as supply vent for the west office in the south corner of the building (see Pictures 2 and 2A). This blockage can serve to reduce air supply and pollutant removal from the east office on the first floor.

In order to have proper ventilation with a mechanical supply and exhaust system, the systems must be balanced to provide an adequate amount of fresh air to the interior of a room while removing stale air. The ventilation system had reportedly not been balanced at the time of the May 24, 2002 assessment.

The Massachusetts Building Code requires a minimum ventilation rate of 20 cubic feet per minute (cfm) per occupant of fresh outside air or have openable windows in each room (SBBRS, 1997; BOCA, 1993). 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. For more information concerning carbon dioxide, please see Appendix II.

Temperature readings recorded during the assessment ranged from 70 ^{o} F to 74 ^{o} F on March 5, 2000, which were within the BEHA's recommended comfort range. On May 24, 2002, temperature measurements ranged from 65 ^{o} F to 72 ^{o} F, some of which were below the BEHA's recommended comfort range (see Tables). 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. The HVAC system air-conditioning system was operational on May 24, 2002. An increase in the number of building occupants would be expected to raise temperatures, since people release heat as part of the metabolic process. 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.

Relative humidity measurements ranged from 14 to 17 percent on March 5, 2002, which were below the BEHA comfort guidelines in all areas surveyed. On May 24, 2002, relative humidity measurements ranged 37 to 51 percent, which were within or close to the BEHA comfort guidelines. The BEHA recommends that indoor air relative humidity is comfortable in a range of 40 to 60 percent. The sensation of dryness and irritation is common in a low relative humidity environment. Humidity is more difficult to control during the winter heating season. Low relative humidity is a very common problem during the heating season in the northeast part of the United States.

Microbial/Moisture Concerns

The east office in the south corner of the first floor of the building contains fire standpipes that traverse the exterior wall (see Picture 3). The standpipes are housed within a cabinet constructed of GW (see Picture 4). The seam between the stand pipe fixture and stone slab of the exterior wall does not have any sealing compound to prevent water penetration behind the plate. This condition may allow moisture to migrate to the interior of the cabinet along the pipes. The condition of the cabinet along the exterior wall/pipe junction could not be examined due to the configuration of the cabinet. Since materials that can support microbial growth (e.g., GW) exist in this cabinet, it is suggested that the interior of the cabinet be opened for examination.

One of the primary concerns which prompted BEHA involvement was related to mold concerns. During the course of the assessment on March 5, 2002, LPS personnel reported that materials that were previously housed in the basement were moved to a fourth floor office for examination. Since materials previously stored in the basement could carry residue of mold growth, it is not recommended that any more materials be removed from the basement to occupied areas in upper floors to prevent cross contamination. Please refer to Recommendations section of this report for advice concerning handling of possible mold-contaminated materials.

The placement of a dehumidifier in the basement was recommended in a previous report by the Department of Labor and Workforce Development (MDLWD), Division of Occupational Safety concerning this building (MDLWD, 2001). Reit Management has taken steps to examine the feasibility of installing a dehumidification system in the basement. If this is done, steps should be taken to decrease/minimize the draw of outdoor air through unintended areas. As an example, the emergency generator exhaust vent does not have a louver system to limit outdoor air backdraft when deactivated. If a dehumidification system is installed, moisture from outdoors can be drawn into the emergency generator room from outdoors, particularly during hot, humid weather. The elimination/minimization of outdoor air penetration should be employed to prevent moistening of GW and other porous materials.

Other Concerns

Several other conditions that can potentially affect indoor air quality were also identified. An examination of conditions on the fourth floor in offices on the east wall of the building and elevator foyer was conducted on March 5, 2002. As noted previously, materials were moved from the basement and stored inside an office, along with a large amount of cardboard boxes. A number of chemicals are used to make cardboard, including glues, mastics and inks. These materials can off-gas from boxes and be irritating to the eyes, nose and throat. Plastic cases reportedly removed from the basement for inspection were also stored in this room. As part of this reassessment, air monitoring for TVOCs to identify possible eye, nose and respiratory irritant sources was conducted. When the probe of the PID was placed inside an opened plastic case (see Picture 5), levels measured compared to outdoor (ambient) levels were higher in each box sampled (see Table 5). The source of TVOCs is solvents used in inks off gassing from printed materials stored in these containers. When each container is opened, TVOCs are released. While these TVOC levels do not exceed levels of health concerns, some sensitive individuals may experience irritant symptoms when exposed.

Located in and around the work area adjacent to the 4th floor elevator foyer are a number of photocopying machines (see Picture 6). No local exhaust ventilation for the photocopiers exists. A single plastic grill in the ceiling serves as the return vent for this area. Of note is that at least one printer (Risograph®) uses a liquid toner. This product contains petroleum distillate, which is a VOC (see Pictures 7 and 8). TVOC measurements taken from paper printed from this machine produced measurable levels in a range of 0.8 ppm to 1.3 ppm, but again, these results did not exceed levels of health concerns. Photocopiers can also produce VOCs and ozone, particularly if the equipment is older and in frequent use. VOCs and ozone are respiratory irritants (Schmidt Etkin, D., 1992). It is recommended that local separate exhaust systems that do not recirculate into the general ventilation system be used (US DOE, unknown).

Conclusions/Recommendations

In view of the findings at the time of this interim reassessment, the following conclusions and recommendations are made:

1. To prevent uncontrolled water vapor penetration into the building, it is not recommended that windows be opened during hot, humid weather.
2. Expand the size of the hole in GW for the east office in the south corner of the first floor.
3. Open the interior of the fire standpipe cabinet in the east office in the south corner of the first floor and examine for water damage. If water damaged materials exist, replace. Consider installing a cabinet sized, removable grate in the side of the cabinet to allow for inspections and access to pipes.
4. Apply an appropriate sealing compound to the fire standpipe plate/exterior wall junction to prevent water penetration.
5. Do not relocate materials stored in the basement into occupied areas. In areas where this occurred, use a high efficiency particulate arrestance (HEPA) filtered vacuum cleaner to remove residues that may have contaminated surfaces.

6. For material sealed in non-porous containers (plastic cases), wipe the outside of these boxes with a soap and water solution prior to transport from the basement.
7. Open plastic containers in an area that is well ventilated.
8. Do not store large amounts of cardboard boxes in occupied offices.
9. Examine the feasibility of creating a photocopying room with dedicated local exhaust ventilation to remove particles, waste heat, ozone and TVOCs. Do not use the Risograph® unless it can be used in a well-ventilated area. Store Risograph® -printed materials in an area that has adequate ventilation to remove/dilute evaporating TVOCs.
10. If a photocopier room is not feasible, consider dispersing or reducing the number of photocopiers around the 4th floor elevator foyer.
11. Examine the feasibility of increasing fresh air provision to the 4th floor elevator foyer.

References

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MDLWD. 2001. Indoor Air Quality (IAQ) Survey 02S-0158, Lynn Public Schools Administrative Office, 14 Central Avenue, Lynn, MA, December 10, 2001. Department of Labor and Workforce Development, Division of Occupational Safety, West Newton, MA.

MDPH. 2002. Indoor Air Quality Assessment the James Leo McGuinness Administration Building, 14 Central Avenue, Lynn, Massachusetts. Massachusetts Department of Public Health, Bureau of Environmental Health Assessment, Boston, MA. February, 2002.

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.

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

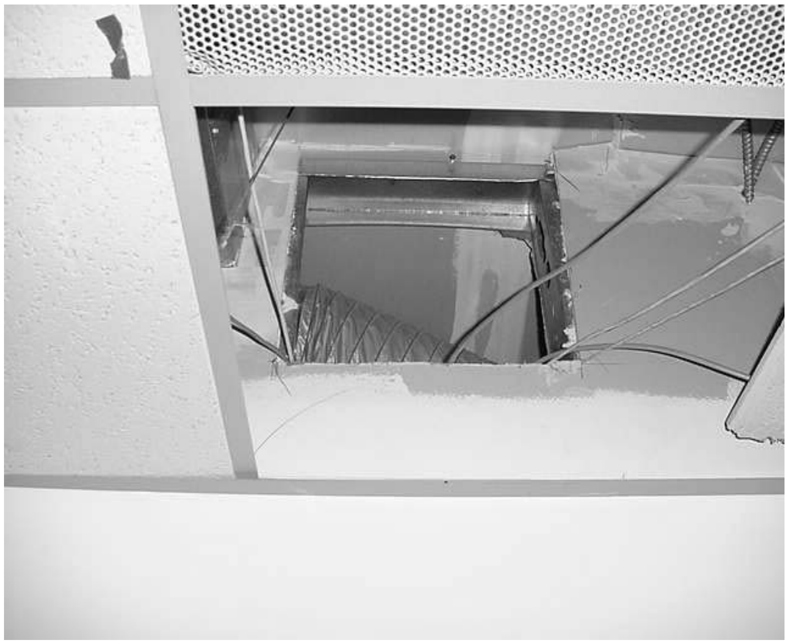
Schmidt Etkin, D. 1992. Office Furnishings/Equipment & IAQ Health Impacts, Prevention & Mitigation. Cutter Information Corporation, Indoor Air Quality Update, Arlington, MA.

US DOE. Unknown. School Design Guidelines for Hot, Dry Climates. US. Department of Energy, High Performance School Initiative, Washington, DC.

Picture 1

Typical Return Hole for 1st Floor Office

Picture 2



Return Hole For The East Office - 50 Percent Blocked By A Flexible Duct

Picture 2A

Return Hole For The East Office - 50 Percent Blocked By A Flexible Duct
(view at same level as return hole)

Picture 3

Fire House Standpipe on Exterior Wall

Picture 4

Cabinet Concealing Fire House Standpipe

Picture 5

Plastic Container with Stored Materials

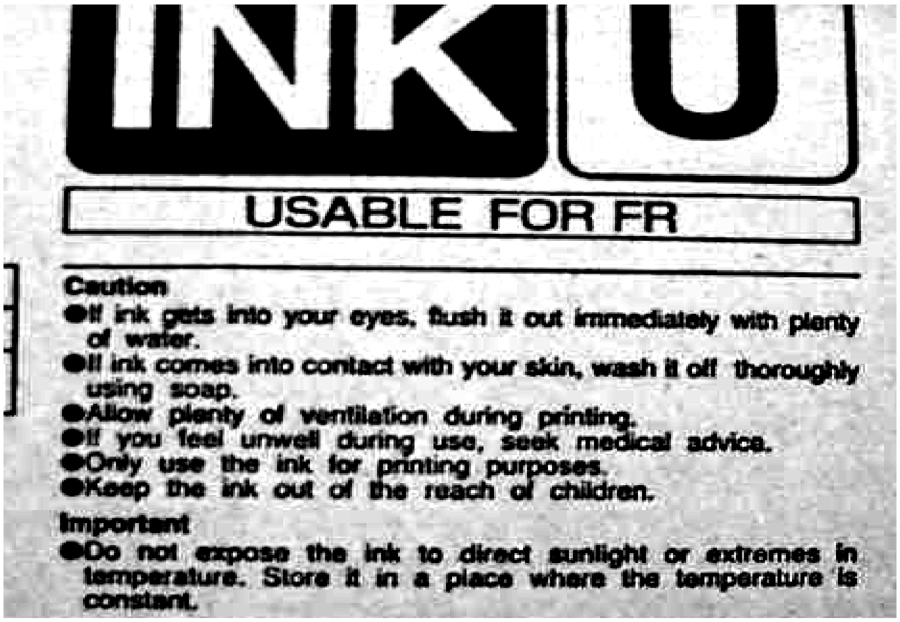
Picture 6

Cluster Of Photocopiers In The 4th Floor Elevator Foyer Area

Picture 7

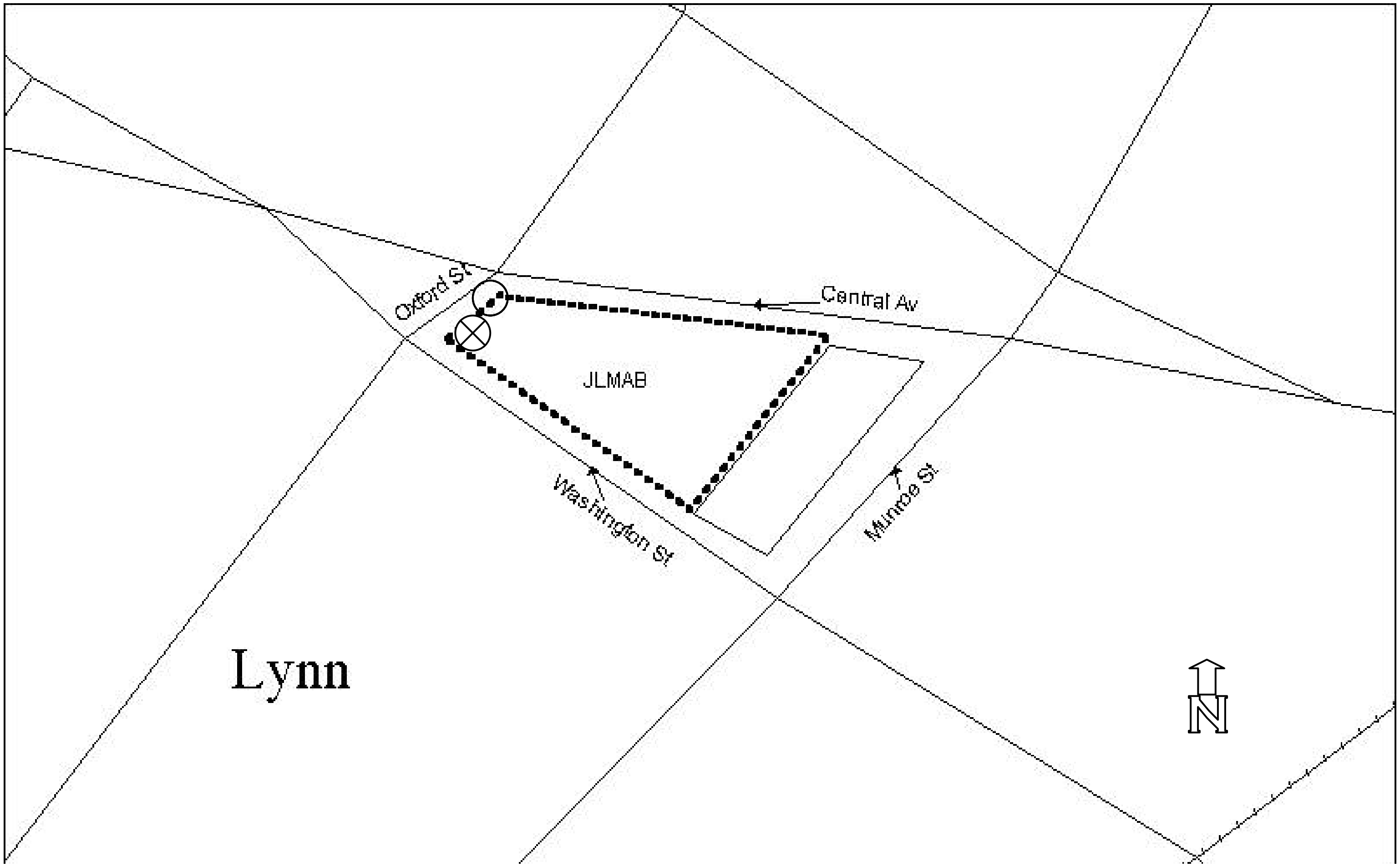
Container of Risograph® Toner

Picture 8



Instructions on Risograph® Toner, Note Third Instruction from Top of List

Map 1



Footprint of the JLMAB in downtown Lynn

⊗Marks the east office evaluated on first floor
○Marks the east office evaluated on first floor

(Map not to scale)

TABLE 1

Indoor Air Test Results – Lynn Schools Administration Building, Lynn, MA – March 5, 2002

Location	Carbon Dioxide *ppm	Carbon Monoxide *ppm	TVOCs *ppm	Temp °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
								Intake	Exhaust	
Outside (Background)	443	ND		42	34					
6th Floor Conference Room	578	ND	0.5	74	14	0	yes			
6th Floor Elevator	564	ND	0.5	73	14	1	no			
5th Floor Elevator Foyer	627	ND	0.8	73	16	0	no			
5th Floor SE Conference Room	559	ND	0.6	74	15	0	yes			
4th Floor Elevator Foyer	585	ND	0.7	73	14	0	no			
4th Floor SE Corner Office	713	ND	0.7	70	17	3	yes			

*** ppm = parts per million parts of air**
ND = Nondetectable measurement

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 – Lynn Schools Administration Building, Lynn, MA – May 24, 2002

Location	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
Outside (Background)	423	83	35					
3rd Floor - Meeting Room	487	68	42	0		yes	yes	
3rd Floor – Center	454	69	40	1		yes	yes	
3rd Floor - East	459	70	40	1	yes	yes	yes	window open
4th Floor – N Elevator	519	71	39	1		yes	yes	
4th Floor – Center Office	488	70	38	4		yes	yes	
4th Floor – E Office	471	71	38	2		yes	yes	photocopier
5th Floor – N	490	71	38	1		yes	yes	
5th Floor – Center	469	69	37	2		yes	yes	
5th Floor – East	447	68	38	0		yes	yes	
6th Floor – Front Desk	543	69	39	0		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 3

Indoor Air Test Results – Lynn Schools Administration Building, Lynn, MA – May 24, 2002

Location	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
6th Floor – School Committee Room	458	68	38	0		yes	yes	
6th Floor – Chapman	588	68	42	0		yes	yes	
6th Floor – Johns	468	72	40	0	yes	yes	yes	window open
6th Floor – Center Office Reception	455	71	38	0		yes	yes	
4th Floor – East Office	476	71	38	0		yes	yes	cardboard
Basement – Under Corner Office	509	67	37	0			yes	
Basement – Center	507	67	38	0			yes	
Basement – North	534	67	39	0			yes	
1st Floor – East Corner	554	65	43			yes	yes	exhaust ½ blocked by flexi-duct
1st Floor – North Corner	485	63	43			yes	yes	
1st Floor – East	457	60	51					

*** 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 – Lynn Schools Administration Building, Lynn, MA – May 24, 2002

Location	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
2nd Floor – 102	448	68	48	0		yes	yes	exhaust-off at thermostat
2nd Floor – Center	425	67	45	0		yes	yes	
2nd Floor – Science	460	68	44					

*** 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%