INDOOR AIR QUALITY REASSESSMENT

Massasoit Community College
Student Center/Library
One Massasoit Boulevard
Brockton, Massachusetts 02302

Prepared by:
Massachusetts Department of Public Health
Bureau of Environmental Health
Indoor Air Quality Program
October 2008

Background/Introduction

At the request of Betty Ann Learned, Chief Financial Officer for Massasoit Community College (MCC), the Massachusetts Department of Public Health's (MDPH), Bureau of Environmental Health (BEH) provided assistance and consultation regarding indoor air quality concerns at the Student Center (SC) on the MCC Brockton Campus. On July 18, 2008, a visit to conduct an indoor air quality reassessment at the SC was made by Cory Holmes, an Environmental Analyst/Regional Inspector within BEH's Indoor Air Quality (IAQ) Program.

BEH staff had previously visited the SC in November of 2007. A report detailing conditions observed at the time of the visit with recommendations for improving indoor air quality was issued (MDPH, 2008). The previous BEH assessment occurred during the heating season. As part of an on-going investigation, BEH staff returned to the SC to observe the building under cooling/air-conditioning conditions and document progress made towards implementing previous MDPH recommendations to improve IAQ.

At the time of the reassessment, MCC was working with the Massachusetts Division of Capital Asset Management (DCAM) on a feasibility study to replace many of the original mechanical ventilation components on campus, including units that service the SC. In addition, MCC was awaiting bids from a contractor to replace all water-damaged ceiling tiles in the SC.

Actions on Previous MDPH Recommendations

As mentioned, MDPH staff had previously visited the building and issued a report with recommendations to improve indoor air quality (MDPH, 2008). A summary of actions taken on previous recommendations is included as Appendix A.

Methods

Air tests for carbon dioxide, carbon monoxide, temperature and relative humidity were conducted with the TSI, Q-TRAK™ IAQ Monitor, Model 8551. BEH staff performed a visual inspection of building materials for water damage and/or microbial growth. Moisture content of porous building materials was measured with a Delmhorst, BD-2000 Model, Moisture Detector equipped with a Delmhorst Standard Probe.

Results

The SC houses approximately 20 staff members and is visited by hundreds of students daily. Tests were taken during normal operations and results appear in Table 1.

Discussion

Ventilation

It can be seen from Table 1 that carbon dioxide levels were below 800 parts per million (ppm) in all areas, indicating adequate air exchange at the time of the assessment. However, it is important to note that a number of areas with carbon dioxide levels below 800 ppm were sparsely populated or unoccupied during the assessment. These conditions can greatly reduce carbon dioxide levels. Carbon dioxide levels would be expected to be higher with increased occupancy.

The mechanical ventilation systems are discussed in detail in the previous MDPH report (MDPH, 2008). The systems were operating during the assessment; however, shortly prior to the arrival of BEH staff, MCC maintenance personnel noticed that one of the rooftop air

handling units (AHUs) was deactivated. Therefore the unit had only been running for a short time, which may account for some of the slightly elevated relative humidity levels (Table 1).

To maximize air exchange, the MDPH recommends that both supply and exhaust ventilation operate continuously during periods of occupancy. 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 from the room. It is recommended that existing ventilation systems be re-balanced every five years to ensure adequate air systems function (SMACNA, 1994).

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 (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 MDPH 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 B.

Temperature measurements in the building ranged from 68^{o} F to 75^{o} F, which were within the MDPH recommended comfort guidelines in the majority of areas surveyed. The MDPH 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. 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. Occupants reported difficulty with temperature control, primarily during the cooling season, most likely due to the age and efficiency of the air conditioning system.

The relative humidity ranged from 48 to 70 percent, which in many areas was above the MDPH recommended comfort range at the time of the assessment. The MDPH recommends a comfort range of 40 to 60 percent for indoor air relative humidity. While temperature is mainly a comfort issue, relative humidity in excess of 70 percent for extended periods of time can provide an environment for mold and fungal growth (ASHRAE, 1989). As discussed in the previous assessment, due to the age of some of the original components of the central AC system, they do not appear to be operating at an optimal capacity to maintain comfort (e.g., temperature and relative humidity levels). During the heating season, relative humidity levels would be expected to drop below the recommended comfort range. The sensation of dryness and irritation is common in a low relative humidity environment. Low relative humidity is a very common problem during the heating season in the northeast part of the United States.

Conclusions/Recommendations

MCC officials, working in conjunction with faculty members and maintenance staff, have improved indoor environmental conditions in the building by implementing the majority of BEH's previous recommendations. In view of the findings at the time of the reassessment, the following recommendations are made to further improve indoor air quality:

- **Continue to implement all applicable recommendations listed in the previous MDPH report (MDPH, 2008).**
- **Continue working with DCAM with plans for replacement of original mechanical ventilation components in the SC and other areas campus-wide.**
- **Continue with plans for replacement of water damaged ceiling tiles.**
- **Monitor areas of previous roof leaks and encourage staff to report to the maintenance department for prompt remediation.**
- **Consider adopting a balancing schedule of every 5 years for all mechanical ventilation systems, as recommended by ventilation industrial standards (SMACNA, 1994).**
- **Clean carpeting annually (or semi-annually in soiled high traffic areas) as per recommendations of the Institute of Inspection, Cleaning and Restoration Certification (IICRC). Copies of the IICRC fact sheet can be downloaded at: http://www.cleancareseminars.com/carpet_cleaning_faq4.htm (IICRC, 2005)**
- **Ensure dehumidifiers are cleaned/maintained as per the manufacturer's instructions to prevent mold/bacterial growth.**

- **Refer to resource manual and other related indoor air quality documents located on the MDPH's website for further building-wide evaluations and advice on maintaining public buildings. These documents are available at: http://mass.gov/dph/indoor_air.**

References

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

ASHRAE. 1989. Ventilation for Acceptable Indoor Air Quality. American Society of Heating, Refrigeration and Air Conditioning Engineers. ANSI/ASHRAE 62-1989

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

IICRC. 2005. Carpet Cleaning FAQ 4 Institute of Inspection, Cleaning and Restoration Certification. Institute of Inspection Cleaning and Restoration, Vancouver, WA.

MDPH. 2008. Indoor Air Quality Assessment Massasoit Community College, Student Center, Brockton, MA. Massachusetts Department of Public Health, Executive Office of Human Services, Boston, MA. November 2008.

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

SMACNA. 1994. HVAC Systems Commissioning Manual. 1st ed. Sheet Metal and Air Conditioning Contractors' National Association, Inc., Chantilly, VA.

Location: Massasoit Community College, Student Center **Indoor Air Results**

Address: Brockton, MA

Table 1

Date: 7/18/2008

Location/ Room	Occupants in Room	Temp (°F)	Relative Humidity (%)	Carbon Dioxide (ppm)	Windows Openable	Ventilation		Remarks
						Supply	Exhaust	
background		90	70	339				Hazy, hot and humid Winds: WSW 10-15 mpg (gusts up to 20)
Advise & Council	3	75	48	373		Y	Y	
126	0	73	51	372		Y	Y	DO, dehumidifier-off
125	0	73	53	373		Y	Y	DO, dehumidifier-unplugged
123	0	71	59	387		Y	Y	DO
Career Placement	0	72	62	412		Y	Y	
SC 120	2	72	61	440		Y	Y	Dehumidifier-full
Academic Resource Center	1	71	66	398		Y	Y	DO
SC 116	3	70	65	430		Y	Y	
Writing Center	1	69	68	392		Y	Y	
114	0	68	68	389		Y	Y	

ppm = parts per million DO = door open

MT = missing ceiling tile CT = water damaged ceiling tile

Comfort Guidelines

Carbon Dioxide:	< 600 ppm = preferred	Temperature:	70 - 78 °F
	600 - 800 ppm = acceptable	Relative Humidity:	40 - 60%
	> 800 ppm = indicative of ventilation problems	Particle matter 2.5	< 35 ug/m^3

Location: Massasoit Community College, Student Center **Indoor Air Results**

Address: Brockton, MA **Date: 7/18/2008**

Table 1 (continued)

Location/ Room	Occupants in Room	Temp (°F)	Relative Humidity (%)	Carbon Dioxide (ppm)	Windows Openable	Ventilation		Remarks
						Supply	Exhaust	
Circulation Desk	3	70	70	560		Y	Y	WD CT-scheduled for replacement
202	0	70	69	454		Y	Y	DO
Break Room	0	71	69	446		Y	Y	DO
204	1	71	68	407		Y	Y	DO
200	0	71	67	415		Y	Y	4 CTs
Stacks 14-16	1	71	67	438		Y	Y	
Stacks 5-7	1	71	67	427		Y	Y	4 CTs near column
Stacks 1-3	0	71	67	435		Y	Y	
Stacks 27-30	0	71	67	425		Y	Y	4 CTs, 2 MT from previous roof leaks
Central Computer Area	4	71	67	459		Y	Y	
Stacks 20-23	0	72	67	433		Y	Y	

ppm = parts per million DO = door open

MT = missing ceiling tile CT = water damaged ceiling tile

Comfort Guidelines

Carbon Dioxide:	< 600 ppm = preferred	Temperature:	70 - 78 °F
	600 - 800 ppm = acceptable	Relative Humidity:	40 - 60%
	> 800 ppm = indicative of ventilation problems	Particle matter 2.5	< 35 ug/m^3

Table 1 (continued)

Location/ Room	Occupants in Room	Temp (°F)	Relative Humidity (%)	Carbon Dioxide (ppm)	Windows Openable	Ventilation		Remarks
						Supply	Exhaust	
Stacks 17-19	0	71	66	424		Y	Y	
Reference	0	71	67	460		Y	Y	
Corner Office	0	71	66	430				DO, 1 CT

ppm = parts per million DO = door open

MT = missing ceiling tile CT = water damaged ceiling tile

Comfort Guidelines

Carbon Dioxide:	< 600 ppm = preferred	Temperature:	70 - 78 °F
	600 - 800 ppm = acceptable	Relative Humidity:	40 - 60%
	> 800 ppm = indicative of ventilation problems	Particle matter 2.5	< 35 ug/m^3

Appendix A

Actions on Previous MDPH Recommendations

The following is a status report of action(s) taken on MDPH recommendations (**in bold**) based on reports from MCC officials, faculty, maintenance personnel and BEH staff observations.

- **Remove and examine the veneer wood around the library pillars. If the interior section is mold colonized, replace the veneer wood. If feasible, remove the delamination from the surface of all library pillars by an appropriate measure (e.g., sanding). Conduct all restoration activities in a manner to reduce/eliminate possible exposure to building occupants if work is conducted during business hours.**

  Action: Delaminating library pillars were sanded down and refinished.

- **Contact an HVAC engineering firm for a ventilation systems assessment, particulary the efficiency of AC components during the cooling season. Based on the age, physical deterioration and availability of parts for ventilation components, such an evaluation is necessary to determine the operability and feasibility of repairing/replacing the equipment.**

  Action: At the time of the reassessment, MCC was working with DCAM to conduct a full evaluation of mechanical ventilation components, the SC included for replacement.

- **Contact an HVAC engineering firm to determine the best practices to provide mechanical ventilation, air conditioning and/or dehumidification.**

  Action: See above.

- **Utilize AC system and/or dehumidifiers to reduce relative humidity during periods of excessive relative humidity (e.g., over 70% for extended periods of time).**

  Action: Dehumidifiers were observed in operation in several areas in the SC.

Appendix A

- **Consider replacing carpet in below grade levels with a non-porous floor covering (e.g., tiles).**

  Action: All carpeting in the lower level of the SC had been replaced with carpet squares.