INDOOR AIR QUALITY ASSESSMENT

Land Court
New Suffolk County Court High-Rise
4th and 5th Floors
3 Pemberton Square
Boston, Massachusetts

Prepared by:
Massachusetts Department of Public Health
Bureau of Environmental Health
Indoor Air Quality Program
May 2012

Background/Introduction

In response to a request from Michael Lane, Environmental Coordinator, Court Capital and Facilities Management Department, Massachusetts Administrative Office of the Trial Court (AOTC), the Massachusetts Department of Public Health (MDPH), Bureau of Environmental Health (BEH) conducted an indoor air quality assessment at the Land Court (LC). The Land Court is located on the fourth and fifth floors of the Suffolk County Court High-Rise (SCC), 3 Pemberton Square, Boston, Massachusetts. Concerns about indoor air quality and eye and respiratory irritation prompted the request.

On February 24, 2012, Michael Feeney, Director of BEH's Indoor Air Quality (ER/IAQ) Program, made a visit to this building. Mr. Feeney was accompanied by Jill Ziter, Acting Land Court Administrator, and Mr. Lane. The LC is located in an office suite along the eastern wall of the SCC. Windows in the building are openable.

Methods

Air tests for carbon dioxide, temperature and relative humidity were taken with the TSI, Q-Trak, IAQ Monitor. Air tests for airborne particle matter with a diameter less than 2.5 micrometers were taken with the TSI, DUSTTRAK™ Aerosol Monitor Model 8520. Screening for total volatile organic compounds (TVOCs) was conducted using a Thermo Environmental Instruments Inc., Model 580 Series Photo Ionization Detector (PID). MDPH staff also performed a visual inspection of building materials for water damage and/or microbial growth.

Results

The LC has an employee population of over 20. Tests were taken under normal operating conditions 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 surveyed, which generally indicates adequate fresh air supply in a building. Fresh air in rooms is supplied by a unit ventilator (univent) system. Univents draw air from outdoors through a fresh air intake located on the exterior walls of the building and return air through an air intake located at the base of each unit (Figure 1). Fresh and return air are mixed, filtered, heated and provided to rooms through an air diffuser located in the top of the unit. Window-mounted air conditioners provide cooling during hot weather. No functioning exhaust system exists in these offices. This measure was implemented in an effort to prevent negative pressurization of occupied spaces within the building and thus prevent the draw of air/odors from external sources (e.g., wall cavities, exterior) into occupied areas.

The Massachusetts Building Code requires that each room have a minimum ventilation rate of 20 cubic feet per minute (cfm) per occupant of fresh outside air or openable windows (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 A.

Temperature measurements ranged from 70 ºF to 75 ºF, which were within the MDPH recommended comfort guidelines in all areas surveyed during the assessment. MDPH recommends that indoor air temperatures be maintained in a range of 70 ºF to 78 ºF in order to provide for the comfort of building occupants.

The relative humidity in the building ranged from 18 to 22 percent, which was below the MDPH recommended comfort range in all areas surveyed on the day of the assessment. The MDPH recommends a comfort range of 40 to 60 percent for indoor air relative humidity. 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 common during the heating season in the northeast part of the United States.

Microbial/Moisture Concerns

Plants were observed in a number of rooms within the LC, including on top of univents (Table 1). Moistened plant soil and drip pans can provide a source of mold growth and pollen. Plants should be located away from the air stream of ventilation sources to prevent the aerosolization of mold, pollen or particulate matter. Plants should have drip pans to prevent wetting of porous building materials and subsequent mold colonization. Over watering of plants should be avoided and drip pans should be inspected periodically for mold growth. Plants should not be placed on carpeting.

Other IAQ Evaluations

Indoor air quality can be negatively influenced by the presence of respiratory irritants, such as products of combustion. The process of combustion produces a number of pollutants. Common combustion emissions include carbon monoxide, carbon dioxide, water vapor and smoke (fine airborne particle material). Of these materials, exposure to carbon monoxide and particulate matter with a diameter of 2.5 micrometers (μm) or less (PM2.5) can produce immediate, acute health effects upon exposure. To determine whether combustion products were present indoor, BEH staff conducted tests to measure carbon monoxide and PM2.5.

Carbon Monoxide

Carbon monoxide is a by-product of incomplete combustion of organic matter (e.g., gasoline, wood and tobacco). Exposure to carbon monoxide can produce immediate and acute health affects. Several air quality standards have been established to address carbon monoxide and prevent symptoms from exposure to these substances. The MDPH established a corrective action level concerning carbon monoxide in ice skating rinks that use fossil-fueled ice resurfacing equipment. If an operator of an indoor ice rink measures a carbon monoxide level over 30 ppm, taken 20 minutes after resurfacing within a rink, that operator must take actions to reduce carbon monoxide levels (MDPH, 1997).

The American Society of Heating Refrigeration and Air-Conditioning Engineers (ASHRAE) has adopted the National Ambient Air Quality Standards (NAAQS) as one set of criteria for assessing indoor air quality and monitoring of fresh air introduced by HVAC systems (ASHRAE, 1989). The NAAQS are standards established by the US EPA to protect the public health from six criteria pollutants, including carbon monoxide and particulate matter (US EPA, 2006). As recommended by ASHRAE, pollutant levels of fresh air introduced to a building should not exceed the NAAQS levels (ASHRAE, 1989). The NAAQS were adopted by reference in the Building Officials & Code Administrators (BOCA) National Mechanical Code of 1993 (BOCA, 1993), which is now an HVAC standard included in the Massachusetts State Building Code (SBBRS, 1997). According to the NAAQS, carbon monoxide levels in outdoor air should not exceed 9 ppm in an eight-hour average (US EPA, 2006).

Carbon monoxide should not be present in a typical, indoor environment. If it *is* present, indoor carbon monoxide levels should be less than or equal to outdoor levels. On the day of the

assessment, outdoor carbon monoxide concentrations were non-detect (ND). No levels of carbon monoxide were detected inside the building during the assessment (Table 1).

Particulate Matter (PM2.5)

The US EPA has established NAAQS limits for exposure to particulate matter. Particulate matter is airborne solids that can be irritating to the eyes, nose and throat. The NAAQS originally established exposure limits to particulate matter with a diameter of 10 μm or less (PM10). According to the NAAQS, PM10 levels should not exceed 150 micrograms per cubic meter ($\mu g/m^3$) in a 24-hour average (US EPA, 2006). These standards were adopted by both ASHRAE and BOCA. Since the issuance of the ASHRAE standard and BOCA Code, US EPA established a more protective standard for fine airborne particles. This more stringent PM2.5 standard requires outdoor air particle levels be maintained below 35 $\mu g/m^3$ over a 24-hour average (US EPA, 2006). Although both the ASHRAE standard and BOCA Code adopted the PM10 standard for evaluating air quality, MDPH uses the more protective PM2.5 standard for evaluating airborne particulate matter concentrations in the indoor environment.

Outdoor PM2.5 concentrations were measured at 15 $\mu g/m^3$ (Table 1). Indoor PM2.5 levels ranged from 8 to 14 $\mu g/m^3$ (Table 1), which were below the NAAQS PM2.5 level of 35 $\mu g/m^3$. Frequently, indoor air levels of particulates (including PM2.5) can be at higher levels than those measured outdoors. Sources of indoor airborne particulates may include but are not limited to particles generated during the operation of fan belts in the HVAC system, use of stoves or microwave ovens; use of photocopiers, fax machines and computer printing devices; operation of an ordinary vacuum cleaner and heavy foot traffic indoors.

Volatile Organic Compounds

Indoor air can be greatly impacted by the use of products containing volatile organic compounds (VOCs). VOCs are carbon-containing substances that have the ability to evaporate at room temperature. Frequently, exposure to low levels of total VOCs (TVOCs) may produce eye, nose, throat and/or respiratory irritation in some sensitive individuals. For example, chemicals evaporating from a paint can stored at room temperature would most likely contain VOCs. In an effort to identify whether chemical respiratory irritants existed within the LC offices, sampling for TVOCs was conducted.

Air sampling for TVOCs was conducted in all accessible rooms in the LC as well as in the seventh floor hallway and elevator lobby (Table 1). An outdoor air sample was taken for comparison. Outdoor TVOC concentrations were ND (Table 1). Indoor TVOC concentrations were also ND in all areas surveyed (Table 1).

Several areas contain photocopiers and laminators (Table 1). As mentioned, the area is not equipped with local mechanical exhaust ventilation, which aid removal of particulates and odors from this equipment. 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, 1992).

Conclusions/Recommendations

The symptoms reported by occupants within the LC appear most likely to be related to low relative humidity. As previously discussed, low relative humidity is typical of fall/winter months in New England and particularly in a building with steam heat radiators during an extended period of extremely dry weather. In view of the findings at the time of the assessment, the following recommendations are made:

1. Move office desks and chairs a minimum of 5 feet away from univents. Open windows as needed to provide fresh air, except during hot and humid weather when air conditioning is operating.
2. 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 high efficiency particulate arrestance (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).
3. Remove plants from direct contact with carpeting and from the air stream of univents. Ensure all plants are equipped with drip pans. Examine drip pans for mold growth and disinfect areas of water leaks with an appropriate antimicrobial where necessary.
4. Refer to resource manuals and other related indoor air quality documents for further building-wide evaluations and advice on maintaining public buildings. Copies of these materials are located on the MDPH's website: http://mass.gov/dph/iaq.

References

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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.

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US EPA. 2006. National Ambient Air Quality Standards (NAAQS). US Environmental Protection Agency, Office of Air Quality Planning and Standards, Washington, DC. http://www.epa.gov/air/criteria.html.

Location: Land Court **Indoor Air Results**

Address: 3 Pemburton Sq., Boston, MA **Table 1** **Date: 2/24/2012**

Location	Carbon Dioxide (*ppm)	Carbon Monoxide (*ppm)	Temp (°F)	Relative Humidity (%)	TVOCs (*ppm)	PM2.5 (ug/m3)	Occupants in Room	Windows Openable	Ventilation		Remarks
									Intake	Exhaust	
Background (outdoors)	325	ND	38	72	ND	15					
Land Court Main Office	472	ND	73	21	ND	11	8	N	Y	Y	Plants on carpet, Plants on univent
410	434	ND	75	18	ND	10	0	N	N	N	Book odor
412	458	ND	75	20	ND	11	1	Y	Y	Y	
414	407	ND	70	20	ND	14	0	Y	Y	N	Plants
415	407	ND	70	20	ND	12	1	Y	Y	N	
419	416	ND	74	19	ND	10	0	Y	Y	N	
420	445	ND	74	19	ND	10	0	Y	Y	N	
421	501	ND	74	21	ND	10	1	Y	Y	Y	
422 Survey room	519	ND	75	21	ND	14	4	Y	Y	N	
422	465	ND	72	22	ND	13	1	Y	Y	N	Door open

ppm = parts per million µg/m3 = micrograms per cubic meter ND = non-detect

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%

Location: Land Court **Indoor Air Results**

Address: 3 Pemburton Sq., Boston, MA **Table 1 (continued)** **Date: 2/24/2012**

Location	Carbon Dioxide (*ppm)	Carbon Monoxide (*ppm)	Temp (°F)	Relative Humidity (%)	TVOCs (*ppm)	PM2.5 (ug/m3)	Occupants in Room	Windows Openable	Ventilation		Remarks
									Intake	Exhaust	
422A	506	ND	73	22	ND	12	1	Y	Y	Y	
431	426	ND	74	19	ND	10	0	Y	Y	Y	
506	481	ND	74	20	ND	10	1	Y	Y	Y	Door open
508	454	ND	74	18	ND	9	1	Y	N	Y	Transom open, Door open
509	450	ND	73	18	ND	10	0	Y	N	Y	
511	497	ND	75	19	ND	9	0	N	N	Y	
512A	464	ND	74	20	ND	13	0	Y	Y	Y	
512	469	ND	74	19	ND	8	1	N	N	Y	Transom open
513	515	ND	76	19	ND	8	1	N	Y	N	Door open
515D	639	ND	74	21	ND	9	1	Y	Y	N	
517	454	ND	74	20	ND	10	0	N	Y	Y	Door open

ppm = parts per million µg/m3 = micrograms per cubic meter ND = non-detect

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Location: Land Court **Indoor Air Results**

Address: 3 Pemburton Sq., Boston, MA **Table 1 (continued)** **Date: 2/24/2012**

Location	Carbon Dioxide (*ppm)	Carbon Monoxide (*ppm)	Temp (°F)	Relative Humidity (%)	TVOCs (*ppm)	PM2.5 (ug/m3)	Occupants in Room	Windows Openable	Ventilation		Remarks
									Intake	Exhaust	
518	490	ND	74	19	ND	10	0	N	Y	Y	
520	410	ND	72	20	ND	10	0	Y	Y	Y	
522	422	ND	72	20	ND	10	0	N	N	Y	
523	493	ND	72	22	ND	10	0	N	N	Y	Photocopier
523A	428	ND	72	22	ND	11	0	Y	Y	N	

ppm = parts per million µg/m3 = micrograms per cubic meter ND = non-detect

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		