INDOOR AIR QUALITY ASSESSMENT

Taunton District Court
40 Broadway Street
Taunton, Massachusetts

Prepared by:
Massachusetts Department of Public Health
Bureau of Environmental Health
Indoor Air Quality Program
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Background/Introduction

In response to a request from Mr. Dennis Maietta, Acting Chief Probation Officer, the Massachusetts Department of Public Health (MDPH), Bureau of Environmental Health (BEH) conducted an indoor air quality (IAQ) assessment at the Taunton District Court (TDC), Probation Department, located at 40 Broadway Street, Taunton, Massachusetts. The assessment was coordinated through Mr. Douglas Loud, Building Systems Manager, Court Capital and Facilities Management Department. On December 7, 2011, Cory Holmes, Environmental Analyst/Regional Inspector for BEH's IAQ Program made a visit to the TDC to conduct an IAQ assessment.

The TDC is a four-story stone-block building with a basement that was opened summer of 2011. The Probation Department is located on the north side of the 2nd floor. The space consists of open work areas separated by cloth-covered dividers, a customer service counter, private office space, storage and common areas. The space has suspended ceiling tiles and flooring consisting of carpet squares in the majority of areas; some areas have vinyl floor tile. Windows are openable along exterior walls.

Methods

Air tests for carbon monoxide, carbon dioxide, temperature and relative humidity were conducted with the TSI, Q-Trak, IAQ Monitor, Model 7565. Air tests for airborne particle matter with a diameter less than 2.5 micrometers were taken with the TSI, DUSTTRAK™ Aerosol Monitor Model 8520. BEH staff also performed visual inspection of building materials for water damage and/or microbial growth.

Results

Approximately 20 people work in the Probation Department with approximately 50 to 80 members of the public visiting 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 surveyed, indicating adequate air exchange at the time of the assessment (Table 1). Mechanical ventilation is provided by a computerized heating, ventilation and air conditioning (HVAC) system. Air-handling units (AHU) located in a basement mechanical room (Picture 1) draw fresh air through air intakes located at ground level (Picture 2). Fresh air passes through a box-type pre-filter (to catch larger particulates/debris) then through a bank of pleated air filters that screen out fine particulates (Picture 3). Conditioned air is ducted to variable air volume (VAV) boxes where it is tempered as necessary and distributed to occupied areas via ducted air diffusers (Picture 4). Air is ducted back to AHUs via ceiling-mounted return vents (Picture 5).

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 HVAC system balanced prior to opening in 2011.

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.

Temperatures in occupied areas ranged from 71 ºF to 73 ºF, which were within the MDPH recommended comfort guidelines. The 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. 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.

The relative humidity measured ranged from 52 to 56 percent, which was also within the MDPH recommended comfort range in all areas surveyed. The MDPH recommends a comfort range of 40 to 60 percent for indoor air relative humidity. 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.

Microbial/Moisture Concerns

Room 2114 had a water cooler and refrigerator on carpeting. Carpeting underneath this equipment is vulnerable to water damage, which can lead to mold growth. The area underneath this equipment should be covered by a rubber/plastic mat if the equipment cannot be relocated to tiled areas.

Some areas had plants. Plants can be a source of pollen and mold, which can serve as respiratory irritants for some sensitive individuals. Plants should be properly maintained and equipped with drip pans to prevent water damage to porous building materials, which can lead to mold growth. Plants should also be located away from ventilation sources to prevent the aerosolization of dirt, pollen or mold.

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 can produce immediate, acute health effects upon exposure. To determine whether combustion products were present in the building environment, BEH staff obtained measurements for carbon monoxide.

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 effects. 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, Refrigerating 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) (Table 1). No measureable levels of carbon monoxide were detected inside the building during the assessment (Table 1).

Particulate Matter

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 (μg/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 μg/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 was measured at 9 μg/m^3 (Table 1). Indoor PM2.5 levels ranged from 3 to 5 μg/m^3 (Table 1). Both indoor and outdoor PM 2.5 levels were below the NAAQS PM2.5 level of 35 μg/m^3. Frequently, indoor air levels of particulates (including PM2.5) can be at higher levels than those measured outdoors. A number of mechanical devices and/or activities that occur indoors can generate particulate during normal operations. 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 and/or microwave ovens in kitchen areas; use of photocopiers, fax machines and computer printing devices; operation of an ordinary vacuum cleaner; and heavy foot traffic indoors.

Other Conditions

Other conditions that can potentially affect indoor air quality were identified during the assessment. Several personal fans were observed to have accumulated dust/debris (Picture 6). Dust particles can become re-aerosolized when fans are activated providing a source of eye/respiratory irritation.

The restroom had a plug-in air deodorizer (Picture 7). Air fresheners contain chemicals that can be irritating to the eyes, nose and throat of sensitive individuals. In addition, air fresheners do not remove materials causing odors, but rather mask odors which may be present in the area.

Finally, as reported by Mr. Loud, the design of the fresh air intakes for the HVAC system has been problematic on several occasions. The location of the fresh air intake grates at ground level makes them susceptible to drawing in airborne pollutants from outside the building. On one occasion it was reported that welding fumes had been entrained into the system leading to IAQ complaints and respiratory irritation. It was also reported by Mr. Loud that several changes/policies have been made since the incident including: more efficient more frequent changing of filters, reprogramming of the HVAC system to start one hour earlier prior to occupancy to increase air circulation, and the institution of a vendor check-in system for increased control/awareness of building-related projects.

Conclusions/Recommendations

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

1. Continue with system in place for vendor check-in. Schedule projects that produce large amounts of dusts, odors and emissions during unoccupied periods or periods of low occupancy if possible.
2. Communicate scheduling itinerary to all affected parties through meetings, emails and/or other form of notification.
3. 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 surfaces is recommended. Avoid the use of feather dusters. Drinking water during the day can help ease some symptoms associated with a dry environment (throat and sinus irritations).
4. Consider outfitting water dispensers and refrigerators with a rubber/plastic mat to prevent water damage to carpeting.
5. Clean personal fans and supply/return vents periodically of accumulated dust/debris.
6. Ensure plants have drip pans. Examine drip pans periodically for mold growth and disinfect with an appropriate antimicrobial where necessary. Move plants away from the air stream of ventilation sources.
7. Discontinue the use of strongly-scented air fresheners in the building.

8. 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

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.

MDPH. 1997. Requirements to Maintain Air Quality in Indoor Skating Rinks (State Sanitary Code, Chapter XI). 105 CMR 675.000. Massachusetts Department of Public Health, Boston, MA.

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.

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

Picture 1

Air Handling Units in Basement Mechanical Room

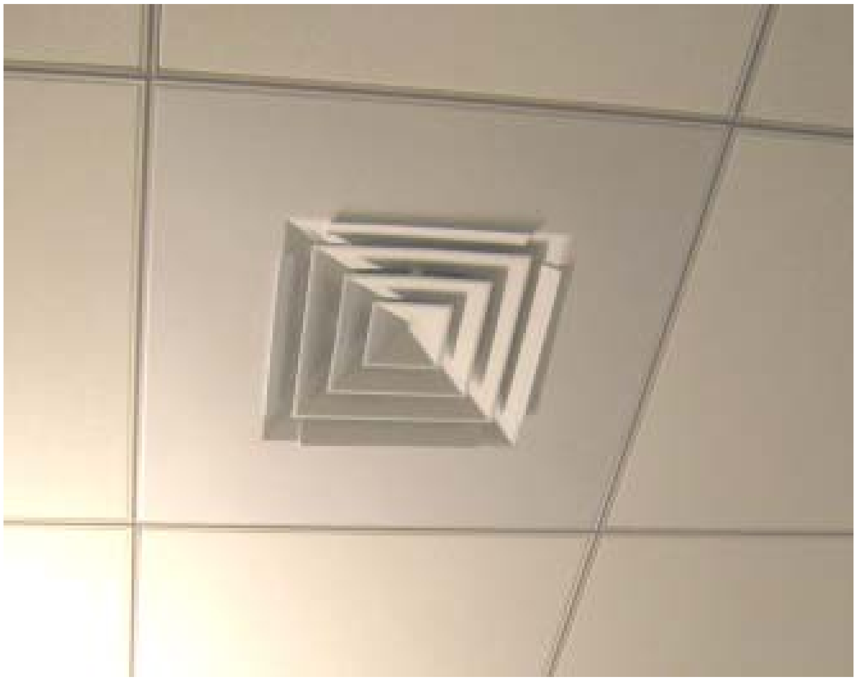
Picture 2

Fresh Air Intake Located at Ground Level

Picture 3

Box-Type Filter on Left and Pleated Filter on Right

Picture 4

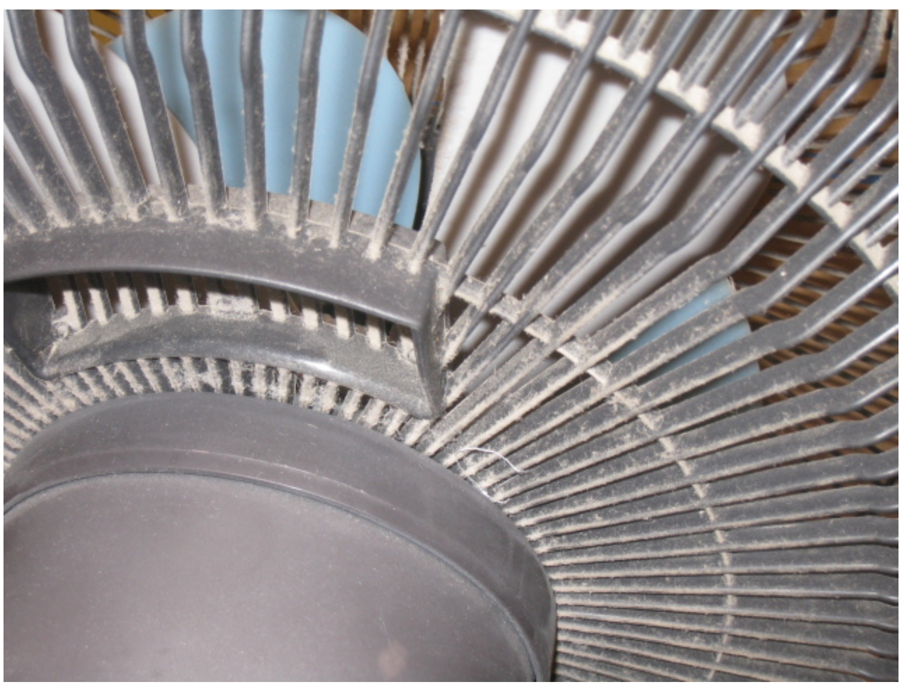


Supply Air Diffuser

Picture 5

Return Vent

Picture 6



Dust/Debris Accumulation on Personal Fan

Picture 7

Plug-in Air Freshener in Restroom

Location: Taunton District Court

Address: 40 Broadway Street, Taunton, MA

Indoor Air Results

Date: 12/7/2011

Table 1

Location	Carbon Dioxide (*ppm)	Temp (°F)	Relative Humidity (%)	Carbon Monoxide (*ppm)	PM2.5 (µg/m³)	Occupants in Room	Windows Openable	Ventilation		
Background	396	63	100	ND	9					Moderate to heavy wind and rain
Supervisor's Area	471	73	55	ND	3	1	Y	Y	Y	
Center (rear) Work Area	452	73	54	ND	4	3	N	Y	Y	
Center (front) Work Area	495	73	53	ND	4	1	N	Y	Y	
Restroom							N	N	Y	Plug in air freshener
Front Counter	523	73	52	ND	3	2	N	Y	Y	
2007 A	550	72	53	ND	4	0	Y	Y	Y	DO
2007 B	591	72	54	ND	4	0	N	Y	Y	DO
2010	649	72	56	ND	5	1	N	Y	Y	DO
2013	568	72	54	ND	4	0	Y	Y	Y	DO
2014	592	72	54	ND	3	1	N	Y	Y	DO

ppm = parts per million
µg/m³ = micrograms per cubic meter

ND = non detect
DO = door open

PF = personal fan

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: Taunton District Court **Indoor Air Results**

Address: 40 Broadway Street, Taunton, MA **Date: 12/7/2011**

Table 1 (continued)

Location	Carbon Dioxide (*ppm)	Temp (°F)	Relative Humidity (%)	Carbon Monoxide (*ppm)	PM2.5 (μg/m³)	Occupants in Room	Windows Openable	Ventilation		
2015	475	71	54	ND	3	0	Y	Y	Y	
2016	531	72	54	ND	4	0	N	Y	Y	DO
2018	544	72	54	ND	5	1	N	Y	Y	DO, plants
2019	479	71	54	ND	4	0	Y	Y	Y	DO
2023 Copy Room	513	73	53	ND	4	0	N	Y	Y	Photocopier and printer directly below exhaust vent
2026	531	73	54	ND	3	0	N	Y	Y	DO
2027	515	72	54	ND	3	0	N	Y	Y	PF-dusty, DO
2028	525	71	54	ND	4	0	N	Y	Y	DO, PF-dusty
2029	512	71	54	ND	4	0	N	Y	Y	DO
Equip Room 2107	478	73	54	ND	4	0	N	Y	Y	Photocopier below exhaust vent, DO, printer, shredder

ppm = parts per million
μg/m³ = micrograms per cubic meter
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PF = personal fan

Comfort Guidelines

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

Location: Taunton District Court **Indoor Air Results**

Address: 40 Broadway Street, Taunton, MA **Table 1 (continued)** **Date: 12/7/2011**

Location	Carbon Dioxide (*ppm)	Temp (°F)	Relative Humidity (%)	Carbon Monoxide (*ppm)	PM2.5 ($\mu g/m^3$)	Occupants in Room	Windows Openable	Ventilation		
2113 Probation Office	424	73	52	ND	3	0	N	Y	Y	
2114 Probation Office	439	73	52	ND	3	0	N	Y	Y	DO, cooler and fridge on carpet
2115	589	73	53	ND	4	0	N	Y	Y	DO, tile floor

ppm = parts per million
$\mu g/m^3$ = micrograms per cubic meter
ND = non detect
DO = door open
PF = personal fan

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		