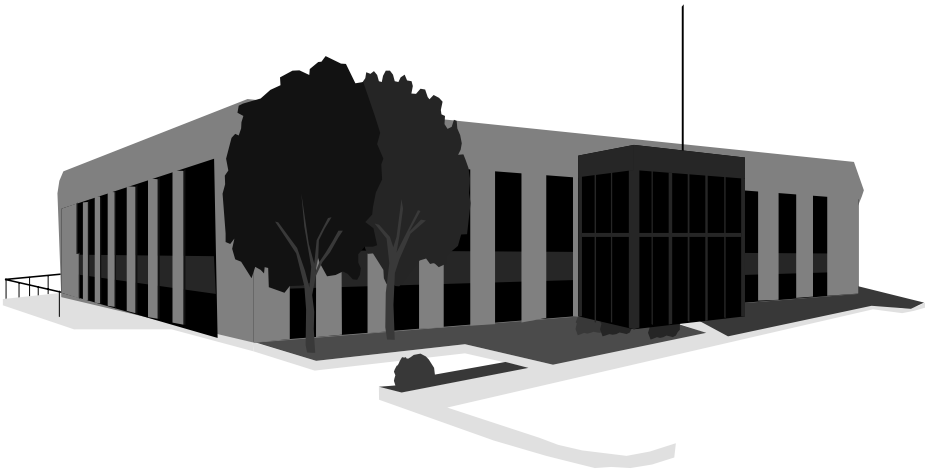
INDOOR AIR QUALITY ASSESSMENT

New Bedford Water Department
Administration Building
1105 Shawmut Avenue
New Bedford, Massachusetts



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

At the request of the New Bedford Health Department, the Massachusetts Department of Public Health (MDPH), Bureau of Environmental Health Assessment (BEHA) provided assistance and consultation regarding indoor air quality issues at the New Bedford Water Department, Administrative Office Building located on Shawmut Avenue in New Bedford, MA. Complaints from building occupants of headaches, light-headedness, stale air and respiratory problems prompted this request.

On May 18, 2000, a visit was made to this building by Cory Holmes, Environmental Analyst of BEHA's Emergency Response/Indoor Air Quality (ER/IAQ) Program. Mr. Holmes was accompanied by Suzan Donahue, Research Assistant, BEHA; Barry Silvia of the New Bedford Health Department and for portions of the assessment Muriel Bruneau, Water Registrar.

The Water Department Building is a one-story brick building built in 1967, which originally served as a repair shop. The building was renovated to provide office space in 1995. The billing area consists of an open office space with a drive up teller window and offices along the perimeter. There are also repair/maintenance shops, storage areas, a conference room, locker room and other administrative offices in the building. The billing area is where complaints from building occupants have been documented.

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

These offices have an employee population of approximately 30 and are visited by approximately 100-150 members of the general public daily. The tests were taken under normal operating conditions. Test results appear in Tables 1-2.

Discussion

Ventilation

It can be seen from the tables that carbon dioxide levels were elevated above 800 parts per million parts of air (ppm) in seven of the nine occupied areas surveyed, which is indicative of an overall ventilation problem in the building. It is important to note that five of the seven areas with carbon dioxide levels above 800 ppm were located in the billing office space. Also of note is that most of these areas were sparsely populated during the assessment, which normally should result in reduced carbon dioxide levels.

Office space and common areas in the building are not equipped with mechanical supply ventilation, but use wall-mounted mechanical fans and passive vents in combination with openable windows to circulate air (see Pictures 1-3). When the building was converted to office space in 1995, interior walls were constructed which prohibited access to windows on the exterior walls. In an effort to provide fresh air, wall-mounted mechanical fans were installed along the east wall and passive vents were installed in the west wall to facilitate airflow (see Figure 1). Also noted in the main

office area are several wall-mounted air-conditioning (A/C) units. Chilled water for the system is provided by rooftop chillers (see Pictures 4 & 5). These A/C units provide no fresh air and recirculate only.

A number of complaints of stale air and poor ventilation were expressed to BEHA staff. Although efforts were made to facilitate airflow into the main office area, the configuration of the building with the construction of interior walls obstructs direct access to openable windows. In addition, most of the windows were closed and a number of the fans were deactivated during the assessment. Without a mechanical supply ventilation system, the sole source of ventilation in the building is openable windows.

Mechanical exhaust ventilation is provided by ceiling-mounted intake grills connected to ductwork. All exhaust vents were functioning throughout the building (see Pictures 6-8). Restrooms also have mechanical exhaust ventilation to help remove excess moisture and/or odors.

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.

Temperature measurements ranged from 70^{o} F to 79^{o} F, which was very close to the BEHA recommended comfort range. 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. A number of complaints of uneven heating and cooling were also expressed by employees. 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. As previously mentioned a number of the fans installed in the main office area to help facilitate airflow were not operating at the time of the assessment. These fans should be utilized in conjunction with the building's heating/cooling systems and/or openable windows to provide for the comfort of occupants.

The relative humidity in the building ranged from 34 to 46 percent, which was below the BEHA recommended comfort range in a number of areas. The one exception was the water meter room The relative humidity level measured in the water meter room was 61 percent. Elevated humidity levels would be expected in this area, due to numerous sources of moisture. The BEHA recommends a comfort range of 40 to 60 percent for indoor air relative humidity. Relative humidity levels 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 very common problem during the heating season in the northeast part of the United States.

Microbial/Moisture Concerns

Several rooms contained a number of plants. Plants can be a source of pollen and mold, which can be a respiratory irritant to some individuals. Plants should have drip pans to prevent wetting and subsequent mold colonization of window frames. Over-watering of plants should be avoided and drip pans should be inspected periodically for mold growth.

A number of areas had water-stained ceiling tiles, which are evidence of roof and/or plumbing leaks (see Picture 9). Water-damaged ceiling tiles can provide a source of mold and mildew growth, especially if they are moistened repeatedly. These tiles should be replaced after a water leak is discovered and repaired. The most likely source of water penetration appears to be around the chilled water pipes, connected to the roof-top chillers (see Picture 10). Holes around utility pipes are breaches of the building envelope and can provide a source of water penetration. In addition, chilled water pipes

should be insulated to avoid condensation build-up and the subsequent wetting of ceiling tiles from dripping pipes. When warm, moist air passes over a surface that is colder than the air; water condensation can collect on the cold surface of the pipes. Over time, water droplets can form, which can then drip from a suspended surface. The cool temperature of the metal piping would make them prone to generating condensation. Dripping condensation can lead to mold growth on porous materials (i.e., ceiling tiles).

Vine growth was noted on the exterior walls of the building (see Picture 11). Clinging plants can cause water damage to brickwork by inserting tendrils into brick and mortar. Water can penetrate into the brick along the tendrils, which can subsequently freeze and thaw during the winter. This freezing/thawing action can weaken bricks and mortar, resulting in damage to the wall. In order to avoid this problem, clinging plants on brickwork should be removed.

Other Concerns

Several other conditions that can potentially affect indoor air quality were also observed. As previously mentioned, many areas contained wall-mounted air conditioners. These units are equipped with filters, which should be changed as per the manufacturer's instructions to avoid the build up and re-aerosolization of dirt, dust and particulate matter (see Picture 12). The filter of the unit in the main office area was inspected by BEHA staff and had heavy dust accumulation (see Picture 13). A number of these units are equipped with indicator lights informing operators of filter status. The indicator light for this unit was red at the time of the assessment; presumably meaning it needed to be changed (see Picture 14).

During a perimeter inspection of the building BEHA staff detected an odor of natural gas. A characteristic hissing sound was noted from the regulator directly outside of the welding shop (see Picture 15). BEHA staff alerted welding shop occupants and Ms. Bruneau, who in turn, notified Commonwealth Gas. BEHA staff called Ms. Bruneau, the following day to determine the status of the leak. Ms. Bruneau reported that Commonwealth Gas had responded, confirmed, the gas leak and corrected the problem.

BEHA staff received reports of occasional complaints from exhaust emissions in the building from automobiles using the drive-thru. This area is equipped with a wall-mounted fan, which if activated will create positive pressure in the drive-thru area that can help prevent auto emissions from infiltrating into the building (see Picture 2/Figure 1). Idling vehicles can result in the entrainment of vehicle exhaust into the building, which may, in turn, provide opportunities for exposure to compounds such as carbon monoxide. M.G.L. chapter 90 section 16A prohibits the unnecessary operation of the engine of a motor vehicle for a foreseeable time in excess of five minutes (MGL., 1996).

Conclusions/Recommendations

Symptoms and complaints reported are consistent with what might be expected in an environment with a poorly operating or non-existent mechanical ventilation system. The absence of a mechanical supply system prevents the dilution of environmental pollutants. This can result in a buildup of dust, dirt, odors and other pollutants in the indoor environment. In order to provide ventilation, windows in conjunction with passive vents and mechanical fans, are used to introduce air into the building. If windows are shut and fans are not operating, inadequate ventilation in the main office

area exists. In view of the findings at the time of this visit, the following recommendations are made:

1. To maximize air infiltration/circulation, open windows and utilize mechanical fans during periods of occupancy.
2. Consider consulting a heating, ventilating and air-conditioning (HVAC) engineer regarding the installation of a mechanical ventilation system to provide fresh air to the interior of the building.
3. Continue to operate mechanical exhaust ventilation during periods of occupancy.
4. Operate wall-mounted air-conditioning units in conjunction with wall fans to provide for the comfort of occupants.
5. 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. Drinking water during the day can help ease some symptoms associated with a dry environment (throat and sinus irritations).
6. Ensure plants are equipped with drip pans. Examine plants for mold growth in water catch basins and disinfect if necessary.

7. Remove clinging plants on brickwork to avoid damage to mortar and brickwork and subsequent water penetration.
8. Repair any existing water leaks and replace any remaining water-stained ceiling tiles. Examine the areas above these tiles for mold growth. Disinfect areas of water leaks with an appropriate antimicrobial as needed.
9. Seal holes around utility pipes to avoid water penetration from the roof. Consider insulating water pipes to avoid condensation and the subsequent wetting of ceiling tiles from dripping pipes.
10. Change filters for A/C units as per the manufacturer's instructions, or more frequently if needed. Clean and vacuum interior of units prior to operation to avoid the re-aerosolization of accumulated dirt, dust and debris.
11. Monitor gas regulator outside of welding shop periodically; report any odors and/or leaks to Commonwealth Gas.
12. Activate wall fan in drive-thru to over pressurize the area to keep exhaust emissions from infiltrating. Post a sign requesting that vehicles shut off engines after five minutes as required by Massachusetts General Laws 90:16A.

References

BOCA. , 1993. The BOCA National Mechanical Code/1993. 8th ed. Building Officials and Code Administrators International, Inc., Country Club Hill, IL. Section M-308.1.1.

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.

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

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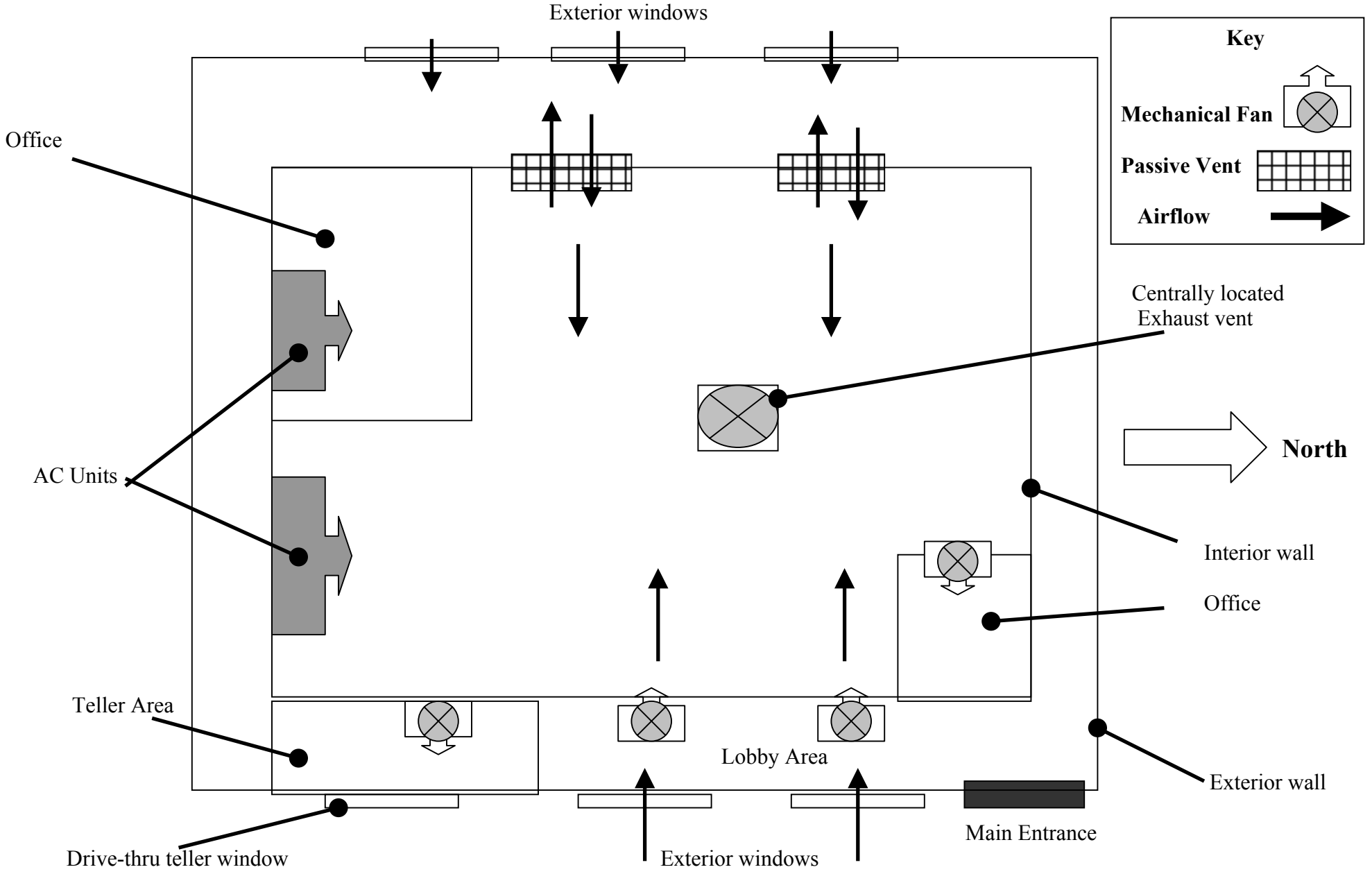
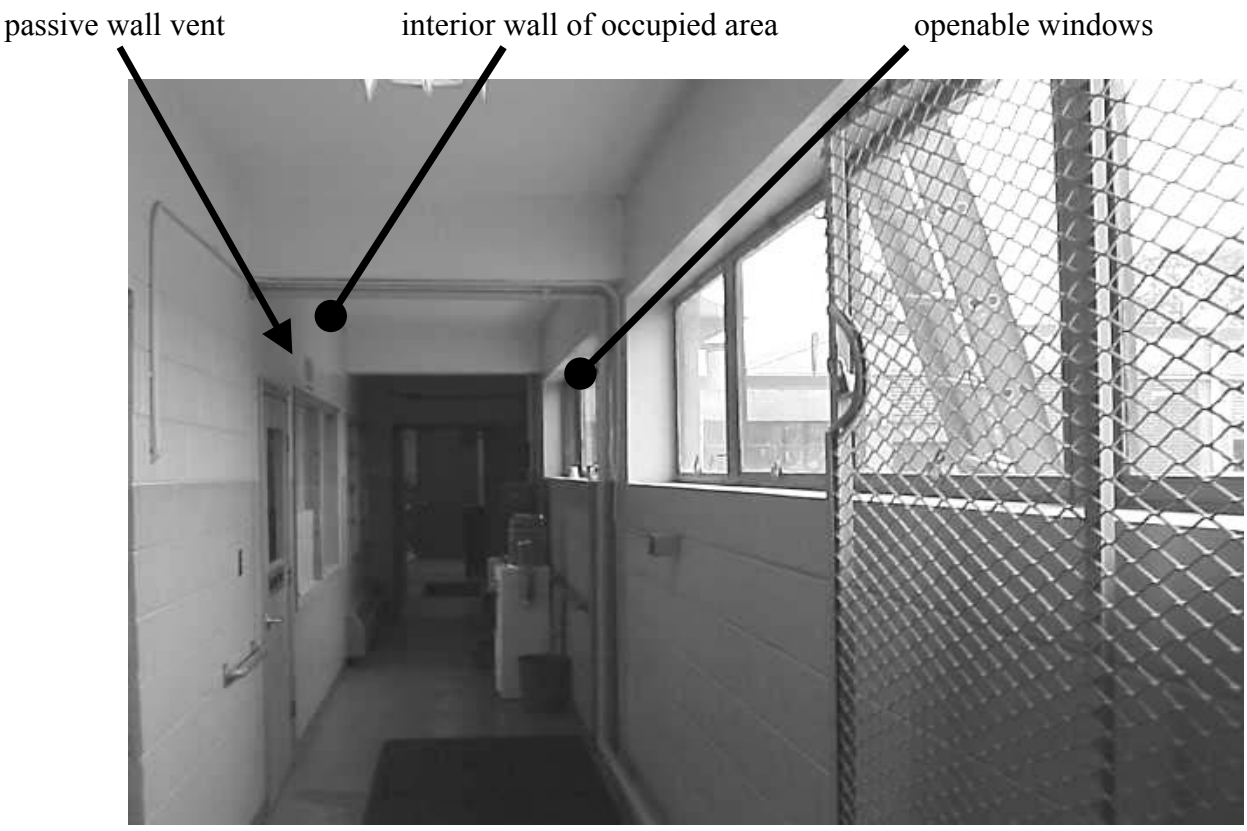
Figure 1
Physical Layout of New Bedford Water Department
Billing Area



Picture 1



Openable Windows on Exterior Wall of Water Department Administration Building
Note Windows are Separated from Occupied Billing Area by Interior Wall

Picture 2

Example of Wall-Mounted Fan Installed in Main Office Area to Facilitate Airflow

Picture 3

Example of Passive Wall Vent Installed in Main Office Area to Facilitate Airflow

Picture 4

Example of Wall-Mounted Air-Conditioning (A/C) Unit
Note A/C Units do not Provide Fresh Air but Recirculate Only

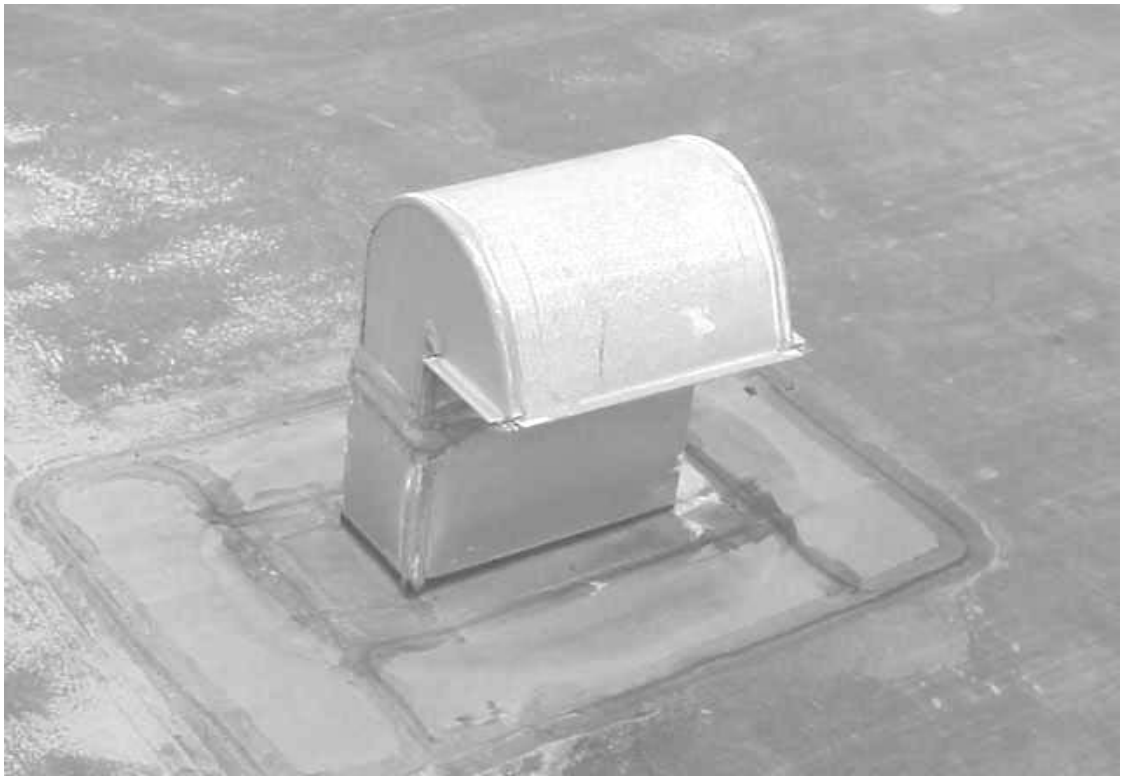
Picture 5

Rooftop Units Providing Chilled Water for A/C Units

Picture 6

Ceiling-Mounted Exhaust Vent Noted in Billing Office Area
Note Tissue Indicating Draw of Air

Picture 7



Rooftop Exhaust Ductwork for Main Office Area

Picture 8

Exhaust Ductwork for Conference Room Noted on West Exterior Wall

Picture 9

Water-Stained Ceiling Tile

Picture 10

Utility Hole for Pipe Penetration through Roof Noted above Ceiling Tiles
Note Water Stained Pipes and Ceiling Plaster Indicating Water Penetration

Picture 11

Vine Growth Noted on Exterior Brick

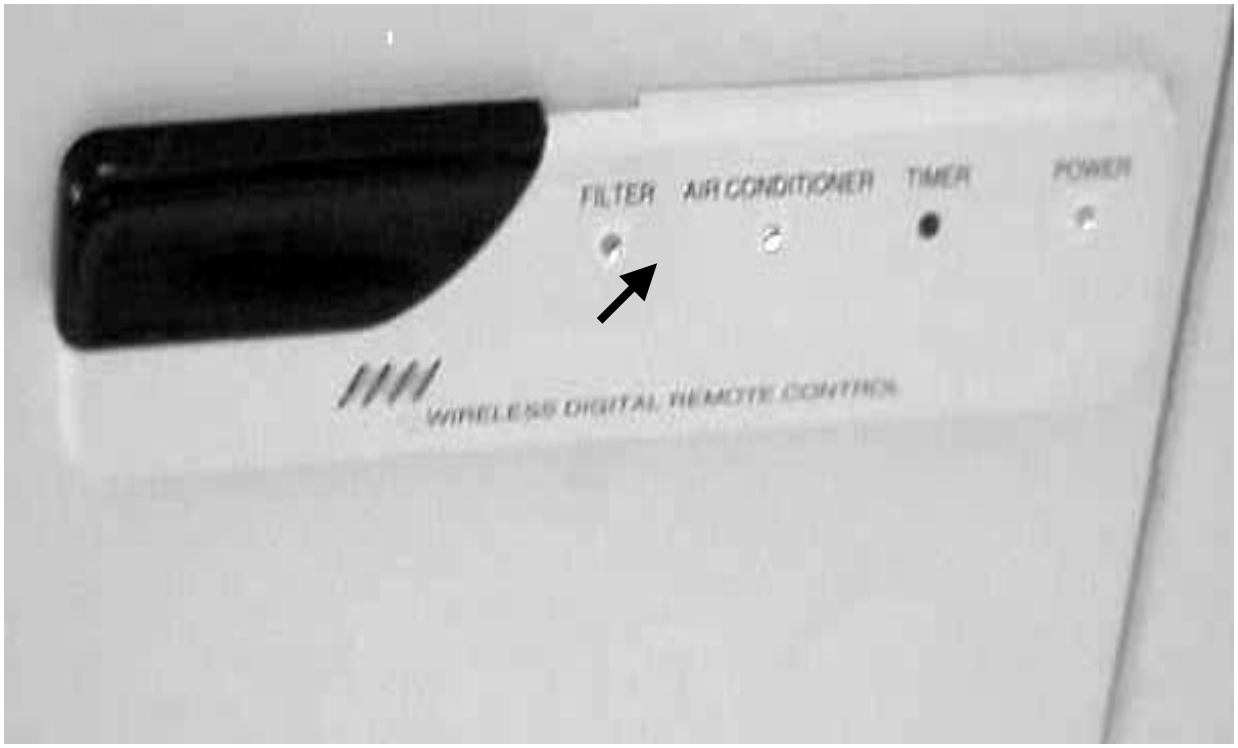
Picture 12

Wall-Mounted A/C Unit Opened to Expose Filter

Picture 13

Close-Up of A/C Filter Note Filter Media Accumulated with Dirt, Dust and Debris

Picture 14



Indicator Lights Noted on Exterior Panel of A/C Unit Note Filter Indicator Light Was Red at the Time of the Assessment

Picture 15

Gas Regulator Noted Leaking on Exterior Eastside Wall

TABLE 1

Indoor Air Test Results –New Bedford Water Department, New Bedford, MA – May 18, 2000

Remarks	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
Outside (Background)	471	72	56					weather conditions: overcast, periodic rain, Southwest wind: 10-15 MPH, gusts of up to 20 MPH
Reception Lobby	1254	79	34	4	yes	no	no	
Restroom						no	yes	air freshener spray
Registrar's Office	1324	77	40	1	no	no	yes	passive vent for exhaust, ceiling mounted air conditioner (a/c) unit, photocopier, carpet, potpourri, computer, plant, baseboard behind cabinets
Billing Office (West)	1412	79	37	1	no	no	no	carpet, personal fan, 1 CT, coffee maker-odor, food
Billing Office (East)	1401	79	36	3	no	no	yes	ceiling mounted a/c unit, exhaust fans in wall, personal fan, carpet, 1 CT, candy dish
Payment Office	1393	79	36	1	no	no	no	drive-up payment window, 3 plants, wall mounted fan (from billing office east)
Storage Area/Break Room	756	78	37	0	no	no	no	utility holes, personal fan, open files/shelves/paper/plans,

*** 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 –New Bedford Water Department, New Bedford, MA – May 18, 2000

Remarks	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
								refrigerator, coffee maker, dust
Storage Basement		72	43	0	no	no	no	cleaners, parts, paper/plans
Meter room	641	70	61	1	yes	no	no	window mounted a/c, utility holes
Administration Office	846	75	44	3	yes	no	yes	window open, odor-mulberry candle, personal fan, photocopier, 1 CT, carpet, ~5 plants, ceiling mounted a/c
Superintendent's Office	730	76	46	0	yes	no	no	ceiling mounted a/c, 1 CT, carpet
Repair Shop Office	791	75	45	3	yes	no	no	ceiling mounted a/c, ~13 plants, flowers in vase, water damaged ceiling plaster
Conference Room	822	75	43	5	yes	no	yes	ceiling mounted a/c, carpet, exterior door
Roof Notes								2 exhaust vent motors-on, restroom exhaust-on, interior drains, no air intakes noted, chillers

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