The Commonwealth of Massachusetts
Executive Office of Health and Human Services
Department of Public Health
250 Washington Street, Boston, MA 02108-4619

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May 3, 2006

The Honorable Robert A. Mulligan
Chief Justice for Administration and Management
Administration Office of the Trial Court
2 Center Plaza, 5th floor
Boston, MA 02108

Dear Chief Justice Mulligan:

Enclosed is a copy of the report by our Emergency Response/Indoor Air Quality Program, on their visits to Hall of Justice, Springfield MA to conduct an indoor air assessment. The report shows that there were problems identified. Please refer to the recommendations section for advice on how to correct these problems.

If you have any questions regarding the report or if we can be of further assistance in this matter, please feel free to call us at (617) 624-5757.

Sincerely,

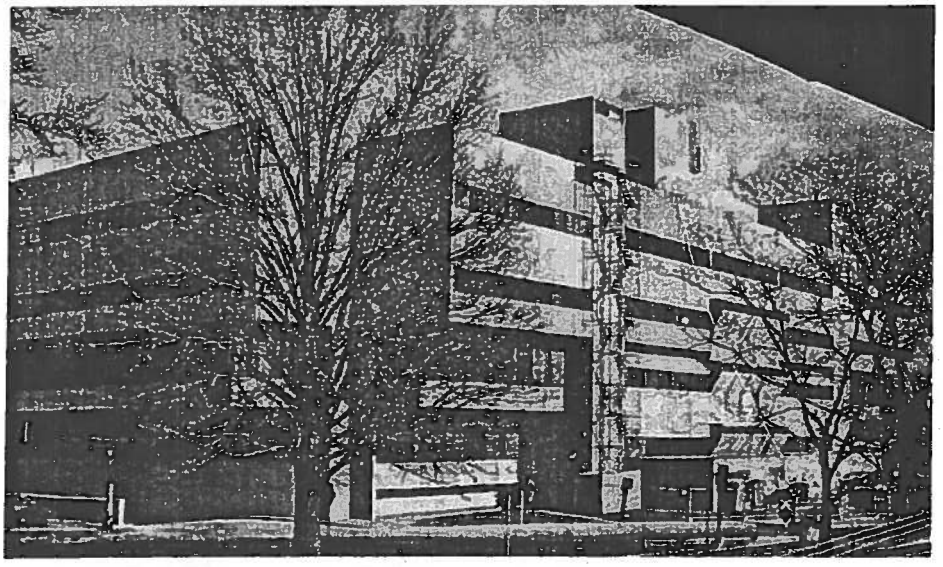
Suzanne K. Condon, Associate Commissioner
Center for Environmental Health

Enclosure

cc: Michael Feeney, Director, CEH Emergency Response/Indoor Air Quality Program
Robert P. Panneton, Chief of Staff, Administrative Office of the Trial Court
Honorable Lynda M. Connolly, Chief Justice, Administrative Office of the District Court
Honorable William W. Teahan, Jr., Presiding Justice (Acting), Springfield District Court
Honorable Barbara J. Rouse, Chief Justice of the Superior Court
William M. Bennett, District Attorney, Hampden County
Donald Ashe, Registrar, Hampden County Registry of Deeds
Senator Stephen J. Buoniconti
Senator Brian P. Lees
Representative Mary S. Rogeness
Representative Sean Curran
Representative Cheryl A. Rivera
Representative Benjamin Swan
Representative Gale D. Candaras
Representative James T. Welch
Representative Thomas M. Petrolati

INDOOR AIR QUALITY ASSESSMENT

Hall of Justice
50 State Street
Springfield, Massachusetts



Prepared by:
Massachusetts Department of Public Health
Center for Environmental Health
Emergency Response/Indoor Air Quality Program
May 2006

Background/Introduction

In response to a request from the Hampden County District Attorneys Office and Jim Pagliaro, Regional Court Facilities Manager, the Massachusetts Department of Public Health's (MDPH), Center for Environmental Health (CEH) conducted an indoor air quality assessment at the Hall of Justice (HOJ), 50 State Harvard Street, Springfield, Massachusetts. Concerns about indoor air quality, water damage and temperature control as well the former use of the site prompted the request.

On April 21-22, 2005, Michael Feeney, Director of CEH's Emergency Response/Indoor Air Quality (ER/IAQ) Program, made an initial visit to this building. Mr. Feeney returned on February 7, 2006 to complete the assessment and to observe the operation of the heating, ventilating and air-conditioning (HVAC) system during the heating season.

The HOJ is a four-story, tiered, cement and steel frame building constructed in 1973 as an energy efficient facility. A gasoline service station existed on the HOJ site prior to construction (Blueprint 1). According to HOJ staff, the building was originally designed to have a fifth floor. A number of characteristics were found in the building that support this hypothesis:

- The penthouse for the roof top HVAC system and elevators is over two stories tall (Picture 1). In similar facilities evaluated by CEH staff, such structures of this type are usually one story tall.
- The elevator floor indicator has an unlabelled light button (Picture 2).

- The roof has a number of protrusions through the deck the size of the I-beam steel girders that make up the frame of the building (Picture 3). It appears that the existing roof membrane was installed over these roof protrusions.
- The decking below the roof does not appear to have any insulation.

At the time of the February 2006 visit, a project to renovate the roof had begun (Picture 4). The project includes reconfiguring the roof to provide appropriate insulation, which will help to regulate the temperature of the building.

The upper floors of the building have a larger footprint than the base of the building, which creates significant areas that overhang on the north (Picture 5), east (Picture 6) and south (Picture 7) exterior walls of the building. The windows are openable in some areas and consist of a single pane of glass in a metal frame (Picture 8). An underground parking garage exists between the HOJ and the Housing Court building. The parking garage does not appear to be located beneath the footprint of the building.

Methods

Air tests for carbon dioxide, temperature and relative humidity were taken with the TSI, Q-Trak, IAQ Monitor. Screening for total volatile organic compounds (TVOCs) was conducted using a HNu Photo Ionization Detector (PID). Surface temperature of building components were taken with a Thermotrace laser thermometer.

Results

The HOJ has an employee population of over 200 with several hundred visitors on a daily basis. Tests were taken under normal operating conditions and results appear in

Tables 1 through 4. Air sampling results are listed in the Tables by location that the air sample was taken.

Discussion

Ventilation

It can be seen from Tables 1 and 2 that carbon dioxide levels were below 800 parts per million parts (ppm) in all areas sampled during the April 2005 assessment. During the February 7, 2006 air sampling, carbon dioxide levels were above 800 parts per million (ppm) parts of air in all areas sampled (Table 3). As reported by HOJ facilities staff, the boiler was not operating during the February 7, 2006 visit. To maintain heat in the building, the HVAC system was operating, but the fresh air supply intakes were intentionally closed. Without the introduction of fresh, outside air, carbon dioxide levels would be expected to increase. With the HVAC system operating and fresh air intake dampers open, carbon dioxide levels would be expected to decrease.

The April 2005 measurements indicate that the heating, ventilating and air-conditioning (HVAC) system is providing an adequate amount of fresh air when operating as designed (i.e., with fresh air intakes open). Please note that a number of areas that had carbon dioxide levels below 800 ppm were measured in unoccupied areas or with low population, which can greatly decrease carbon dioxide levels.

As described by HOJ facilities staff, the ventilation system is separated into three zones: the building core, western and eastern sides. The building core includes the courtrooms in the center of the building on multiple floors. The western side includes all of the areas that are located on the side of the building closest to Interstate 91. The eastern

side includes the offices located in the half of the building closest to the Housing Court building. Fresh air intakes are located in a variety of areas, including the rooftop penthouse and at ground level. Fresh air is supplied by ceiling or wall mounted fresh air supply vents. Each area adjacent to windows is equipped with fan coil units (FCUs) (Picture 9). The FCUs do not provide fresh air, but rather help to heat or cool air. Therefore, FCUs recirculate air only.

Exhaust ventilation is provided by ceiling mounted exhaust vents. Of note were the holding cells located in the western side of the building. Above the hallway door to the cells is a retrofitted fan that appears to exhaust air from the cells into the hallway (Picture 10). Each cell appears to be equipped with exhaust vents that did not appear to be drawing air. In this condition, odors within the holding cells can be directed into the hallway by these fans.

The fourth floor registry of deeds office had a series of retrofitted wall fans installed and were operating during the CEH visits. According to Registry of Deeds staff, a fan was placed in the suspended ceiling to provide heat relief (Picture 11). CEH staff recommended the removal of the fan from the ceiling since it could be a fire hazard.

The garage contains a series of exhaust vents that were not activated during any of the CEH visits. It is likely that these vents were deactivated since the air from the garage appears to exhaust at a ground level bus stop (Picture 12).

To maximize air exchange, the MDPH recommends that all components of the ventilation system (e.g., supply ventilation, exhaust ventilation and FCUs) operate continuously during business hours. Without the HVAC system operating as designed, normally occurring pollutants cannot be diluted or removed, allowing them to build up and

lead to indoor air quality/comfort complaints. In order to have proper ventilation, the systems should also 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 HVAC systems be re-balanced every five years to ensure adequate air systems function (SMACNA, 1994). The date of the last balancing of these systems was not available at the time of the assessment.

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). 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 MPDH 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, see Appendix A.

The following temperature ranges were measured within the HOJ.

April 21, 2005	72° to 84° F
April 22, 2005	72° to 77° F
February 7, 2006	71° to 77° F

Temperature readings on both April 2005 visits were above or mostly in the upper part of the MDPH recommended temperature range of 70° to 78° F. Employees expressed concerns about temperature control in the building (e.g., not enough heat in winter, not enough cooling in hot weather). There are a number of factors that are either heat sources or contribute to these temperature control difficulties.

- The building was originally designed to have large open floors that would be heated or cooled by both the AHU and FCUs located around the perimeter of each office below windows. After the building was constructed, a number of areas were subdivided into offices without taking into consideration the design of the HVAC system. In a number of areas, the FCUs are now separated from the main floor by floor to ceiling, prefabricated walls. These walls disrupt the intended airflow pattern, making temperature control difficult. In an effort to decrease temperature, a fan was installed to exhaust air into the ceiling plenum (Picture 11). Room 421was a newly created room that was separated from the FCUs by an interior wall with windows. During the April 21, 2005 visit, CEH staff suggested removing one of these windows to improve

airflow. When CEH returned to the building in February 2006, the windows remained in place.

- As mentioned previously, the portion of the building that serves as the roof does not appear to be designed as a roof, but rather is a rubber membrane installed over an uninsulated structure. Without insulation, heat from the sun would heat the cement decking of the fourth floor, which would subsequently heat the ceiling plenum and the office space below the suspended ceiling.
- The window system of the building consists of a single pane of glass installed inside a metal frame. When exposed to direct sunlight in warm weather, the glass and metal of the windows become a significant heat source (during the April 2005 visits, surface temperature of windows in sunlight was measured over 100°F in an office on the south wall of the HOJ). Conversely, windows that are not exposed to sunlight and are exposed to northwesterly winds during frigid weather have a significantly lower temperature than interior walls (window frame temperatures ranged from 48°F to 74°F; windowpane temperatures ranged from 43°F to 75°F) during the February 2006 visit. In both instances, the location of the room and weather conditions will have a significant influence on room temperature.
- The floors of offices that overhang the ground had a temperature in a range of 57°F to 59°F, which were lower than temperatures of the floor in areas that exist toward the building core. It could not be determined whether the floor of overhanging offices are insulated.
- In areas where the FCUs are installed, a significant number of large computer monitors exist. The air temperature measured in the vent at the top of a monitor was 115°F.

- Some areas had thermostats installed in a manner that limits their ability to measure air temperature. Some thermostats were installed behind shelves filled with files (Picture 13). In one case, a computer monitor was directly below the thermostat (Picture 14). Thermostats need to be installed in a location that can measure airflow representative of the area and not be in close proximity to a heat source (computer monitors, photocopiers, etc.).

Therefore, a number of factors exist that contribute to the difficulty in controlling temperature in this building. Please note that even without these design and construction issues, fluctuations of temperature in occupied spaces are typically experienced, even in a building with an adequate fresh air supply.

The following relative humidity ranges were measured within the HOJ.

April 21, 2005	13% to 21%
April 22, 2005	16% to 28%
February 7, 2006	19% to 31%

The relative humidity in the HOJ was below the MDPH recommended range of 40 to 60 percent in all areas sampled. Relative humidity 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 a common problem during the heating season in the northeast part of the United States.

Microbial/Moisture Concerns

The east wall of the fourth floor consists of a short wall with large sloping windows. The window system was designed to direct rainwater onto a short roof behind a

parapet (Picture 15). Heavy moss growth was noted on this roof, particularly around drains (Picture 16). Moss growth around these drains is an indication of chronic water pooling on the roof. The freezing and thawing of water during winter months can lead to roof leaks and subsequent water penetration into the interior of the building. Areas in the District Attorney's office and law library had extensive water damage (Pictures 17 and 18).

The American Conference of Governmental Industrial Hygienists (ACGIH) and the United States Environmental Protection Agency (US EPA) recommend that porous materials be dried with fans and heating within 24 to 48 hours of becoming wet (ACGIH, 1989; US EPA, 2001). If porous materials are not dried within this time frame, mold growth may occur. Water-damaged porous materials cannot be adequately cleaned to remove mold growth. The application of a mildewcide to moldy porous materials is not recommended.

The Registry of Deeds built a server room that requires air conditioning (AC) for computer equipment. A self-contained AC system was installed in this room. As air conditioning equipment operates, moisture accumulates in the cooling coils that require a drain to remove water from the cabinet. CEH staff located the drain, but could not identify if the drainpipe was connected to a building drainage system. If not connected to a building drainage system, water likely accumulates and pools within the AC unit. Pooling water of this nature can serve as a mold growth medium. CEH staff inspected several FCUs, which were equipped with drip pans and drains connected to a drainage system (Picture 19).

Plants were observed in a number of rooms. Moistened plant soil and drip pans can provide a source of mold growth. Plants are also a source of 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.

A large planter is located along the western wall of the HOJ (Picture 20). A public records area exists beneath and adjacent to the planter. The ceiling in this area appeared to be water damaged in a manner similar to the third floor of the HOJ. As with roofs, planters of this type must adequately drain in order to prevent water damage to adjacent walls and ceilings.

Other Concerns

Building occupants expressed concerns about a possible chemical exposure within the HOJ resulting from the past use of the site. As revealed by HOJ facilities staff, the HOJ was built on the site of a former gasoline service station (Blueprint 1). Gasoline is a complex mixture of a variety of volatile organic compounds (VOCs). In order to assess whether residual contamination was present within the HOJ, air sampling for the presence of volatile organic compounds (VOCs) was conducted. VOCs are substances that have the ability to evaporate at room temperature. For example, solvent-based chemicals that rapidly evaporate at room temperature and would likely contain VOCs. Frequently, exposure to low levels of total VOCs (TVOCs) may produce eye, nose, throat and/or respiratory irritation in some sensitive individuals.

CEH staff conducted TVOC sampling in offices and all common areas (Table 1). Air sampling was also conducted in areas that would be most likely impacted by VOCs

from a high water table (e.g., the basement). A likely route for odor and vapors to enter into the HOJ would be through floor penetrations (e.g. access ports, drains or cracks). Background (i.e. outdoor) TVOC sampling was conducted for comparison. No measurable levels of TVOCs were detected inside the HOJ or outdoors on the day of assessment. Therefore, it does not appear likely that any residual contamination from possible gasoline contamination exists.

The location of the HOJ however, does make it prone to entraining outdoor pollutants into the building via the HVAC system. In Massachusetts, the wind direction is predominantly from a westerly direction. A number of sources that produce pollutants were observed west/southwest (upwind) from the HOJ. The following conditions were either reported to or directly observed by CEH staff:

- A major truck route intersects State Street and E. Columbus Avenue at a stop light to the southwest of the building (Picture 21). Exhaust from idling vehicles is directed toward the HOJ under certain wind conditions.
- Building occupants reported periodic odors, mainly during southwest winds, from Bondi Island, which contains the Springfield Regional Wastewater Treatment Facility (Map 1).
- Approximately 30 feet above E. Columbus Street is an elevated portion of Interstate-91 (Picture 22).
- A construction project was observed beneath an Interstate 91 overpass west of the building (Picture 23).

Under certain wind patterns, each of these pollutants sources has likely had some influence on the indoor air quality at the HOJ. As reported by HOJ facilities staff, when odors from

Bondi Island are reported, the ventilation system fresh air intakes are closed, which would be the most appropriate procedure since HVAC system filters do not have the ability to remove gaseous materials from air. The HOJ uses a roller filter system, which also does not likely filter extremely fine dust, such as vehicle exhaust particulates.

FCUs are normally equipped with filters that strain particulates from airflow. Filter materials cut to size were found inside the FCUs (Picture 24). Air may bypass improperly sized filters through spaces in the frame and result in aerosolization of dust. In order to decrease aerosolized particulates, disposable filters with an adequate dust spot efficiency should be installed. The dust spot efficiency is the ability of a filter to remove particulates of a certain diameter from air passing through the filter. Filters that have been determined by ASHRAE to meet its standard for a dust spot efficiency of a minimum of 40 percent would be sufficient to reduce airborne particulates (Thornburg, 2000; MEHRC, 1997; ASHRAE, 1992).

The interiors of a number of FCUs were examined. An antimicrobial agent was found in FCU drip pans (Picture 25). The use of this product in FCU drip pans is not necessary. In order to support bacteria growth such as *L. pneumophila*, moisture within a certain temperature range must be achieved. The ideal temperature for this microorganism to grow is at temperatures between 80 to 120° F (27 to 49° C) in the presence of sunlight, oxygen, and nutrients such as phosphorous, nitrogen, sulfate and carbon dioxide (Lane, R.W., 1993). Organisms such as algae, mold, *Legionella pneumophila* (Gold, D. 1992) and other microbes have been found to grow within HVAC equipment that reuses water, such as cooling towers. The purpose of cooling towers in an HVAC system is to ***remove heat from coolant***, which warms water to the requisite temperature for microbial growth.

The purpose of drip pans is to ***drain*** moisture generated by *cooling coils*. The temperature of FCU coils in the cooling mode during the summer is less than 60° F. Lower temperature and removal of moisture through proper drainage would limit microbial growth in FCUs, rendering the use of the antimicrobial agent unnecessary.

Of note are the constituents of the antimicrobial product that are frequently alkaline materials. The odor produced by this product is characterized as a "mothball-like" odor. As condensation comes into contact with the antimicrobial ingredients they form a solution. This solution may become aerosolized during FCU operation if standing water exists in drip pans. Exposure to this product may cause irritation to the eyes and skin.

A number of offices contained photocopiers, which can produce irritating odors during use. 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). These areas are not equipped with local exhaust ventilation to help reduce excess heat and odors.

Of note was a variety of break rooms that were equipped with stoves or microwave ovens. Each of these areas appear not to have exhaust vents designed to remove cooking odors. Cooking odors can enter the general ventilation system and be subsequently distributed to other areas serviced by the general HVAC system.

An unused drain was found in the floor of a room in the Registry of Deeds (Picture 26). The drain likely has a dry trap, which can allow sewer gases/odors to migrate from the drain system into occupied space. The drain should be filled regularly with water or sealed to prevent this contingency.

Conclusions/Recommendations

The indoor air quality conditions at the HOJ are somewhat complex and interconnected. Decisions made concerning the design and construction of the building make it prone to entraining a variety of odors and pollutants from surrounding sources. In addition, the configuration of the roof and the type of window system installed make it difficult to control temperatures in the building. The subsequent subdivision of floors without consideration for the adequacy of ventilation also plays a significant role in temperature control. The lack of measurable TVOC levels would indicate that the HOJ does not appear to be impacted from the previous use of this site.

While some problems can be addressed as soon as practicable, others will require planning and resources. For this reason, a two-phase approach consisting of **short-term** measures to improve air quality and **long-term** measures to address the overall indoor air quality concerns is recommended.

Short Term Recommendations

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

1. During times of odors from the Bondi Island area, continue to limit fresh air intake into the HOJ until the odor passes.
2. Do not install fans into the suspended ceiling as depicted in Picture 11.
3. Discuss with the City of Springfield the feasibility of decreasing the length of time that traffic is stopped at the State Street intersection.

4. No further subdivision of floor space should be conducted by building occupants unless this reconfiguration is done in consultation with the Bureau of Court Facilities to ensure that adequate airflow and temperature control can be provided for such space.

5. Consideration should be give to relocating thermostats to locations that have free airflow, or that materials obstructing airflow to thermostats be relocated.

6. Remove all waste heat producing electronic devices from close proximity to thermostats.

7. Use window shades/blinds as much as practical to reduce heat/cold transmission into offices. Operate the FCUs in a manner to heat/temper air in perimeter areas.

8. Seal the drain shown in Picture 26.

9. Remove antimicrobial pads from all FCUs.

10. Relocate photocopiers from vicinity of FCUs.

11. Remove the window from the interior wall of the Registry of Deeds room to facilitate airflow.

12. Examine the feasibility of connecting the self-contained air conditioner in the Registry of Deeds' server room to the drain system. Connect this drain to the main HVAC/FCU drain system. Any installation of air chilling equipment must provide for adequate means to drain condensation. Any installation of such equipment should be done in consultation with the Bureau of Court Facilities to ensure that adequate drainage for equipment exists.

13. Install properly fitted filters for FCUs. Consult with a ventilation engineer concerning the appropriate filter media for the FCUs.

14. Consult a ventilation engineer concerning re-balancing of the ventilation systems. Ventilation industrial standards recommend that mechanical ventilation systems be balanced every five years (SMACNA, 1994).

15. Repair the exhaust vent system for holding cells.

16. 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).

17. Remove debris from the short roof.

18. Continue with replacement of wet ceiling tiles and channel leaking water into collection containers until roof repairs are complete. Once the roof repair is complete, repair the water damaged areas in the building in a manner consistent with guidelines set forth in "Mold Remediation in Schools and Commercial Buildings" published by the US Environmental Protection Agency (US EPA, 2001).

Long Term Recommendations

1. Continue with repairs to establish a functional, insulated roof to eliminate water leaks and improve temperature control.

2. Consideration should be given to replacing the existing window system with an energy efficient, double-paned type in order to eliminate heat/cold transmission into exterior walls.

3. In order to improve air distribution from FCUs, consideration should be given to replacing floor-to-ceiling retrofitted walls with barriers that are open at the top to increase airflow.

4. Examine the feasibility of installing dedicated exhaust vents for all areas with cooking equipment.

5. While the parking garage does not appear to have an impact on the HOJ, consideration should be given to reconfiguring the exhaust system to eliminate its venting at sidewalk level.

References

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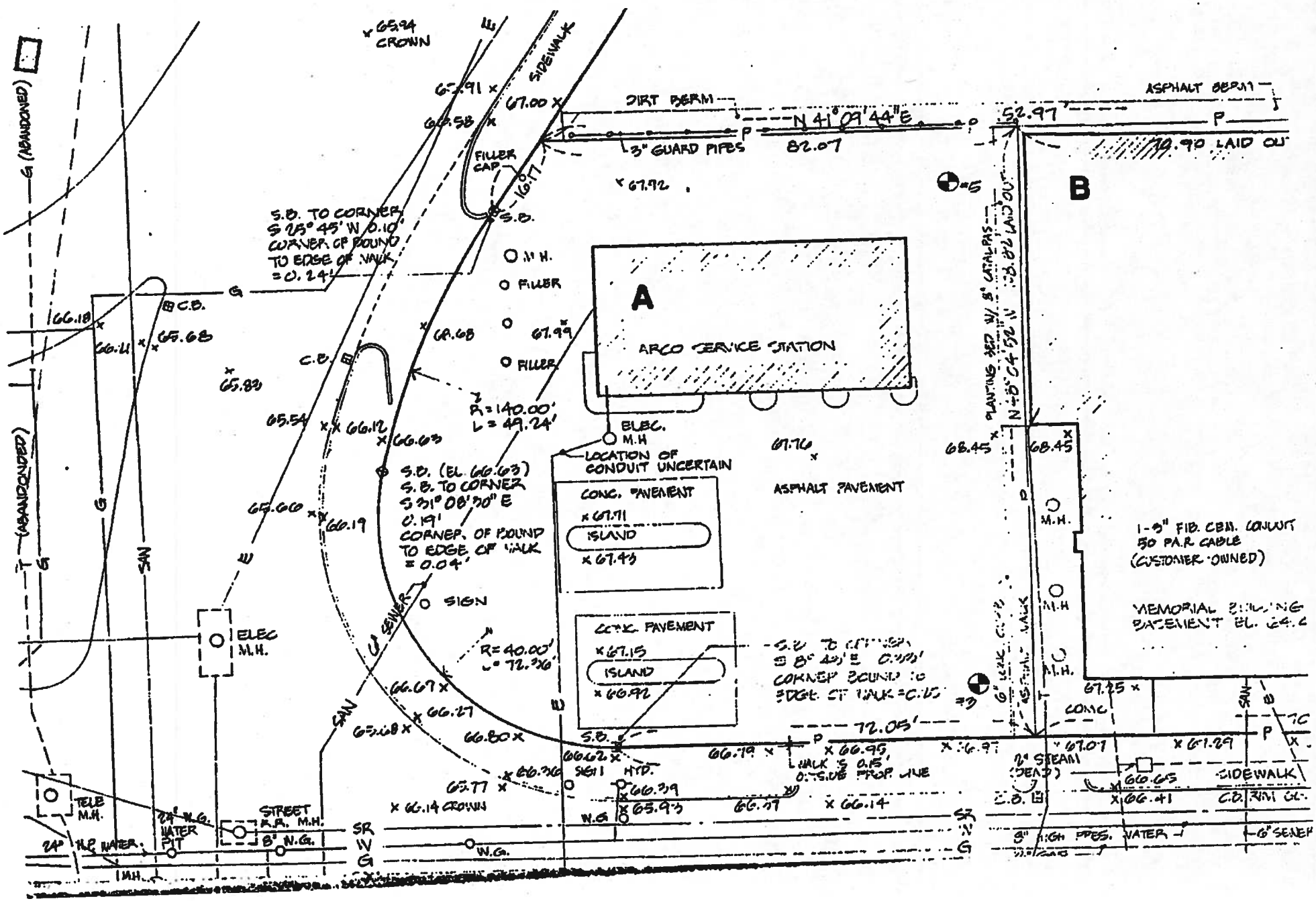
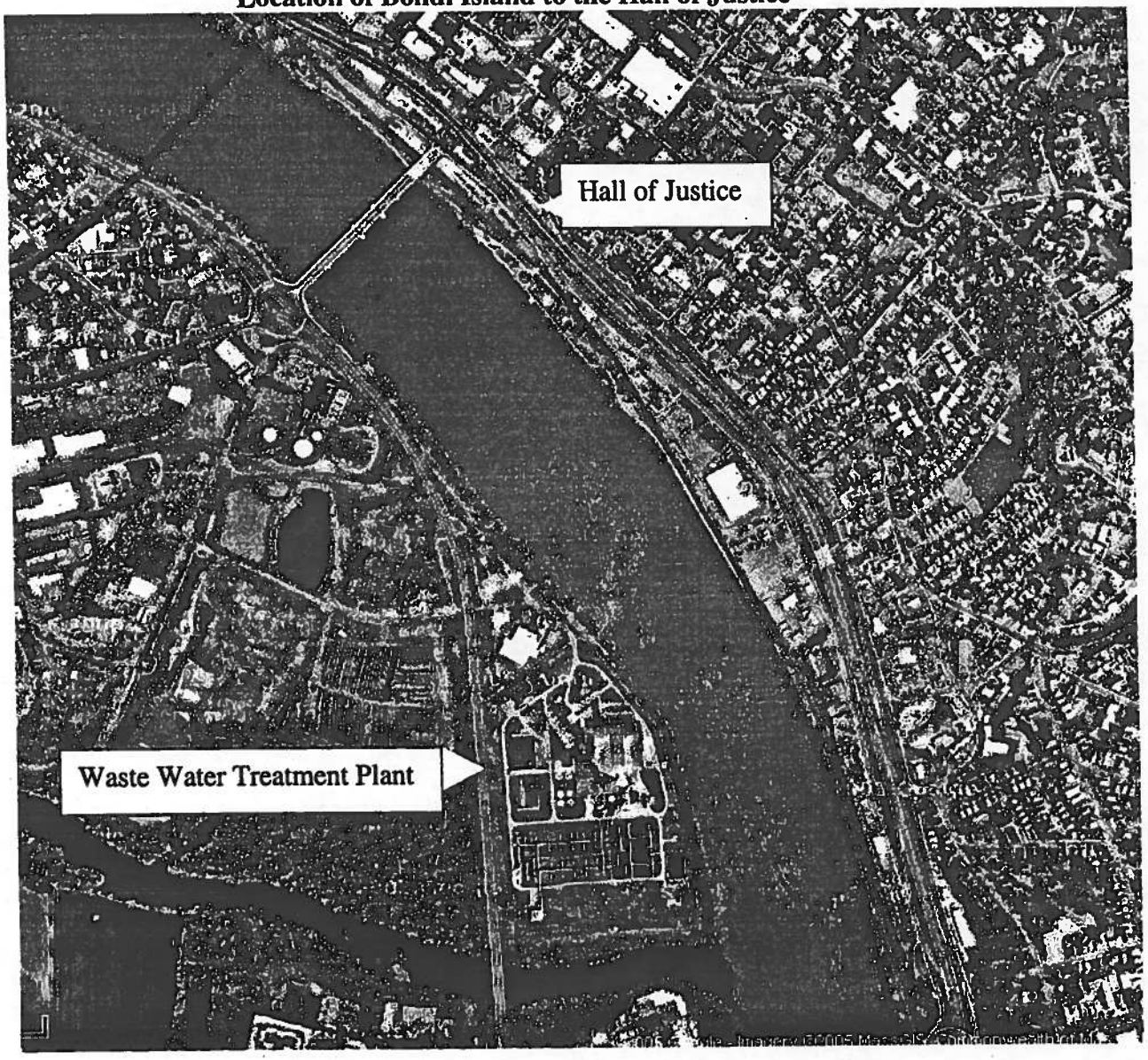
Blueprint 1

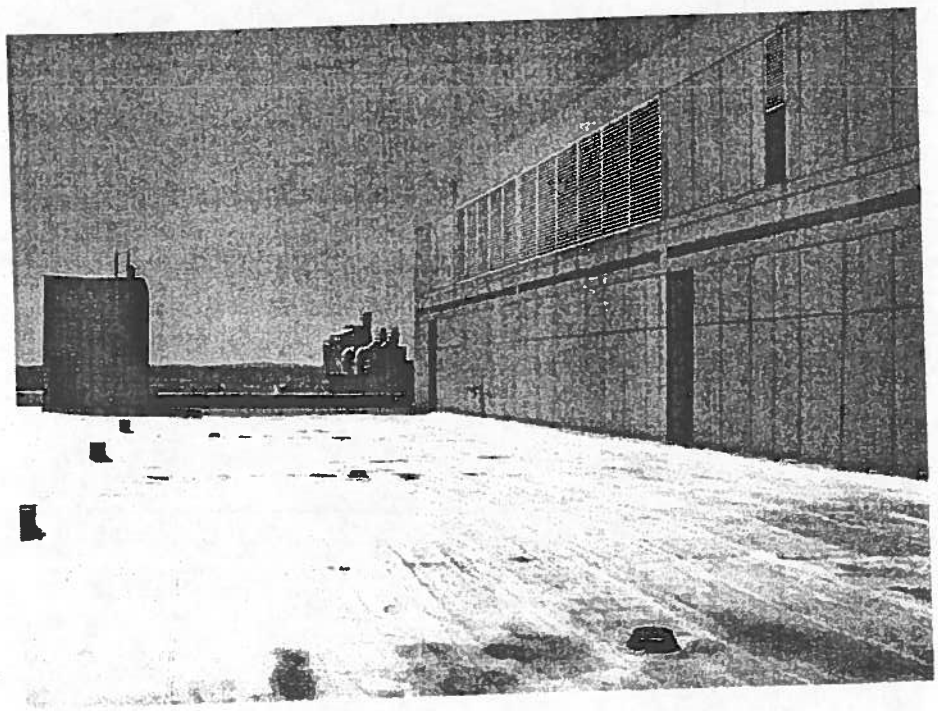
Blueprint of Hall Of Justice Plot, Indication a Gasoline Station Existed on the Site Previous to Construction



Map 1
Location of Bondi Island to the Hall of Justice

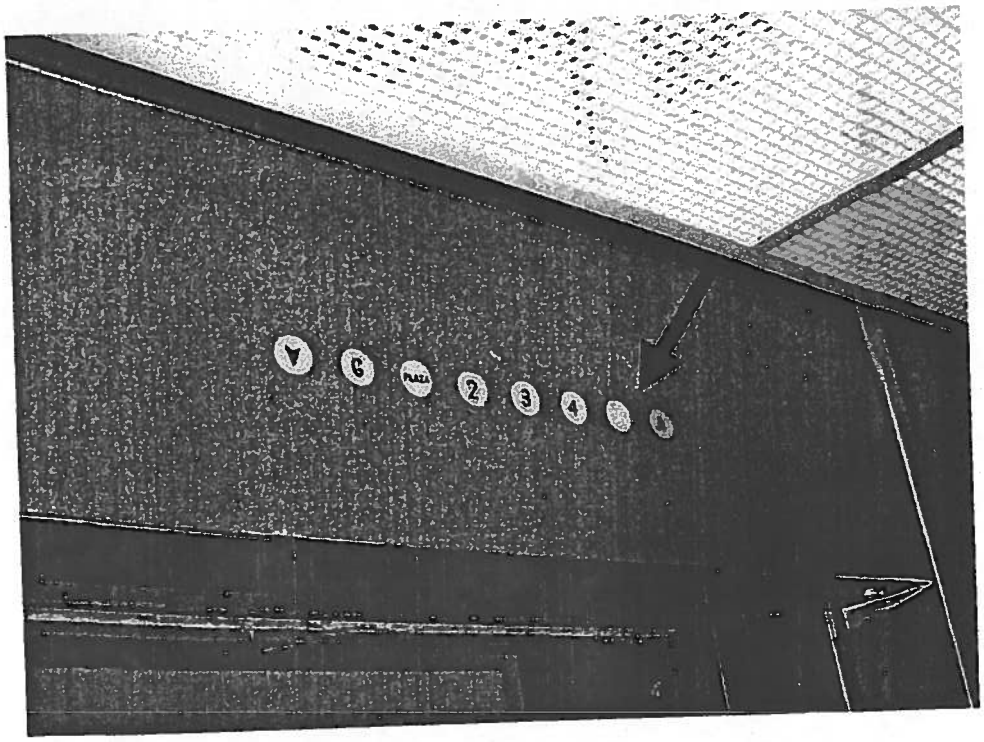


Picture 1



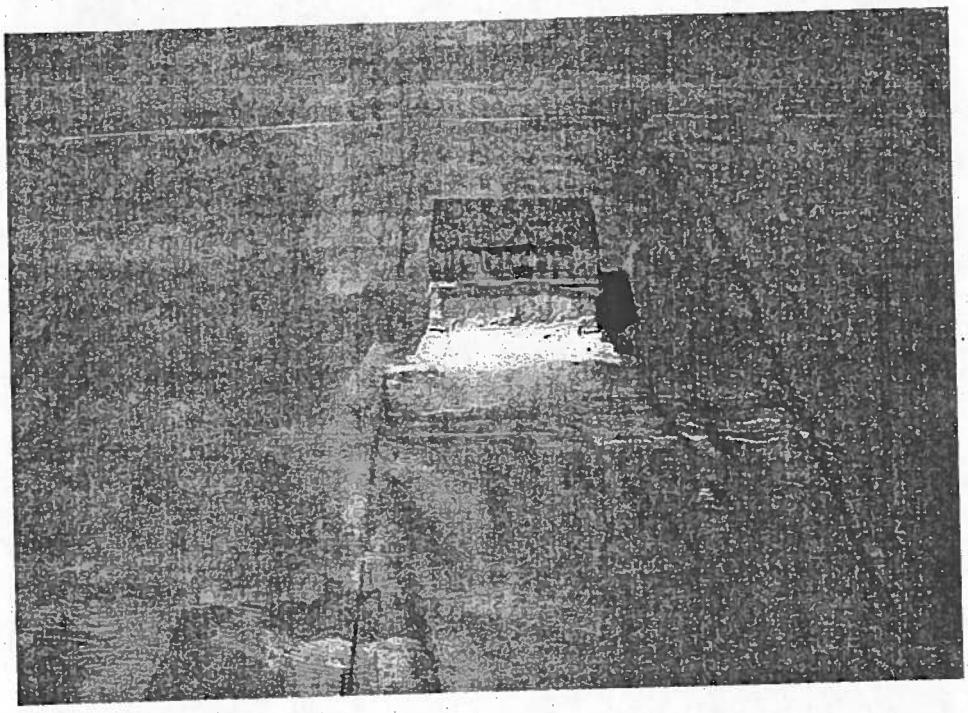
Two-Story Rooftop Penthouse

Picture 2



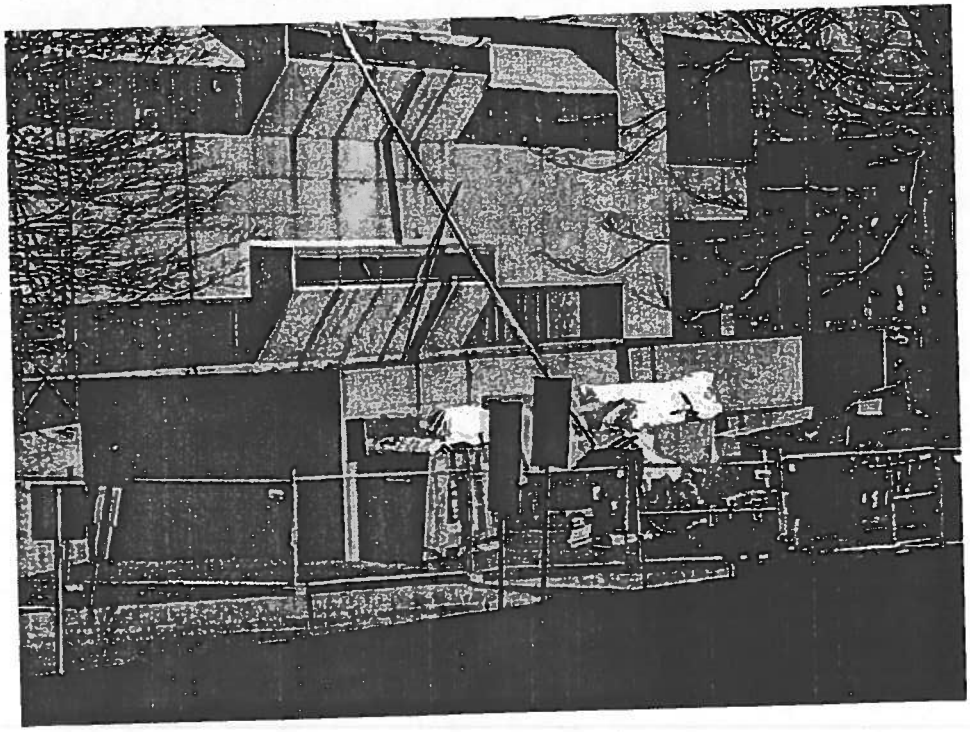
Elevator Floor Indicator Has an Extra-Unlabelled Light

Picture 3



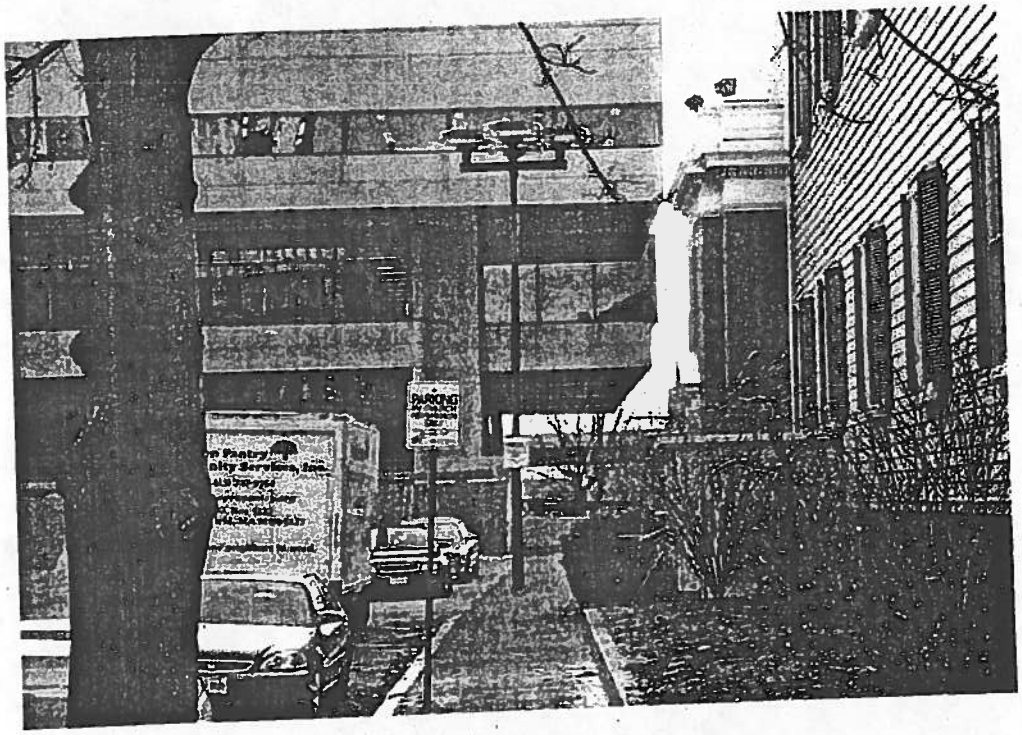
Roof Membrane, Note I-Beams Installed Through Roof

Picture 4



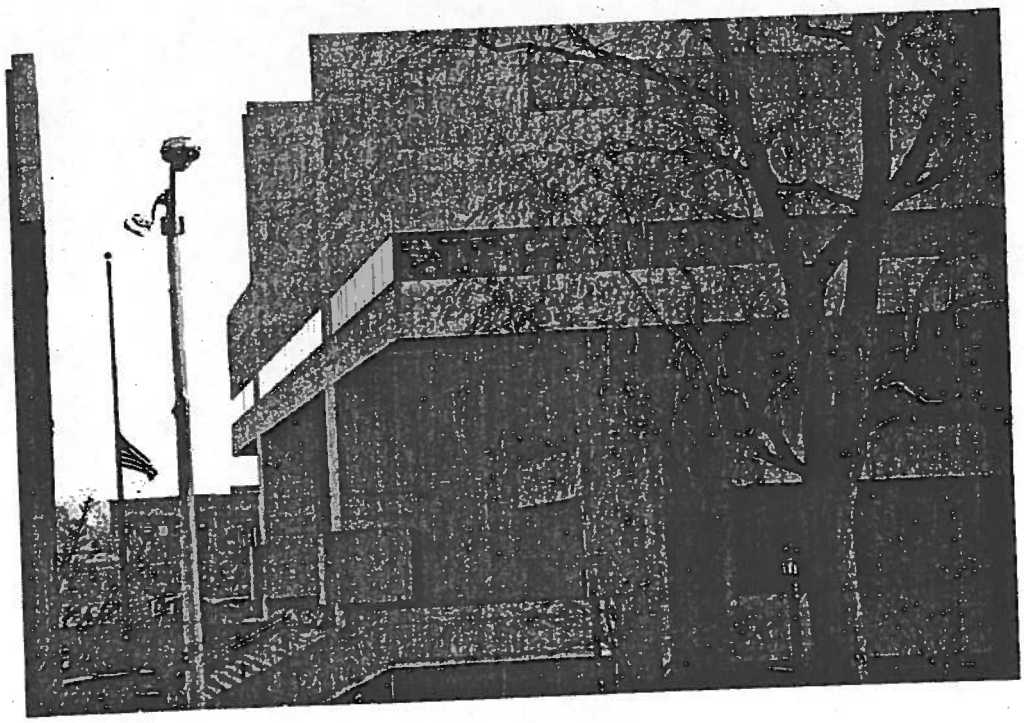
Roof Work Staging Area

Picture 5



Floor Overhang over Driveway, North

Picture 6

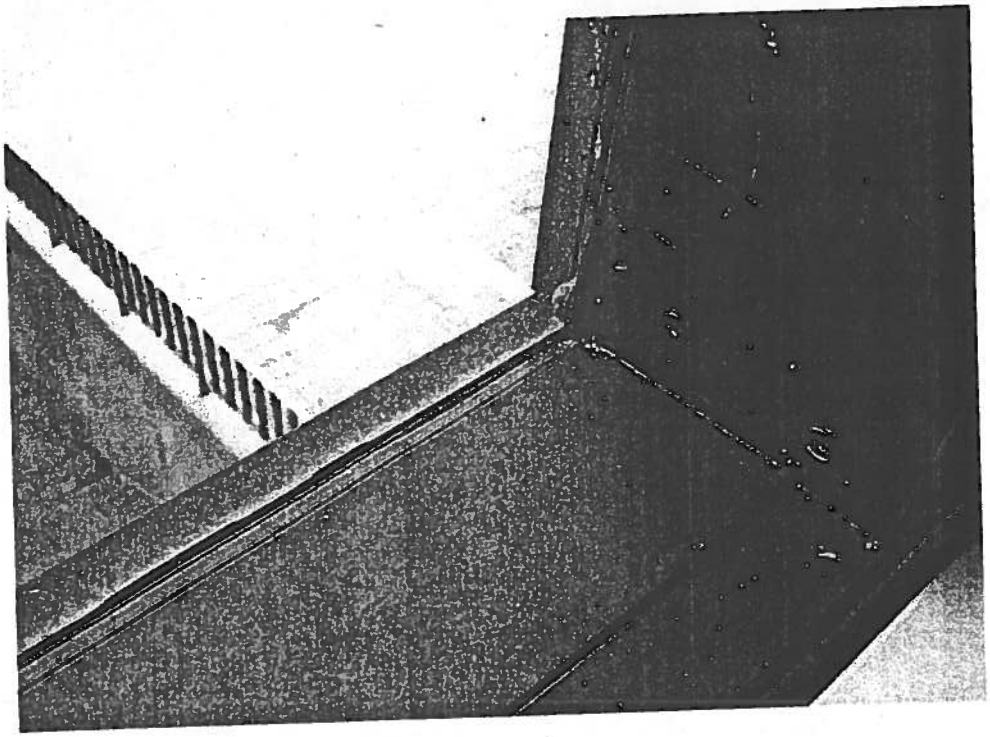


Floor Overhang, East

Picture 7

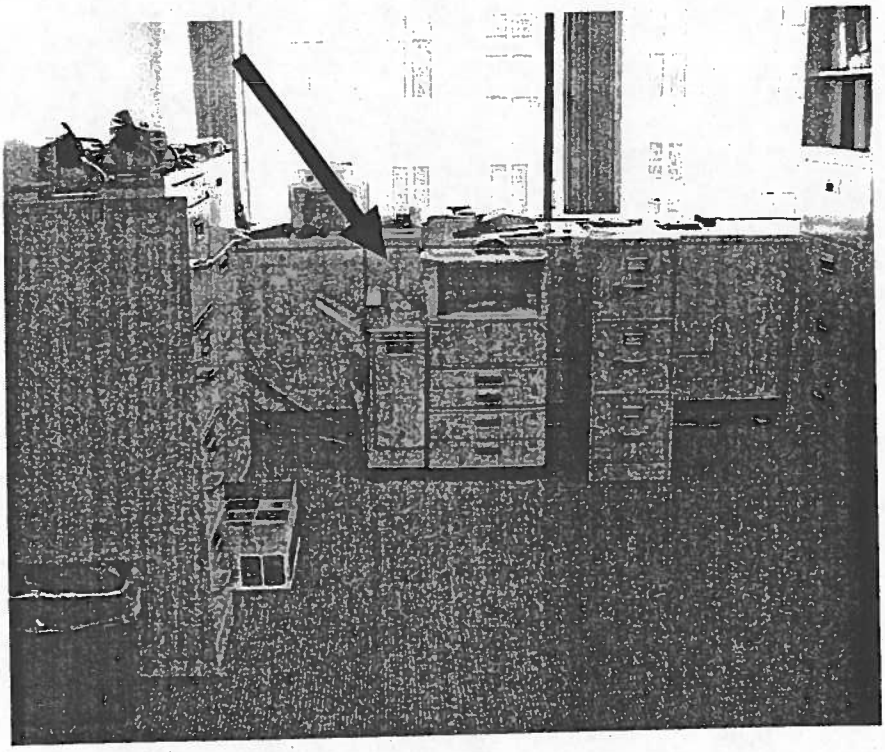
Floor Overhang, South

Picture 8



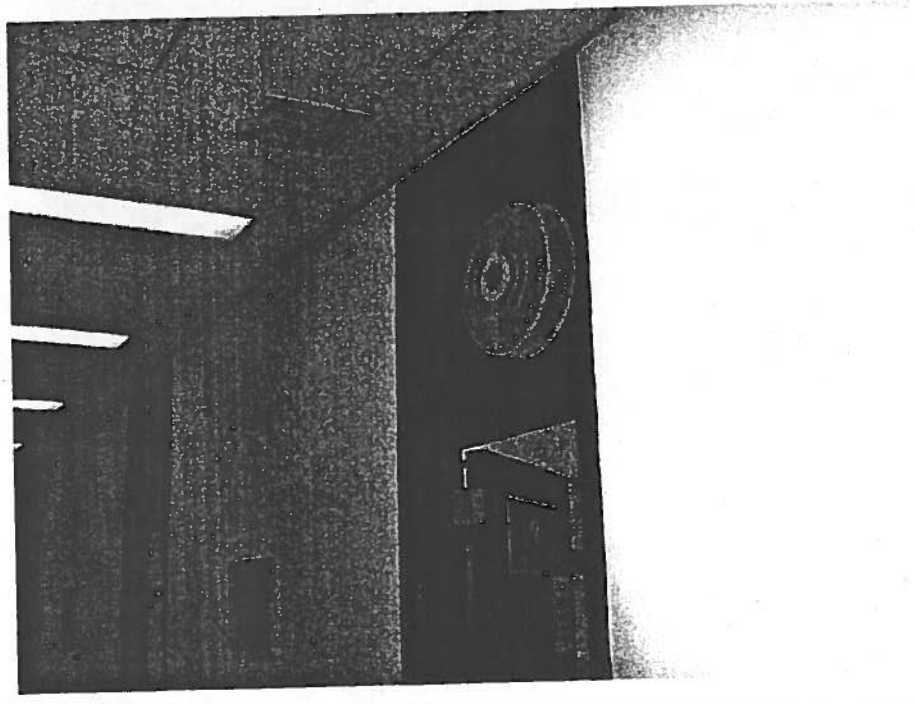
Windows Are Single Glass Panes in Metal Frames

Picture 9



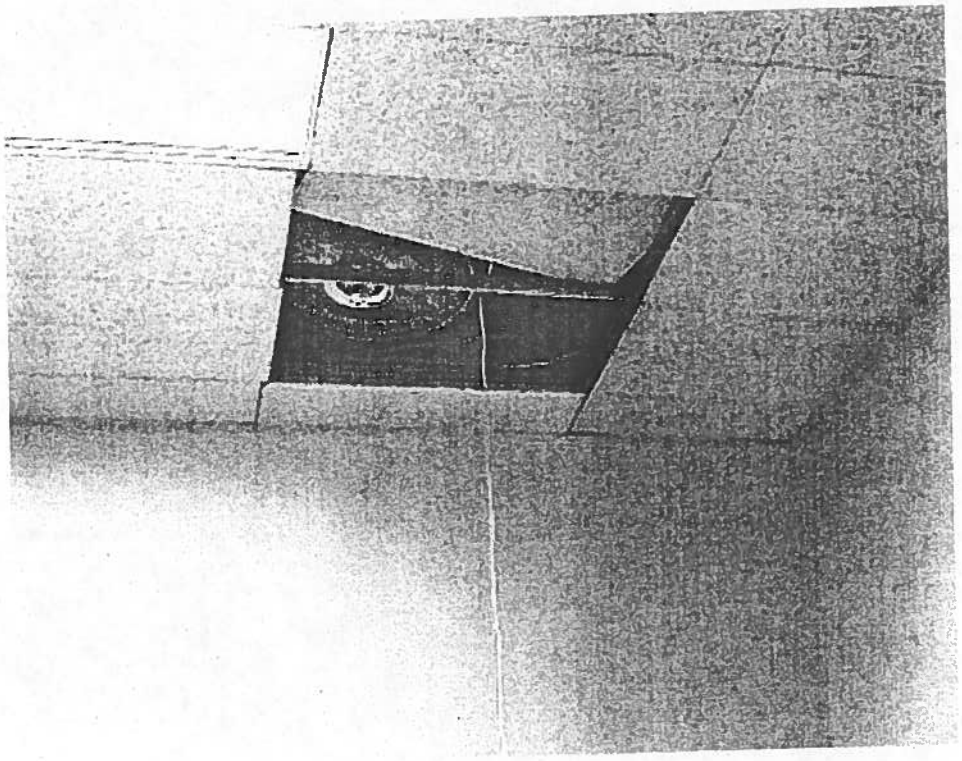
Fan Coil Unit (Arrow) Blocked By Photocopier

Picture 10



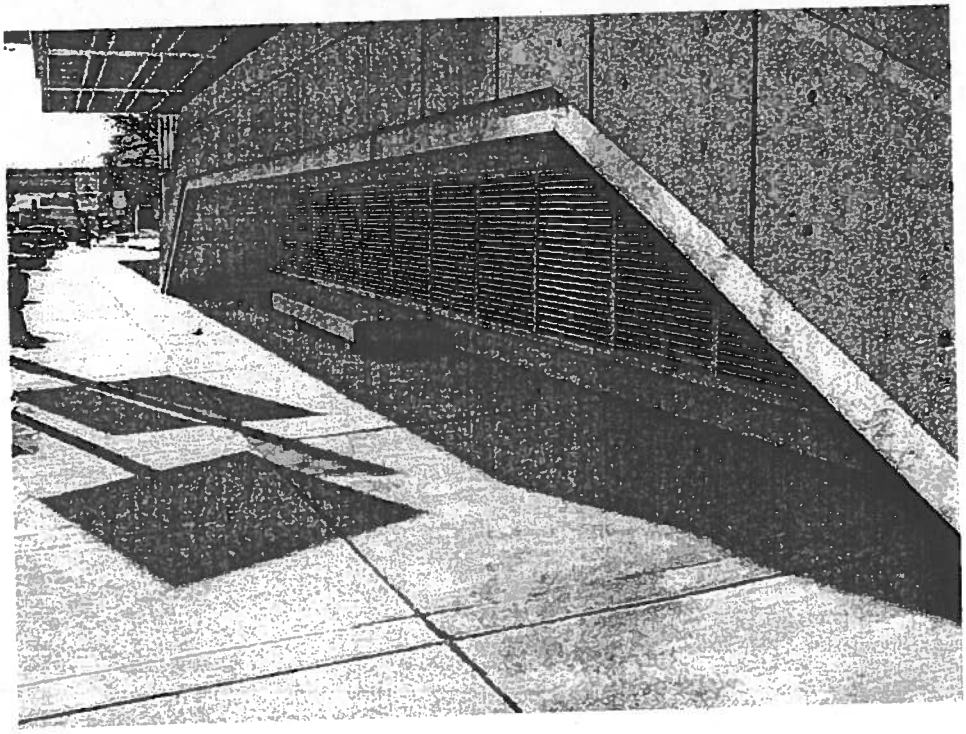
Fan Retrofitted Into the Top of Doorway Leading the Holding Cells

Picture 11



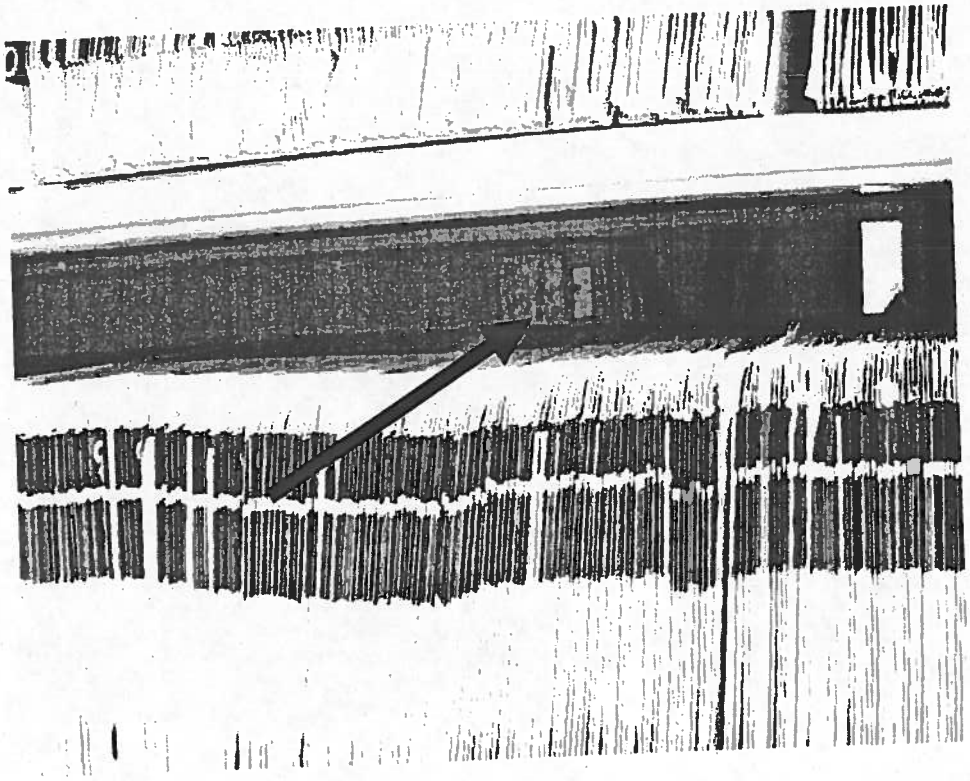
Fan Placed In Ceiling Plenum in Room Of Registry of Deeds

Picture 12



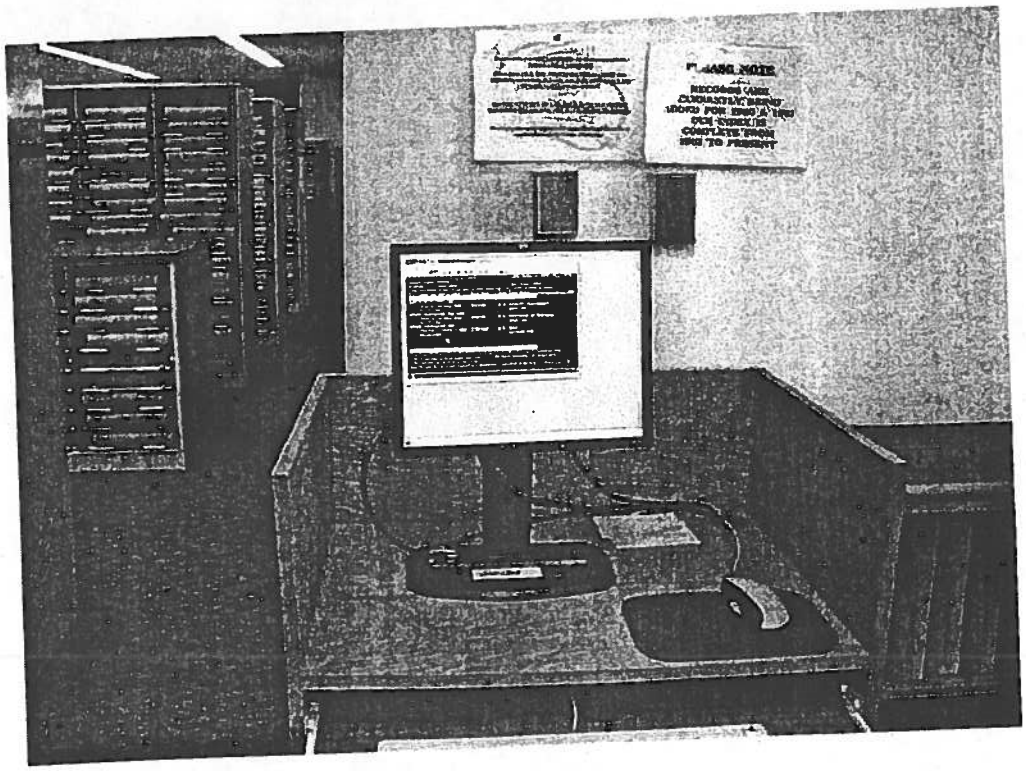
Exhaust Vent for Parking Garage

Picture 13



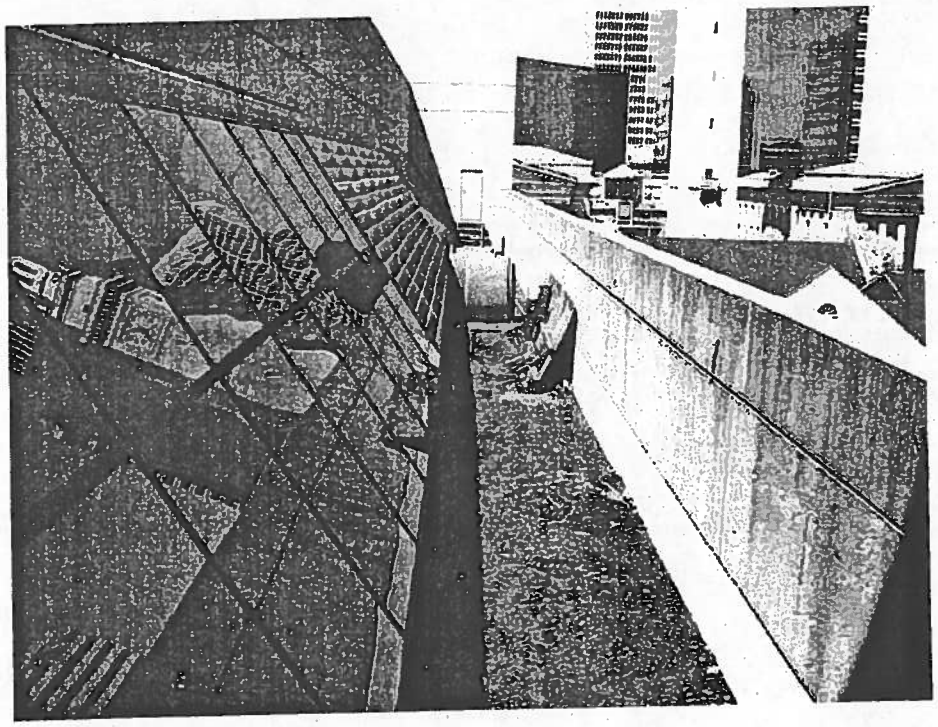
Thermostat Located Behind Files on Shelf

Picture 14



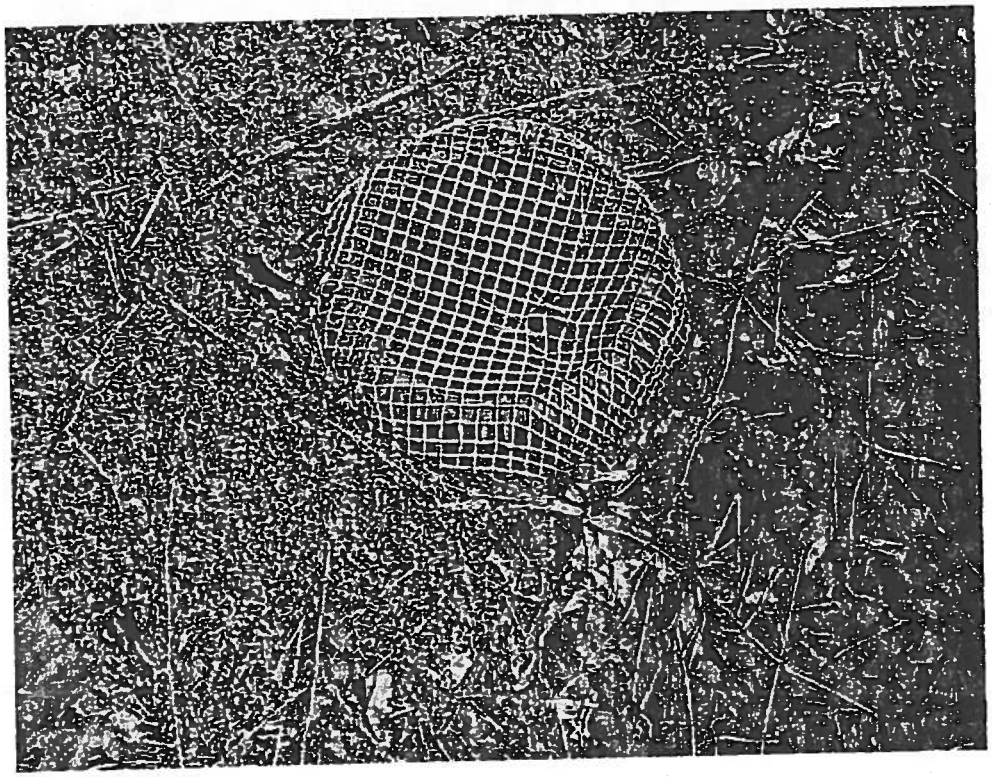
Thermostat Located Above Computer Monitor in Registry of Deeds

Picture 15



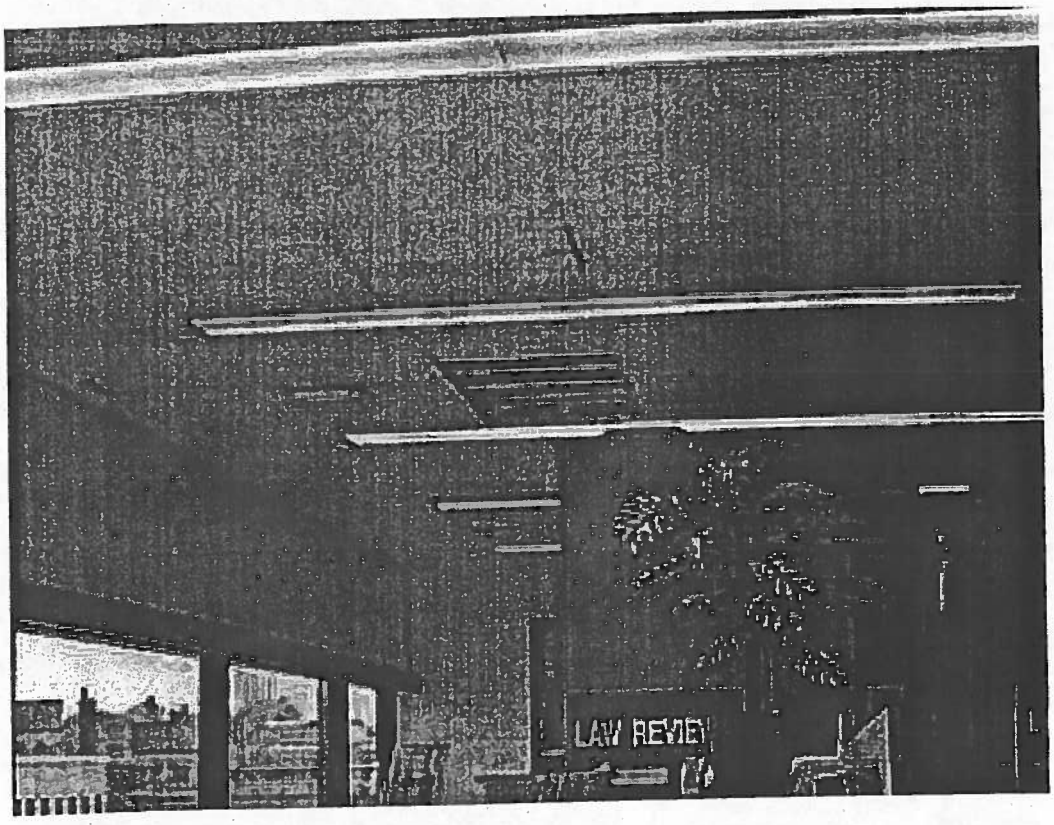
Short Roof over Library at Fourth Floor Level, Note Moss and Debris on Roof

Picture 16



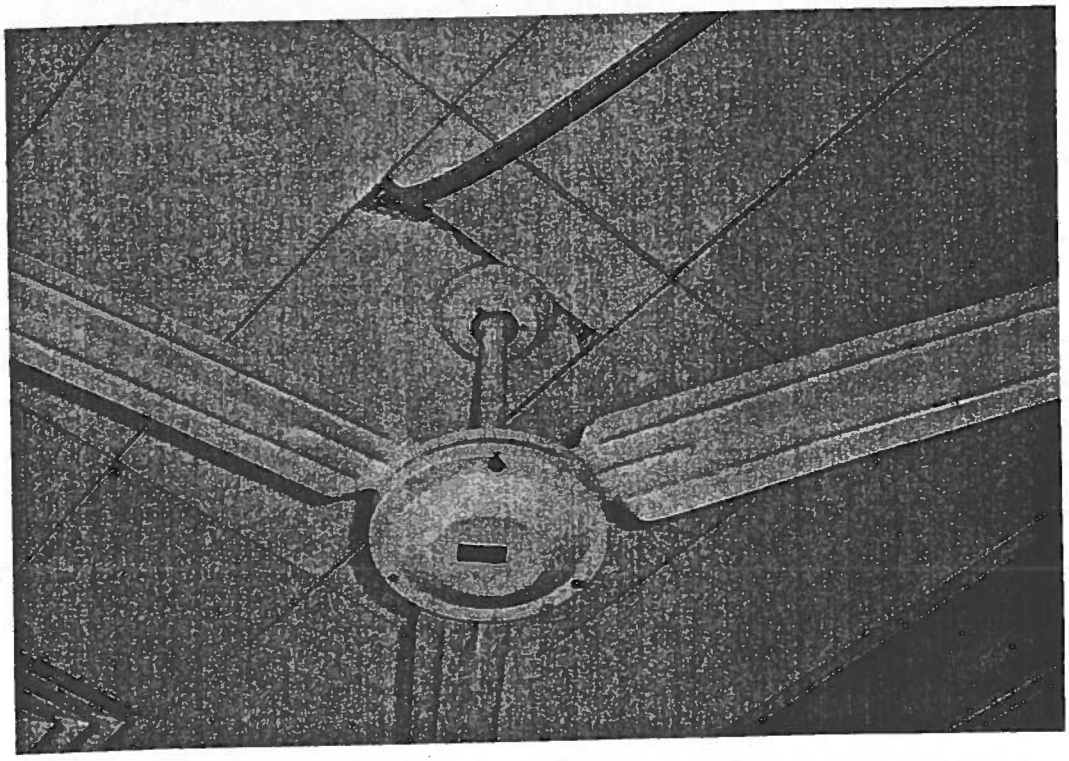
Roof Membrane Damage and Moss Growth

Picture 17



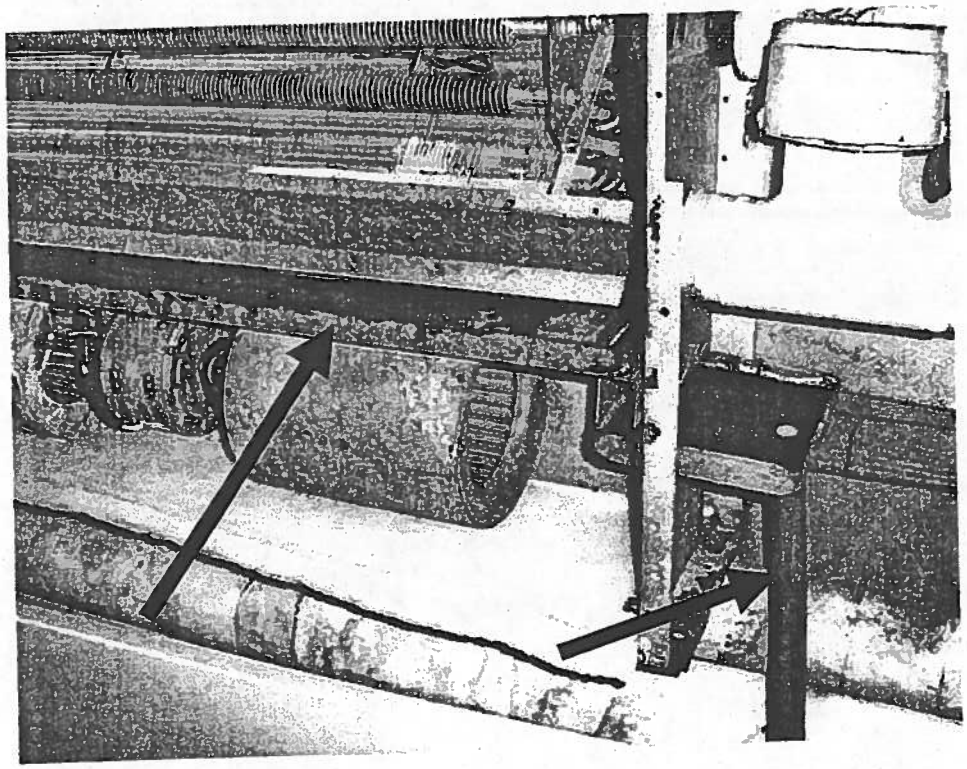
Water Damage Ceiling in Library

Picture 18



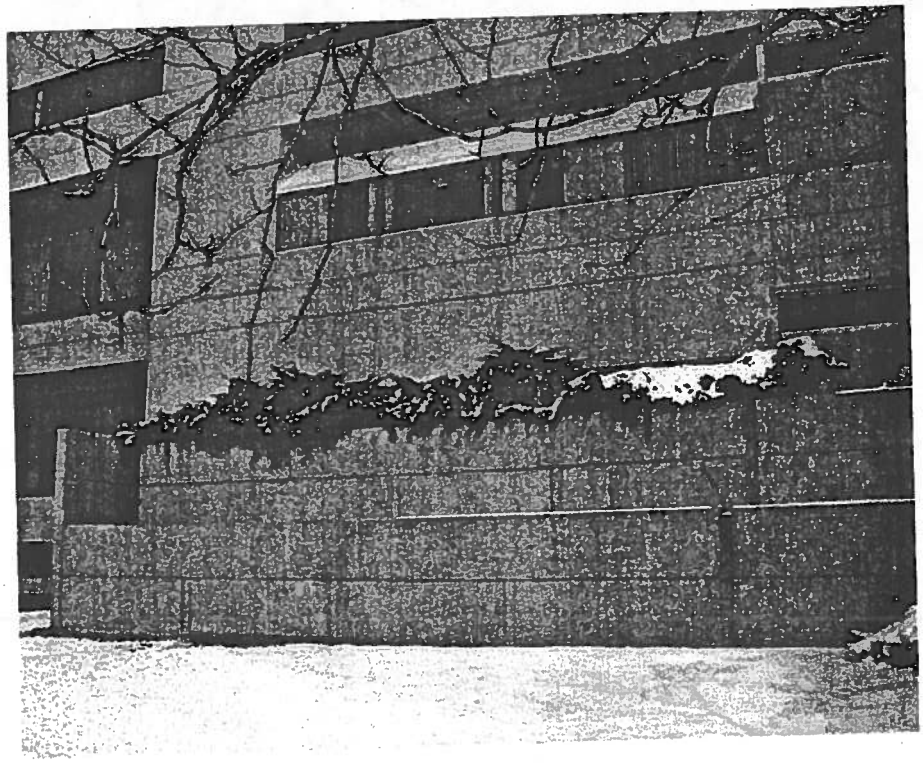
Water Damage Ceiling in DA's Office Suite, East Wall

Picture 19



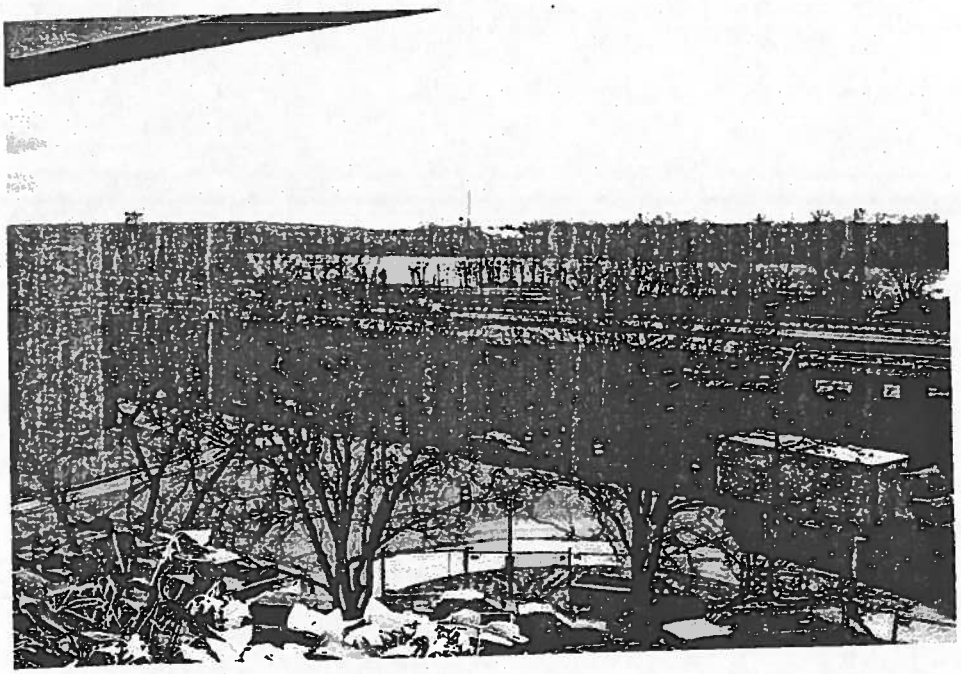
Drip Pan and Drain in FCU (Arrows)

Picture 20



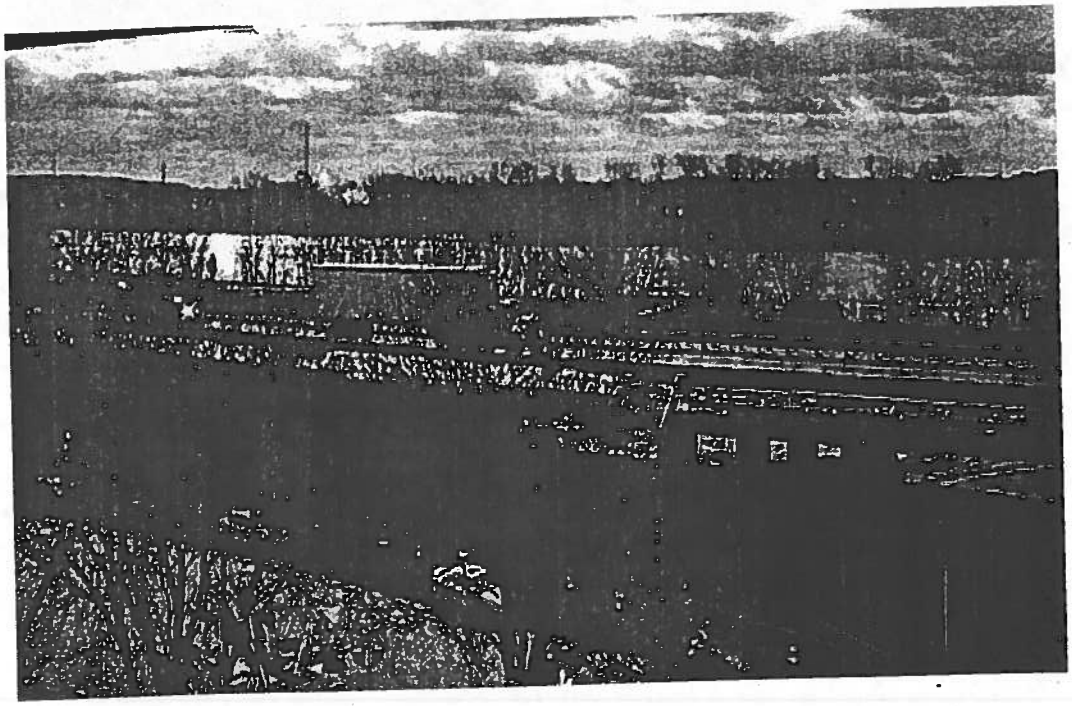
Planter Built Into Building

Picture 21



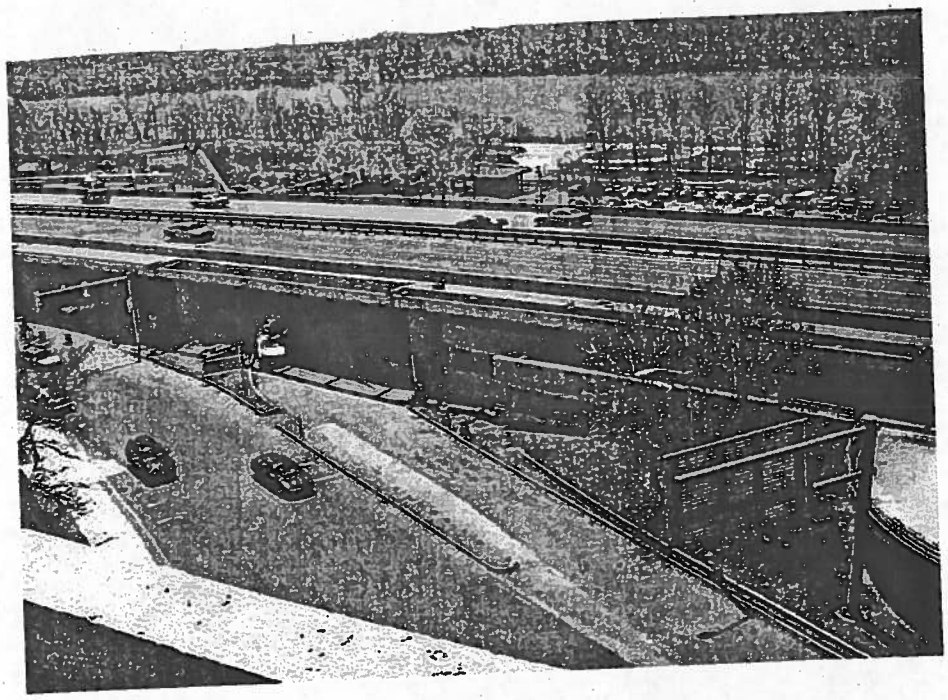
Intersection of E. Columbus Avenue and State Street, Southwest of HOJ, Second Floor Judge's Lobby

Picture 22



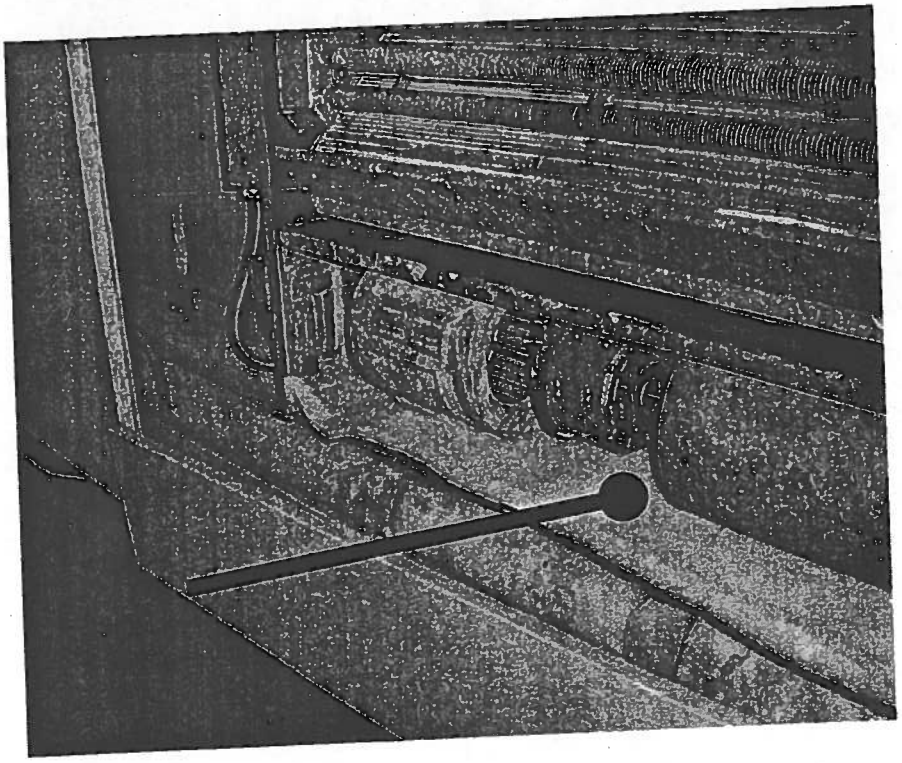
Interstate 91, View from inside HOJ, Second Floor Judge's Lobby

Picture 23



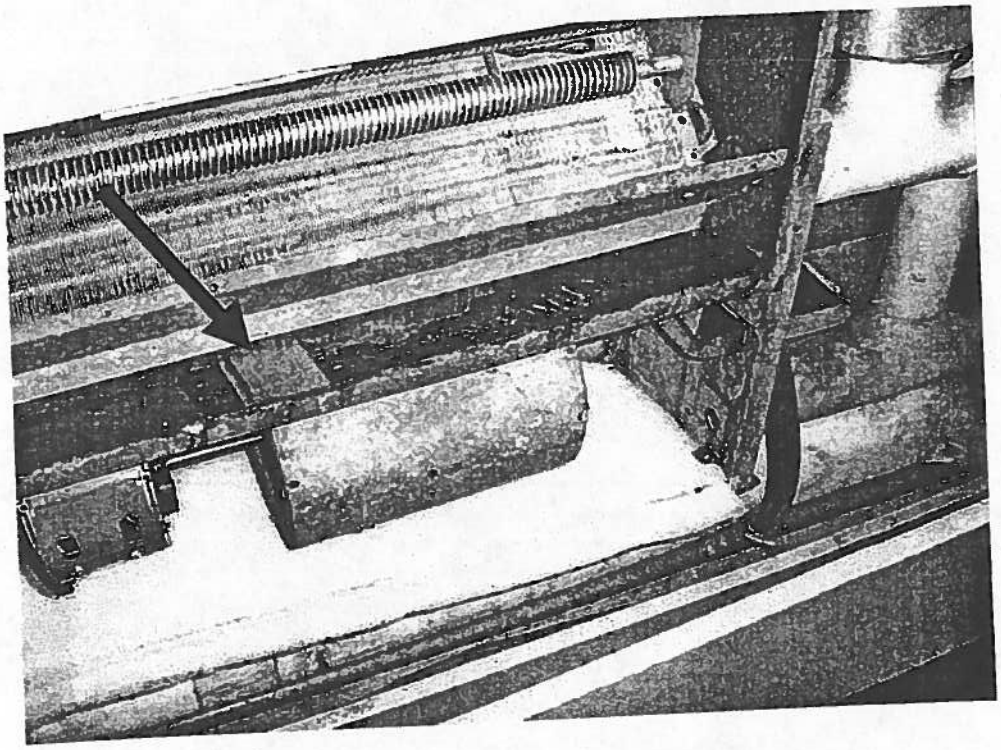
Construction beneath I-91 Overpass, West Of HOJ

Picture 24



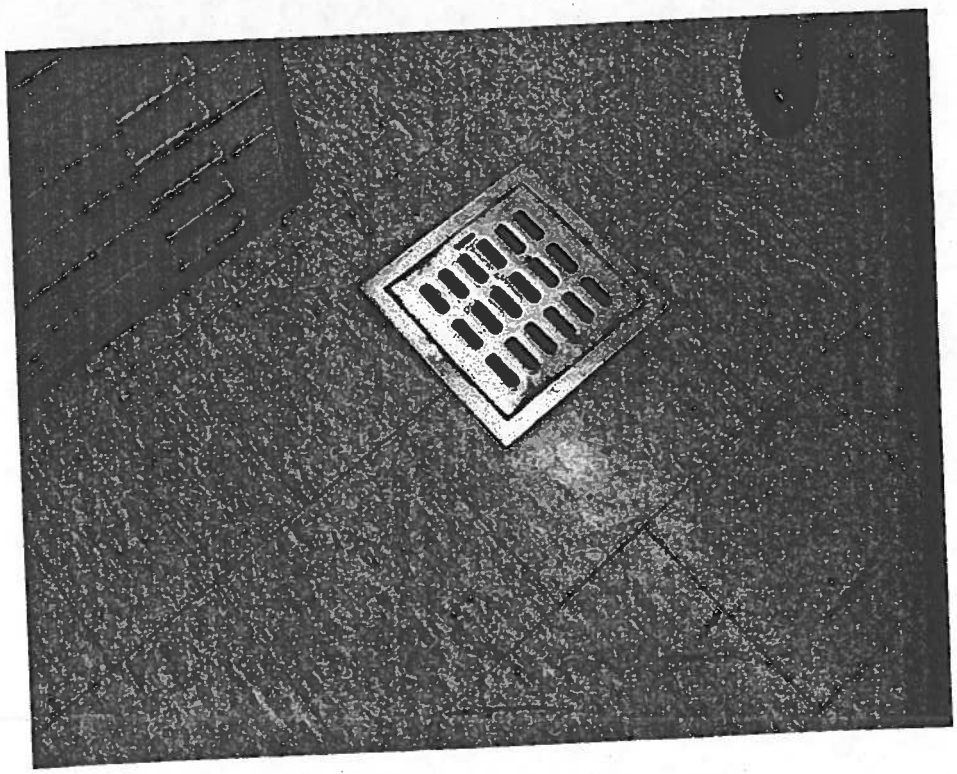
Filter Media Cut To Fit FCU

Picture 25



Antimicrobial Agent in FCU Drip Pan

Picture 26



Drain In Floor of Registry of Deeds

TABLE 1

Indoor Air Test Results
Hall of Justice, 50 State Street, Springfield, MA
April 21, 2005

Location	Carbon Dioxide (*ppm)	Temp. (°F)	Relative Humidity (%)	Total Volatile Organic Compound (*ppm)	Occupants in Room	Windows Openable	Ventilation		Remarks
							Supply	Exhaust	
Outside (Background)	457	68	18	ND					
Jury pool	700	77	21	ND	3	N	Y	Y	Floor fans
Hall 437	656	81	19	ND	0	N	Y	Y	3 missing ceiling tiles
Vault 440	652	81	18	ND	3	N	Y	Y	8 water damaged ceiling tiles door open
431	660	81	18	ND	0	Y	Y	Y	Fan coil unit off
Registry rear office	742	81	19	ND	0	N	Y	Y	Computers
428	773	81	18	ND	2	N	Y	Y	Fan coil unit off Door open
428B	674	81	19	ND	0	N	Y	Y	

- **ppm = parts per million parts of air**
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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 1-1

TABLE 1
Indoor Air Test Results
Hall of Justice, 50 State Street, Springfield, MA
April 21, 2005

Location	Carbon Dioxide (*ppm)	Temp. (°F)	Relative Humidity (%)	Total Volatile Organic Compound (*ppm)	Occupants in Room	Windows Openable	Ventilation		Remarks
							Supply	Exhaust	
423	631	81	18	ND	1	N	Y	Y	Floor fans Door open
Parking garage	420	64	29	ND	4	N	N	Y	Exhaust system off Carbon monoxide non-detectable 1 van idling in garage
Registry of Deeds main desk	625	81	21	ND	10+	N	Y	Y	30 computers retrofitted fans operating ceiling fans operating door open
Registry of Deeds outside 402	597	81	20	ND	5	N	Y	Y	Ceiling fans on
401A	631	81	20	ND	1	Y	N	N	Ceiling fan on Door open
402	601	81	20	ND	0	N	Y	Y	

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Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%

TABLE 1
Indoor Air Test Results
Hall of Justice, 50 State Street, Springfield, MA
April 21, 2005

Location	Carbon Dioxide (*ppm)	Temp. (°F)	Relative Humidity (%)	Total Volatile Organic Compound (*ppm)	Occupants in Room	Windows Openable	Ventilation		Remarks
							Supply	Exhaust	
403A	671	81	20	ND	3	N	Y	Y	
403	668	81	20	ND	2	N	Y	Y	4 computers 1 scanner 1 photocopier plants
403B	644	81	19	ND	0	N	Y	Y	
403C	767	77	21	ND	0	N	Y	Y	Interior air conditioning unit with no condensation
411	615	82	19	ND	2	N	Y	Y	Missing ceiling tile 4 computers 2 photocopiers odor complaints
422	749	82	19	ND	1	N	Y	Y	Floor fan

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TABLE 1
Indoor Air Test Results
Hall of Justice, 50 State Street, Springfield, MA
April 21, 2005

Location	Carbon Dioxide (*ppm)	Temp. (°F)	Relative Humidity (%)	Total Volatile Organic Compound (*ppm)	Occupants in Room	Windows Openable	Ventilation		Remarks
							Supply	Exhaust	
420	746	82	19	ND	1	N	Y	Y	Fan coil unit blocked Door open
421	724	82	19	ND	1	N	Y	Y	Fan coil unit blocked Door open
421	716	81	18	ND	2	N	Y	Y	Fan in ceiling Door open
416	695	82	18	ND	0	N	Y	Y	Fan coil unit off Floor fan
Probate court	494	79	14	ND	0	N	Y	Y	
Jury pool	787	82	21	ND	1	N	Y	Y	Fan coil unit off Floor fan
412	643	82	18	ND	2	Y	Y	Y	Floor fans Door open
414	599	84	18	ND	0	Y	Y	Y	Floor drain Door open

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TABLE 1
Indoor Air Test Results
Hall of Justice, 50 State Street, Springfield, MA
April 21, 2005

Location	Carbon Dioxide (*ppm)	Temp. (°F)	Relative Humidity (%)	Total Volatile Organic Compound (*ppm)	Occupants in Room	Windows Openable	Ventilation		Remarks
							Supply	Exhaust	
415	614	81	18	ND	1	N	Y	Y	Floor fan Door open
413A	635	82	18	ND	0	N	Y	Y	Portable fan placed in ceiling Plants
408	611	82	17	ND	0	N	Y	Y	Ceiling fan Door open
408A	652	81	17	ND	0	N	Y	Y	Door open
407	624	81	17	ND	1	N	Y	Y	Floor fan
427 break room	752	79	18	ND	20+	N	Y	Y	Microwave Stove No dedicated exhaust, odors drawn into general ventilation
Registry of Probate	744	80	19	ND	20+	N	Y	Y	Floor fan

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TABLE 1

Indoor Air Test Results
Hall of Justice, 50 State Street, Springfield, MA
April 21, 2005

Location	Carbon Dioxide (*ppm)	Temp. (°F)	Relative Humidity (%)	Total Volatile Organic Compound (*ppm)	Occupants in Room	Windows Openable	Ventilation		Remarks
							Supply	Exhaust	
365	465	72	16	ND	0	N	Y	Y	Door open
373	488	73	15	ND	0	N	Y	Y	4 water damaged ceiling tiles Fan coil unit off Door open
Dineen office	487	72	15	ND	0	N	y	Y	Drainage hose in ceiling 4 water damaged ceiling tiles Door open
DA main Office	654	73	15	ND	7	N	Y	Y	Ceiling fan
354	488	73	14	ND	2	N	Y	Y	Door open
DA Cafeteria	516	73	15	ND	3	N	y	N	No dedicate exhaust vent for cooking Microwave oven Food storage

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TABLE 1
Indoor Air Test Results
Hall of Justice, 50 State Street, Springfield, MA
April 21, 2005

Location	Carbon Dioxide (*ppm)	Temp. (°F)	Relative Humidity (%)	Total Volatile Organic Compound (*ppm)	Occupants in Room	Windows Openable	Ventilation		Remarks
							Supply	Exhaust	
366	533	74	14	ND	3	N	Y	Y	Door open
DA's Private Office	582	78	14	ND	3	N	Y	Y	Water damaged wall material
DA Waiting Area	588	75	13	ND	4	N	Y	N	
347	551	74	14	ND	0	N	Y	Y	Plants
330	612	74	14	ND	3	N	Y	Y	Ceiling fans on Door open
Superior Court 1	487	74	13	ND	6	N	Y	Y	
320	320	75	15	ND	0	N	Y	Y	Door open
317	553	76	14	ND	2	N	Y	Y	Door open

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Indoor Air Test Results
Hall of Justice, 50 State Street, Springfield, MA
April 21, 2005

Location	Carbon Dioxide (*ppm)	Temp. (°F)	Relative Humidity (%)	Total Volatile Organic Compound (*ppm)	Occupants in Room	Windows Openable	Ventilation		Remarks
							Supply	Exhaust	
315	511	74	13	ND	1	N	Y	Y	Water cooler on carpet Plants Door open
314	501	74	13	ND	1	N	Y	Y	10+ water damaged ceiling tiles
313	417	74	13	ND	0	N	Y	Y	10+ water damaged ceiling tiles door open
Court stenographer	518	74	13	ND	0	N	Y	Y	5 water damaged ceiling tiles 1 missing ceiling tile

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Temperature - 70 - 78 °F
Relative Humidity - 40 - 60%

TABLE 2
Indoor Air Test Results
Hall of Justice, 50 State Street, Springfield, MA
April 22, 2005

Location	Carbon Dioxide (*ppm)	Temp. (°F)	Relative Humidity (%)	Total Volatile Organic Compound (*ppm)	Occupants in Room	Windows Openable	Ventilation		Remarks
							Supply	Exhaust	
Outside (Background)	422	61	34	ND					
Recorder of Land Court	651	75	19	ND	1	Y	N	Y	5 water damaged ceiling tiles Photocopier
Lounge 228	549	75	16	ND	1	Y	N	Y	Fan coil units off No dedicated exhaust vents Door open
210A	572	73	16	ND	0	Y	N	Y	Fan coil units off Door open
210	538	72	16	ND	1	Y	N	Y	Water cooler on carpet Door open
209	495	72	16	ND	0	Y	N	Y	Fan coil unit off
208	496	72	16	ND	1	N	Y	Y	Photocopier Fan coil unit off
207 A + B	691	72	18	ND	2	N	Y	Y	Plants

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Temperature - 70 - 78 °F
Relative Humidity - 40 - 60%

Table 2-1

TABLE 2
Indoor Air Test Results
Hall of Justice, 50 State Street, Springfield, MA
April 22, 2005

Location	Carbon Dioxide (*ppm)	Temp. (°F)	Relative Humidity (%)	Total Volatile Organic Compound (*ppm)	Occupants in Room	Windows Openable	Ventilation		Remarks
							Supply	Exhaust	
206	528	72	17	ND	0	N	Y	Y	
204A	586	72	20	ND	0	Y	Y	Y	Plants Fan coil unit off
204	575	72	21	ND	1	Y	Y	Y	Plants Fan coil unit off
Stenographer	592	72	19	ND	2	Y	Y	Y	Fan coil unit off
Civil clerks main office	592	73	19	ND	13	N	Y	Y	16 computers
212	557	73	18	ND	0	N	Y	Y	Door open
216	558	73	18	ND	0	N	Y	Y	Clutter Door open
Vault 221	478	72	19	ND	0	N	Y	Y	Door open

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Comfort Guidelines

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Temperature - 70 - 78 °F
Relative Humidity - 40 - 60%

TABLE 2
Indoor Air Test Results
Hall of Justice, 50 State Street, Springfield, MA
April 22, 2005

Location	Carbon Dioxide (*ppm)	Temp. (°F)	Relative Humidity (%)	Total Volatile Organic Compound (*ppm)	Occupants in Room	Windows Openable	Ventilation		Remarks
							Supply	Exhaust	
219	491	72	18	ND	0	N	Y	Y	Door open
222	471	73	17	ND	0	N	Y	Y	
225	572	72	18	ND	2	N	Y	Y	Door
224A credit union	747	73	18	ND	1	N	Y	Y	Door open
224A retirement board	652	73	18	ND	2	N	Y	Y	Photocopier next to fan coil unit Door open
202B	532	73	17	ND	0	N	Y	Y	
202A	528	73	17	ND	0	N	Y	Y	
246C	506	73	17	ND	0	N	Y	Y	

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Temperature - 70 - 78 °F
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TABLE 2
Indoor Air Test Results
Hall of Justice, 50 State Street, Springfield, MA
April 22, 2005

Location	Carbon Dioxide (*ppm)	Temp. (°F)	Relative Humidity (%)	Total Volatile Organic Compound (*ppm)	Occupants in Room	Windows Openable	Ventilation		Remarks
							Supply	Exhaust	
246	583	75	19	ND	0	N	Y	Y	
246B	523	75	17	ND	0	N	Y	Y	2 water damaged ceiling tile
247	532	75	18	ND	0	N	Y	Y	1 water damaged ceiling tile door open
248	527	75	18	ND	0	n	Y	Y	1 water damaged ceiling tile peeling wallpaper water damaged hard ceiling/wall material
249	513	75	17	ND	1	N	Y	Y	5 water damaged ceiling tiles floor fan
249B	515	75	18	ND	2	N	Y	Y	Peeling wallpaper
249A	503	75	18	ND	0	N	Y	Y	4 water damaged ceiling tiles

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Comfort Guidelines

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Temperature - 70 - 78 °F
Relative Humidity - 40 - 60%

TABLE 2
Indoor Air Test Results
Hall of Justice, 50 State Street, Springfield, MA
April 22, 2005

Location	Carbon Dioxide (*ppm)	Temp. (°F)	Relative Humidity (%)	Total Volatile Organic Compound (*ppm)	Occupants in Room	Windows Openable	Ventilation		Remarks
							Supply	Exhaust	
Monitor room	486	73	18	ND	1	N	Y	Y	Microwave oven Fan coil unit off
Chief of court officers office	503	73	19	ND	1	N	Y	Y	Fan coil unit off
Main lobby balcony	574	73	19	ND	5	N	Y	Y	
Main lobby first floor	570	73	19	ND	20+	N	Y	Y	
Public Prosecutor Main Office	656	75	19	ND	5	N	Y	Y	Fan coil unit blocked by stored materials
117	623	75	19	ND	0	N	Y	Y	Photocopier Door open
120	577	75	19	ND	1	N	Y	Y	1 missing ceiling tile door open
114	651	75	19	ND	2	N	Y	Y	Toaster

*** ppm = parts per million parts of air**

Comfort Guidelines

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

Table 2-5

TABLE 2
Indoor Air Test Results
Hall of Justice, 50 State Street, Springfield, MA
April 22, 2005

Location	Carbon Dioxide (*ppm)	Temp. (°F)	Relative Humidity (%)	Total Volatile Organic Compound (*ppm)	Occupants in Room	Windows Openable	Ventilation		Remarks
							Supply	Exhaust	
149	516	75	23	ND	0	N	Y	Y	Fan coil unit off
151	536	75	22	ND	0	N	Y	Y	Fan coil unit off
152	562	75	23	ND	1	N	Y	Y	
158	558	75	23	ND	1	N	Y	Y	
Probation Lounge	539	73	24	ND	0	N	Y	Y	Fan coil unit blocked Microwave oven Electric stove No dedicated exhaust vent for cooking
164	503	73	23	ND	0	N	Y	Y	
162	523	73	24	ND	1	N	Y	Y	Door open

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Relative Humidity - 40 - 60%

TABLE 2
Indoor Air Test Results
Hall of Justice, 50 State Street, Springfield, MA
April 22, 2005

Location	Carbon Dioxide (*ppm)	Temp. (°F)	Relative Humidity (%)	Total Volatile Organic Compound (*ppm)	Occupants in Room	Windows Openable	Ventilation		Remarks
							Supply	Exhaust	
141	522	75	24	ND	1	N	Y	Y	Door open
140	495	73	24	ND	1	N	Y	Y	Door open
131	596	73	25	ND	7	N	Y	Y	Door open
121A	657	75	24	ND	0	N	Y	Y	Fan coil unit off Door open
121B	514	75	24	ND	0	N	Y	Y	Fan coil unit off Door open
110	578	73	23	ND	3	N	Y	Y	Door open
Duplicating room	558	75	23	ND	1	N	Y	Y	Photocopier
District Court Criminal	598	75	23	ND	8	N	Y	Y	Fan coil unit blocked

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Indoor Air Test Results
Hall of Justice, 50 State Street, Springfield, MA
April 22, 2005

Location	Carbon Dioxide (*ppm)	Temp. (°F)	Relative Humidity (%)	Total Volatile Organic Compound (*ppm)	Occupants in Room	Windows Openable	Ventilation		Remarks
							Supply	Exhaust	
DA office southeast wall	567	75	18	ND	Y	N	Y	Y	3 Fan coil units blocked by stored
Operations	605	75	20	ND	5	N	Y	Y	
Attorney lounge	593	75	19	ND	0	N	Y	Y	
137	589	75	19	ND	1	N	Y	Y	Ceiling fan on Photocopier
138	552	75	19	ND	0	N	Y	Y	Ceiling fan on Floor fan on
135	547	75	19	ND	2	N	Y	Y	Door open
District Court Probation	573	75	23	ND	4	N	Y	Y	Fan coil unit blocked
146	535	75	22	ND	0	N	Y	Y	Fan coil unit off

*** ppm = parts per million parts of air**

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
Hall of Justice, 50 State Street, Springfield, MA
April 22, 2005

Location	Carbon Dioxide (*ppm)	Temp. (°F)	Relative Humidity (%)	Total Volatile Organic Compound (*ppm)	Occupants in Room	Windows Openable	Ventilation		Remarks
							Supply	Exhaust	
111 vault	529	75	22	ND	0	N	Y	Y	Door open
102	567	75	22	ND	1	N	Y	Y	Door open
Cash office	587	77	23	ND	5	N	Y	Y	Ceiling fan on
File room	666	77	22	ND	1	N	Y	Y	Fan coil unit off
101	634	75	21	ND	0	N	Y	Y	Fan coil unit off Plants
Mail room	531	72	24	ND	1	N	Y	Y	Door open
Cafeteria	701	73	26	ND	3	N	Y	Y	5 vending machines microwave oven
G-03	541	72	24	ND	0	N	Y	Y	

*** ppm = parts per million parts of air**

Comfort Guidelines

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Temperature - 70 - 78 °F
Relative Humidity - 40 - 60%

TABLE 2
Indoor Air Test Results
Hall of Justice, 50 State Street, Springfield, MA
April 22, 2005

Location	Carbon Dioxide (*ppm)	Temp. (°F)	Relative Humidity (%)	Total Volatile Organic Compound (*ppm)	Occupants in Room	Windows Openable	Ventilation		Remarks
							Supply	Exhaust	
G-17	765	73	28	ND	6	N	Y	Y	
G-06	783	73	27	ND	2	N	Y	Y	
G-39	675	73	24	ND	5	N	Y	Y	Water damage hard ceiling
G-40	556	72	25	ND	0	N	Y	Y	

*** ppm = parts per million parts of air**

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
Hall of Justice, 50 State Street, Springfield, MA
February 7 2006

Remarks	Carbon Dioxide (*ppm)	Temp. (°F)	Relative Humidity (%)	Occupants in Room	Windows Openable	Ventilation		Remarks
						Supply	Exhaust	
Outside (Background)	489	47	14					
District Court 8	1170	77	23	8	N	Y	Y	
District Court 7	1159	77	22	0	N	Y	Y	
Superior Court 1	1154	76	22	0	N	Y	Y	
Superior Court 5	1118	77	21	3	N	Y	Y	
Superior Court 6	1092	77	21	0	N	Y	Y	
Superior Court 2	1194	76	21	10	N	Y	Y	
Superior Court 3	1142	77	22	11	N	Y	Y	
Superior Court 4	1172	77	22	11	N	Y	Y	
Probate Court 4	1426	74	24	6	N	Y	Y	

*** ppm = parts per million parts of air**
ND = Non-detectable

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
Hall of Justice, 50 State Street, Springfield, MA
February 7 2006

Remarks	Carbon Dioxide (*ppm)	Temp. (°F)	Relative Humidity (%)	Occupants in Room	Windows Openable	Ventilation		Remarks
						Supply	Exhaust	
Hallway outside Probate Court, 4th floor	1650	75	26	10+	N	Y	Y	
District Court 1	1337	74	31	60+	N	Y	Y	
Hall outside District Court 1	975	73	23	30+	N	Y	Y	
District Court 2	1356	74	27	50+	N	Y	Y	
District Court 3	1312	74	25	9	N	Y	Y	
District Court 4	1192	75	25	19	N	Y	Y	
District Court 5	1072	75	24	11	N	Y	Y	
District Court 6	947	75	22	0	N	Y	Y	
District Court 10	1179	75	24	20	N	Y	Y	
District Court 9	1135	76	24	11	N	Y	Y	

*** ppm = parts per million parts of air**
ND = Non-detectable

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
Hall of Justice, 50 State Street, Springfield, MA
February 7 2006

Remarks	Carbon Dioxide (*ppm)	Temp. (°F)	Relative Humidity (%)	Occupants in Room	Windows Openable	Ventilation		Remarks
						Supply	Exhaust	
Probate Court 4	1183	74	23	0	N	Y	Y	
Jury Pool	1495	74	26	60+	N	Y	Y	
Registry of Probate main office	1515	75	26	50+	N	Y	Y	
Registry of Probate south wall	1330	74	25	7	N	Y	Y	
Registry of Probate north wall	1364	74	25	12+	N	Y	Y	
Registry of Probate east wall	1366	74	24	5+	N	Y	Y	
Registry of Probate center	1402	73	25	5+	N	Y	Y	
371	827	75	20	1	N	Y	Y	
366	944	77	22	1	N	Y	Y	
347	955	75	20	0	N	Y	Y	

*** ppm = parts per million parts of air**
ND = Non-detectable

Comfort Guidelines

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

TABLE 3
Indoor Air Test Results
Hall of Justice, 50 State Street, Springfield, MA
February 7 2006

Remarks	Carbon Dioxide (*ppm)	Temp. (°F)	Relative Humidity (%)	Occupants in Room	Windows Openable	Ventilation		Remarks
						Supply	Exhaust	
208	1022	75	21	0	N	Y	Y	
206	941	71	20	0	N	Y	Y	
Meeting room 2nd floor, east wall	1089	72	22	0	N	y	Y	
Hampden County Commissioners meeting room	821	71	20	0	N	Y	Y	
Superior Court clerks office	888	74	20	9	N	Y	Y	
Law Library	805	72	19	5	N	Y	Y	
Main lobby	842	72	19	20+	N	Y	Y	
District Court Criminal	900	73	21	6	N	Y	Y	
District Court break room	952	74	22	2	N	Y	Y	
District Court Probation	829	74	19	5	N	Y	Y	

*** ppm = parts per million parts of air**
ND = Non-detectable

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

Building Component Temperature Measurements
Hall of Justice, 50 State Street, Springfield, MA
February 7, 2006

Location	Air Temp. (°F)	Surface Temp., Interior Wall (°F)	Surface Temp., Window Frame (°F)	Surface Temp., Window Glass (°F)	Surface Temp., Floor (°F)	Location of Room to Exterior Walls
Outside (Background)						
Jury Pool	74	75	75	74	-	South wall
Probate 4th floor office pool	75	64	55	47	-	East Wall
Probate 4th floor office pool	74	67	58	49	-	South wall
Registry of Deeds	74	66	53	48	-	North wall
Registry of Deeds	74	63	56	53	-	East wall
Registry of Deeds center of east wall	73	66	54	59	-	East wall
371	75	66	56	56	-	East wall
366	77	74	63	60	-	South wall
347	75	74	63	67	-	West wall
208	75	67	51	50	-	North wall
206	71	63	52	47	58	North wall

Table 4-1

TABLE 4
Building Component Temperature Measurements
Hall of Justice, 50 State Street, Springfield, MA
February 7, 2006

Location	Air Temp. (°F)	Surface Temp., Interior Wall (°F)	Surface Temp., Window Frame (°F)	Surface Temp., Window Glass (°F)	Surface Temp., Floor (°F)	Location of Room to Exterior Walls
Meeting room, 2nd floor	72	61	49	45	58	East wall
Hampden County Commissioner's meeting room	71	61	49	54	57	East wall
Superior court clerks office	74	68	54	52	59	East wall
Law library	72	63	52	47	67	North wall
Main lobby	72	57	51	47	68	East wall
District court criminal clerk office	73	65	43	45	65	North wall
District court break room	74	67	70	71	65	North wall

Appendix A

Carbon Dioxide and its Use in Evaluating Adequacy of Ventilation in Buildings

The Center of Environmental Health's (CEH) Emergency Response/Indoor Air Quality (ER/IAQ) Program examines indoor air quality conditions that may have an effect on building occupants. The status of the ventilation system, potential moisture problems/microbial growth and identification of respiratory irritants are examined in detail, which are described in the attached report. In order to examine the function of the ventilation system, measurements for carbon dioxide, temperature and relative humidity are taken. Carbon dioxide measurements are commonly used to assess the adequacy of ventilation within an indoor environment.

Carbon dioxide is an odorless, colorless gas. It is found naturally in the environment and is produced in the respiration process of living beings. Another source of carbon dioxide is the burning of fossil fuels. Carbon dioxide concentration in the atmosphere is approximately 250-600 ppm (NIOSH, 1987; Beard, 1982).

Carbon dioxide measurements within an occupied building are a standard method used to gauge the adequacy of ventilation systems. Carbon dioxide is used in this process for a number of reasons. Any occupied building will have normally occurring environmental pollutants in its interior. Human beings produce waste heat, moisture and carbon dioxide as by-products of the respiration process. Equipment, plants, cleaning products or school supplies normally found in any school can produce gases, vapors, fumes or dusts when in use. If a building has an adequately operating mechanical ventilation system, these normally occurring environmental pollutants will be diluted and removed from the interior of the building. The introduction of

fresh air both increases the comfort of the occupants and serves to dilute normally occurring environmental pollutants.

An operating exhaust ventilation system physically removes air from a room and thereby removes environmental pollutants. The operation of supply in conjunction with the exhaust ventilation system creates airflow through a room, which increases the comfort of the occupants. If all or part of the ventilation system becomes non-functional, a build up of normally occurring environmental pollutants may occur, resulting in an increase in the discomfort of occupants.

The MDPH approach to resolving indoor air quality problems in schools and public buildings is generally two-fold: 1) improving ventilation to dilute and remove environmental pollutants and 2) reducing or eliminating exposure opportunities from materials that may be adversely affecting indoor air quality. In the case of an odor complaint of unknown origin, it is common for CEH staff to receive several descriptions from building occupants. A description of odor is subjective, based on the individual's life experiences and perception. Rather than test for a potential series of thousands of chemicals to identify the unknown material, carbon dioxide is used to judge the adequacy of airflow as it both dilutes and removes indoor air environmental pollutants.

As previously mentioned, carbon dioxide is used as a diagnostic tool to evaluate air exchange by building ventilation systems. The presence of increased levels of carbon dioxide in indoor air of buildings is attributed to occupancy. As individuals breathe, carbon dioxide is exhaled. The greater the number of occupants, the greater the amount of carbon dioxide

produced. Carbon dioxide concentration build up in indoor environments is attributed to inefficient or non-functioning ventilation systems. 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).

Carbon dioxide can be a hazard within enclosed areas with **no air supply**. These types of enclosed areas are known as confined spaces. Manholes, mines and sewer systems are examples of confined spaces. An ordinary building is not considered a confined space. Carbon dioxide air exposure limits for employees and the general public have been established by a number of governmental health and industrial safety groups. Each of these standards of air concentrations is expressed in parts per million (ppm). *Table 1* is a listing of carbon dioxide air concentrations and related health effects and standards.

The Department of Public Health uses a guideline of 800 ppm for publicly occupied buildings (SMACNA, 1998; Redlich, 1997; Rosenstock, 1996; OSHA, 1994; Gold, 1992; Burge et al., 1990; Norback, 1990). 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. Several sources indicate that indoor air problems *are significantly reduced* at 600 ppm or less of carbon dioxide (ACGIH, 1998; Bright et al., 1992; Hill, 1992; NIOSH, 1987). Inadequate ventilation and/or elevated temperatures are major causes of complaints such as respiratory, eye, nose and throat irritation, lethargy and headaches.

Appendix A

Air levels for carbon dioxide that indicate that indoor air quality may be a problem have been established by the American Society of Heating, Refrigerating and Air-conditioning Engineers (ASHRAE). Above 1,000 ppm of carbon dioxide, ASHRAE recommends adjustment of the building's ventilation system (ASHRAE, 1989).

Carbon dioxide itself has no acute (short-term) health effects associated with low level exposure (below 5,000 ppm). The main effect of carbon dioxide involves its ability to displace oxygen for the air in a confined space. As oxygen is inhaled, carbon dioxide levels build up in the confined space, with a decrease in oxygen content in the available air. This displacement of oxygen makes carbon dioxide a simple asphyxiant. At carbon dioxide levels of 30,000 ppm, severe headaches, diffuse sweating, and labored breathing have been reported. No **chronic** health effects are reported at air levels below 5,000 ppm.

Air testing is one method used to determine whether carbon dioxide levels exceed the comfort levels recommended. If carbon dioxide levels are over 800-1,000 ppm, the MDPH recommends adjustment of the building's ventilation system. The Department recommends that corrective measures be taken at levels above 800 ppm of carbon dioxide in office buildings or schools. (Please note that carbon dioxide levels measured below 800 ppm may not decrease indoor air quality complaints). Sources of environmental pollutants indoors can often induce symptoms in exposed individuals regardless of the adequacy of the ventilation system. As an example, an idling bus outside a building may have minimal effect on carbon dioxide levels, but can be a source of carbon monoxide, particulates and odors via the ventilation system.

Appendix A

Therefore, the MDPH strategy of adequate ventilation coupled with pollutant source reduction/removal serves to improve indoor air quality in a building. Please note that each table included in the IAQ assessment lists CEH comfort levels for carbon dioxide levels at the bottom (i.e. carbon dioxide levels between 600 ppm to 800 ppm are acceptable and <600 ppm is preferable). While carbon dioxide levels are important, focusing on these air measurements in isolation to all other recommendations is a misinterpretation of the recommendations made in these assessments.

Appendix A

Table 1
Carbon Dioxide Air Level Standards

Carbon Dioxide Level	Health Effects	Standards or Use of Concentration	Reference
250-600 ppm	None	Concentrations in ambient air	Beard, R.R., 1982 NIOSH, 1987
600 ppm	None	Most indoor air complaints eliminated, used as reference for air exchange for protection of children	ACGIH, 1998; Bright et al., 1992; Hill, 1992; NIOSH 1987
800 ppm	None	Used as an indicator of ventilation inadequacy in schools and public buildings, used as reference for air exchange for protection of children	Bell, A. A., 2000; SMACNA, 1998; Redlich, 1997; Rosenstock, 1996; OSHA, 1994; Gold, 1992; Burge et al., 1990; Norback, 1990
1000 ppm	None	Used as an indicator of ventilation inadequacy concerning removal of odors from the interior of building.	ASHRAE, 1989
950-1300 ppm*	None	Used as an indicator of ventilation inadequacy concerning removal of odors from the interior of building.	ASHRAE, 1999
5000 ppm	No acute (short term) or chronic (long-term) health effects	Permissible Exposure Limit/Threshold Limit Value	ACGIH, 1999 OSHA, 1997
30,000 ppm	Severe headaches, diffuse sweating, and labored breathing	Short-term Exposure Limit	ACGIH, 1999 ACGIH. 1986

* outdoor carbon dioxide measurement +700 ppm

Appendix A

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