
**Brighton Division**
**Boston Municipal Court**
**Brighton, MA**

# HVAC SYSTEM EVALUATIONS COVID-19

Office of Court Management

May 14, 2024

Tighe&Bond

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# Section 1
# Existing Conditions & Site Observations

Tighe & Bond visited the Brighton Municipal Courthouse on May 26th, 2021. While on site we inspected the air handling equipment located in the mechanical rooms and toured the facility to determine if the spaces generally matched usages noted on the architectural plans. Tighe and Bond was provided with mechanical design plans from 1994 and 2019. Our analysis is based on these drawings and our one day on site.

Site Visit Attendees:

- *Office of Court Management:*
  - Courthouse Facilities Staff
- *Tighe & Bond*
  - Ryan Ablondi, PE, Senior Mechanical Engineer
  - Matt Mancini, Staff Mechanical Engineer
  - Olivia Robillard, Staff Intern

## 1.1 Existing Ventilation System

The Brighton Municipal Courthouse was constructed in 1925 and is approximately 23,675 square feet in size. Two rooftop air handling units (RTUs) and three air handling units in the lower level provide ventilation air to the building. The two RTUs provide ventilation to the two main courtrooms on the main level and the three AHUs in the basement provide ventilation for the lower level and main level, outside of the courtrooms.

Each RTU contains a supply fan, refrigerant (DX) cooling coils, gas heat, and 2" MERV 13 filters. The supply fan is equipped with a variable speed drive but operates as a constant volume fan. The rooftop units were installed as part of the 2020 renovation and are in very good condition. The outside air and return air dampers and actuators are operational and in very good condition, and the heating and cooling coils are clean.

AHU-1 is a constant volume mixed air unit serving the core of the lower level including the courtroom on the lower level and the probation office area. AHU-1 contains mixed air dampers, 2" MERV-13 filters, a glycol hot water heating coil with 3-way control valve, a chilled water coil with 3-way control valve and a supply fan in a draw through configuration. Based on our physical inspection during the site walk through, the unit appears to be in fair working condition with all dampers, damper actuators and valve actuators appearing to be in good condition. This unit was installed in 1994 and is 27 years old.

AHU-2 is a 100% outside air, constant volume unit which provides outside air to fan coil unit (FCU) zones on the north side of the lower level and throughout the main level, outside of the courtrooms. This unit consists of an outside air damper, 2" MERV-13 filter, glycol hot water coil and supply fan in draw through configuration. This unit was installed in 1994 and is 27 years old.

AHU-3 is a 100% outside air, constant volume unit which serves the holding area on the south side of the lower level. This unit consists of an outside air damper, 2" MERV-13 filter, glycol hot water coil and supply fan in draw through configuration. This unit was installed in 1994 and is 27 years old.

The office areas outside of the courtroom on the main level and on the south side of the lower level are served by 2-pipe fan coil units. Outside air is provided to each FCU zone by AHU-2. Each FCU has a standard filter, supply fan and single water coil which is switched between heating and cooling seasonally. We believe all of these FCUs were installed in 1994 and are not aware of any that have been replaced more recently.

According to the drawings provided to Tighe & Bond, there are six exhaust fans serving the building. The fans were installed during the 2020 renovation project. Information regarding which space each exhaust fan serves is not show on the mechanical plans. All exhaust fans were running at the time of our site visit.

A boiler plant in the lower level mechanical room provides hot water to the lower level AHUs and FCUs throughout the building. The plant consists of four 300 MBH gas-fired modular boilers. Water is distributed to FCUs by two constant volume pumps. A separate HW loop with a single constant volume pump provides hot water to the AHUs in thew lower level.

A 50-ton, air cooled chiller located in the basement mechanical room provides chilled water to all air handlers and fan coil units. Based on the chiller serial number, it appears this chiller was manufactured in 1995. Heat rejection for the chiller is provided by a remote air-cooled condenser on the roof which was installed as part of the 2020 renovation.

Table 1 summarizes the air handling units' designed airflow rates, the MERV rating of the installed filters, and the condition of the units.

**TABLE 1**
Existing Air Handling Units

| Unit | Original Design Airflow (CFM) | Original Design Min. O.A. (CFM) | Filters | Condition |
|---|---|---|---|---|
| AHU-1 | 3,255 | 1,120 | 2" MERV 13 | Fair |
| AHU-2 | 2,600 | 2,600 | 2" MERV 13 | Fair |
| AHU-3 | 1,255 | 1,255 | 2" MERV 13 | Fair |
| RTU-1 | 4,000 | 1,200 | 2" MERV 13 | Very Good |
| RTU-2 | 4,000 | 1,200 | 2" MERV 13 | Very Good |


Photo 1 – Representative Roof Top Unit (RTU)


Photo 2 – Representative Air Handling Unit (AHU)

## 1.2 Existing Control System

The HVAC equipment is controlled by an Automated Logic Building Management System (BMS). Air handlers, exhaust fans, boilers, chillers, fan coil units, etc. are all tied into the system. Based on the control screens on the BMS, there are no demand control ventilation (DCV) sequences for the ventilation equipment in the building. The two RTUs serving the courtrooms on the main floor have economizer sequences. It is unknown if AHU-1 has any economizer.

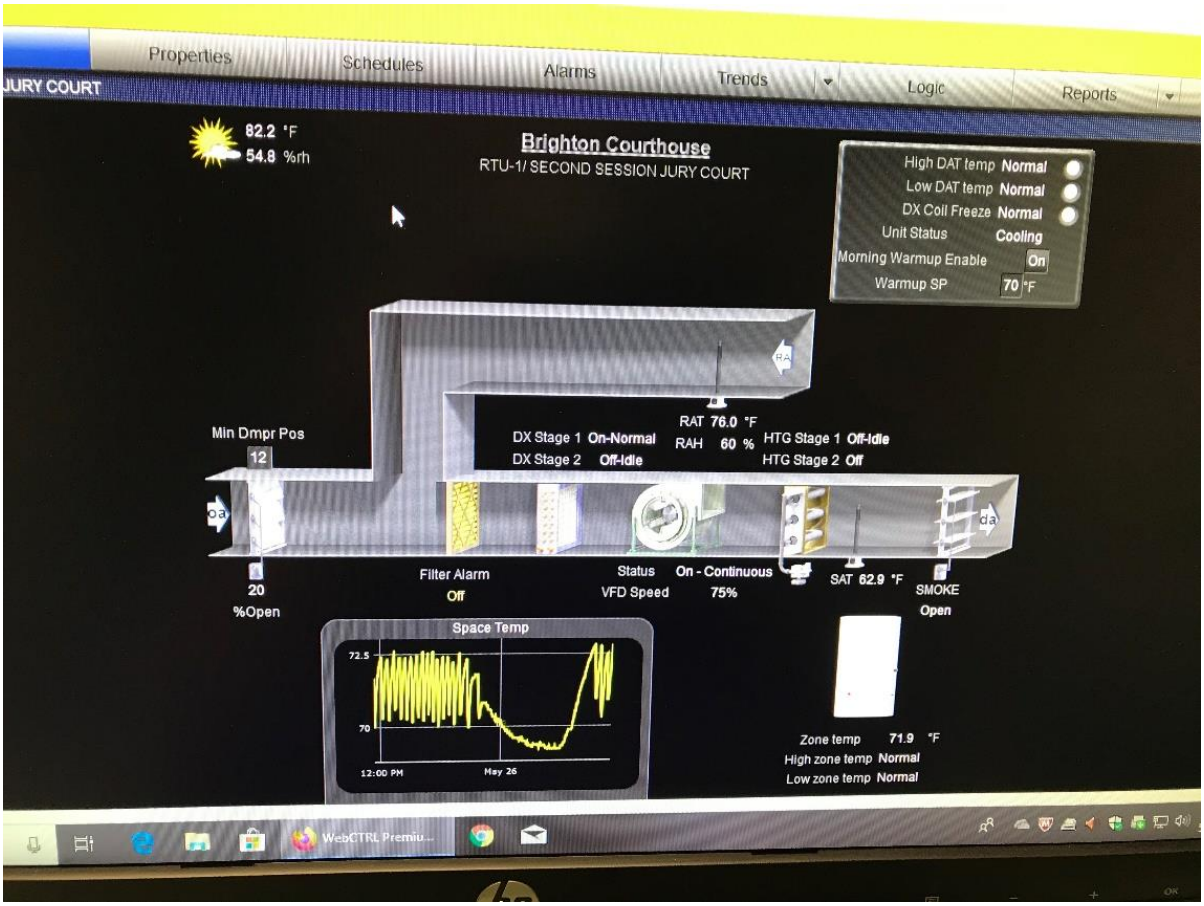


Photo 2 – BMS Screenshot

# Section 2
# Recommendations

Below is a list of recommendations for the Brighton Municipal Courthouse. Please refer to the "Overview of Recommendations" report for further explanation and requirements of the stated recommendations.

## 2.1 Filtration Efficiency Recommendations

The filters in the air handlers were already upgraded with 2" MERV 13 filters. The use of 2" MERV 13 meets the minimum ASHRAE recommendations for filtration during the pandemic. We recommend that a testing and balancing contractor test and document the airflow and static pressure profile of all air handlers, as outlined in recommendation RF-1 in the Overview of Recommendations document. This will help determine if the equipment can accommodate the increase in system static pressure associated with the addition of the MERV 13 filters.

We recommend the following measures be implemented for the existing air handling units:

**RF-3:** *Install a differential pressure sensor with a display across the filter bank.*

This recommendation pertains to AHU-1, 2 & 3 which do not have differential pressure sensors for filter alarming. RTU-1 & RTU-2 already have DPTs installed across the filter banks and connected to the BMS for alarming.

## 2.2 Testing & Balancing Recommendations

Air handling units, AHU-1, 2 & 3 are approximately 27 years old and it is unknown to Tighe & Bond when the last time the units were tested and balanced. Also, the code requirements to determine the outdoor air flow rates that were used to design the original system may be different than the 2015 International Mechanical Code (IMC) and current ASHRAE Standard 62.1 requirements.

The two rooftop units, RTU-1 & 2 were installed in 2020 and Tighe & Bond has reviewed a TAB report dated 11/05/2020 that shows that the units are operating as designed.

We recommend the following testing and balancing measures be implemented:

**RTB-1:** *Test and balance air handling unit supply air and minimum outdoor air flow rates.*

We recommend testing and balancing the outdoor air flow rates for air handling units AHU-1,2 & 3 to the recommended minimum O.A. rates listed in Table 2.

**TABLE 2**
Recommended Air Handler O.A. Flow Rates

| Unit | Original Supply Airflow (CFM) | Original Design Min. O.A. (CFM) | Current Code Min. O.A. Requirements (CFM) | Recommended Minimum O.A. (CFM) |
|---|---|---|---|---|
| RTU-1 | 4,000 | 1,200 | 944 | **1,200** |
| RTU-2 | 4,000 | 1,200 | 944 | **1,200** |
| AHU-1 | 3,255 | 1,120 | 840 | **1,120** |
| AHU-2 | 2,600 | 2,600 | 1,280 | **2,600** |
| AHU-3 | 1,255 | 1,255 | 325 | **1,255** |

Note: Although the ASHRAE Position Document on Infectious Aerosols recommends using the latest published standards and codes as a baseline for minimum ventilation, the mechanical code in effect at the time the HVAC systems were designed and constructed is what governs the required outdoor air flowrate for the HVAC equipment, if there have been no additions, renovations, alterations or changes in occupancy to the building. The 2015 International Mechanical Code does not prevent the continued use of existing systems.

During the pandemic, we recommend maintaining the outdoor airflows at the original designed values where they exceed the code minimums calculated by Tighe & Bond. Supplying more outdoor than required by code will provide better indoor air quality.

The average airflow rate per person is shown below in Table 3. These values are based on the original full design supply airflow rate and the recommended outdoor airflow rates shown in Table 2. The airflow rate per person assumes a diversity factor of 70%, meaning the maximum number of occupants assumed to be in all zones at all times equates to 70% of the code required occupancy.

**TABLE 3**
Average Airflow Rate per Person

| | ***All spaces*** | ***Courtrooms*** | ***Non-Courtroom Spaces*** |
|---|---|---|---|
| Total Occupancy (People) | 285 | 209 | 76 |
| Total Supply Air (CFM/Person) | 53 | 38 | 94 |
| Outdoor Air (CFM/Person) | 26 | 11 | 65 |

The airflow rate per person for each Courtroom and the Jury Pool Room is shown below in Table 4. These values are based on full occupancy without taking diversity into account, the original full design supply airflow rate, and the recommended outdoor airflow rate. The airflow rate per person assumes the full supply airflow is being delivered to the room.

**TABLE 4**
Airflow Rate per Person (Full Occupancy)

| | | Total Air | | Outdoor Air | |
|---|---|---|---|---|---|
| ***Courtroom*** | ***Total People*** | ***Supply Airflow (CFM)*** | ***Airflow Rate (CFM/Person)*** | ***Outdoor Airflow (CFM)*** | ***Airflow Rate (CFM/Person)*** |
| First Session Arrangement Courtroom | 129 | 4,000 | 31 | 1,200 | 9 |
| Second Session Jury Courtroom | 129 | 4,000 | 31 | 1,200 | 9 |
| Courtroom #3 | 32 | 420 | 13 | 145 | 5 |

Note: Courtroom occupant density is based on 70 people/1,000 square feet, per the 2015 International Mechanical Code

The airflow rate per person for each Courtroom and the Jury Pool Room, based on a reduced occupancy schedule determined by the Office of Court Management, is shown below in Table 4a. The airflow rate per person assumes the full supply airflow is being delivered to the room.

**TABLE 4a**
Airflow Rate per Person (Reduced Occupancy)

| | | Total Air | | Outdoor Air | |
|---|---|---|---|---|---|
| ***Courtroom*** | ***Total People*** | ***Supply Airflow (CFM)*** | ***Airflow Rate (CFM/Person)*** | ***Outdoor Airflow (CFM)*** | ***Airflow Rate (CFM/Person)*** |
| First Session Arrangement Courtroom | 23 | 4,000 | 174 | 1,200 | 52 |
| Second Session Jury Courtroom | 26 | 4,000 | 154 | 1,200 | 46 |
| Courtroom #3 | 7 | 420 | 60 | 145 | 21 |

Note: If occupancy is further reduced, the airflow rate per person will increase, assuming full airflow is being delivered to the space.

**RTB-3**: *Increase outdoor air flow rate beyond minimum under non-peak conditions.*

Due to the age of the three AHUs in the lower level, the ability for the coils to maintain the supply air temperature is uncertain. For the two new RTUs, we recommend increasing the outdoor air flow rate by 10% to 30% beyond the recommend values in Table 2 during non-peak outdoor air conditions during the pandemic only. This may require additional controls to implement. We do not believe this would cause a threat of a potential coil to freeze given the amount of outdoor air as a percentage of total supply air, however cold spots on the coil may develop due to poor mixing. This may cause nuisance freeze stat trips via the existing freeze stat. If there is no existing freeze stat, we recommend installing one.

The return air to each air handler will also have to be adjusted to accommodate the additional outdoor air during the operation of this sequence.

**RTB-6**: *Test and balance all air handler chilled and hot water coils.*

Testing and balancing the air handler hot and chilled water coils will help ensure the coils are receiving the proper water flow rates. Due to the age of the coils, the coils

may not perform as required to properly temper the supply air. Coils become fouled over time, which degrades the performance.

## 2.3 Equipment Maintenance & Upgrades

We recommend the following equipment maintenance and upgrades for the three AHUs in the lower level, AHU-1, AHU-2 & AHU-3:

**RE-1:** *Test existing air handling system dampers and actuators for proper operation*.

Replace dampers and actuators that are not functioning properly.

**RE-2:** *Clean air handler coils and drain pans.*

**RE-7:** *Test the existing air handler control valves and actuators for proper operation.*

## 2.4 Control System Recommendations

We recommend the following for the control system:

**RC-1:** *Implement a pre and post-occupancy flush sequence.*

**RC-2:** *Install controls required to introduce outdoor air beyond the minimum requirements for RTU-1 & RTU-2.*

The existing BMS appears to be sophisticated enough to implement this type of sequence, however new control sequences must be defined.

**RC-4:** *Confirm the economizer control sequence is operational.*

**RC-5:** *Disable demand control ventilation sequences.*

We found no evidence on the EMS, drawings we received or during our walk-through of any demand control ventilation controls however, we recommend having the ATC service contractor verify this and disable any demand control ventilation sequences that may be in place.

## 2.5 Additional Filtration and Air Cleaning

We recommend the installation of the following air cleaning devices:

**RFC-1:** *Install portable HEPA filters.*

If the Courthouse is to operate at a high capacity (i.e. 50% occupancy or greater), we recommend installing portable HEPA filters in high traffic areas, such as entrance lobbies. They should also be considered for Courtrooms, depending on the occupancy of the room and how much noise is generated from the filters. The noise levels will vary depending on the manufacturer. Refer to the "Overview of Recommendations" document for further guidance on installing portable HEPA filters.

## 2.6 Humidity Control

Installing duct mounted or portable humidifiers can help maintain the relative humidity levels recommended by ASHRAE. The feasibility of adding active humidification is determined by the building envelope. Buildings that were not designed to operate with active humidification can potentially be damaged due to a lack of a vapor barrier, adequate insulation, and air tightness.

Duct mounted humidifiers must be engineered, integrated into the building control system, tested, and commissioned. They are available in many configurations but require substantial maintenance and additional controls. They also run the risk of adversely affecting IAQ from growing microorganisms, or leaking water through poorly sealed ductwork damaging insulation and ceilings. Portable humidifiers are easier to install and require less maintenance, but still have the potential to damage the building envelope.

While active humidification is not recommended as a whole building solution due to high installation costs, operational costs, potential to damage the building envelope and adversely affect poor IAQ, it may be warranted as a temporary solution in some areas.

## 2.7 Other Recommendations

### 2.7.1 Capital Planning for Replacement of Chiller

The existing chiller in the lower level mechanical room is approx. 27 years old and is likely approaching the end of its useful life. The chiller is currently in fair condition however ASHRAE data shows that the median life expectancy for chillers is 20-23 years. While immediate replacement is not necessary at this time, we would recommend developing a capital plan to replace this chiller in ~5 years.

### 2.7.2 Capital Planning for Replacement of Fan Coil Units

The existing FCUs serving the main and lower levels are approx. 27 years old and likely approaching the end of their useful life. As far as we know all of the FCUs are functional and in fair condition however, the average life expectancy for FCUs is 25-30 years. While immediate replacement is not necessary at this time, we would recommend developing a capital plan to replace these units in ~5 years.

## Disclaimer

Tighe and Bond cannot in any way guarantee the effectiveness of the proposed recommendations to reduce the presence or transmission of viral infection. Our scope of work is intended to inform the Office of Court Management on recommendations for best practices based on the guidelines published by ASHRAE and the CDC. Please note that these recommendations are measures that may help reduce the risk of airborne exposure to COVID-19 but cannot eliminate the exposure or the threat of the virus. Implementing the proposed recommendations will not guarantee the safety of building occupants. Tighe & Bond will not be held responsible should building occupants contract the virus. The Office of Court Management should refer to other guidelines, published by the CDC and other governing entities, such as social distancing, wearing face masks, cleaning and disinfecting surfaces, etc. to help reduce the risk of exposure of COVID-19 to building occupants.

# Section 3
# Testing & Balancing Results

Milharmer Associates visited the Brighton Municipal Courthouse on October 15, 2021 to test the airflow rates of the air handling units. A summary of the tested airflow rates versus the design airflow rates from that visit are shown below in Table 5. Milharmer returned to the site on January 19, 2022 to test the exhaust fans and hot water coils. Tighe & Bond returned on April 12, 2024 to investigate the low airflow in AHU-2 & 3, noted in the TAB report. A summary of the design waterflow rates versus the actual waterflow rates is shown below in Table 6. A summary of the tested airflow rates versus the design airflow rates of the exhaust fans is shown below in Table 7. The full testing and balancing report is attached.

**TABLE 5**
Air Handler Airflow Testing & Balancing Results

| | Design | | | Actual | | |
|---|---|---|---|---|---|---|
| Unit | Total Supply Fan Airflow (CFM) | Recommended Outdoor Airflow (CFM) | Return Airflow (CFM) | Supply Fan Airflow (CFM) | Outdoor Airflow (CFM) | Return Airflow (CFM) |
| AHU-1 | 3,255 | 1,120 | 2,135 | 2,333 | 1,091 | 1,242 |
| AHU-2 | 2,600 | 2,600 | 0 | 2,128 | 2,128 | 0 |
| AHU-3 | 1,255 | 1,255 | 0 | 962 | 962 | 0 |
| RTU-1 | 4,000 | 1,200 | 2,800 | 3,721 | 1,130 | 2,591 |
| RTU-2 | 4,000 | 1,200 | 2,800 | 4,090 | 1,835 | 2,255 |

The typical balancing tolerance for air systems is ±10% of the design airflow.

**TABLE 6**
Air Handler Waterflow Testing & Balancing Results

| | Design Hot Water Flow Rate (GPM) | Actual Hot Water Flow Rate (GPM) |
|---|---|---|
| AHU-1 | 5.8 | 6.2 |
| AHU-2 | 14.2 | 15 |
| AHU-3 | 7.5 | 8.5 |

**TABLE 7**
Exhaust Fan Testing & Balancing Results

| Unit | Serving | Design Return/Exhaust Airflow (CFM) | Actual Return/Exhaust Airflow (CFM) |
|---|---|---|---|
| EF-1 | Restrooms | 820 | 704 |
| EF-2 | Restrooms | 200 | 245 |
| EF-3 | Restrooms | 300 | 336 |
| EF-4 | Restrooms | 1,000 | 682 |
| EF-5 | Holding Cells | 1,340 | 1,271 |
| EF-6 | Holding Cells | 470 | 535 |

The typical balancing tolerance for air systems is ±10% of the design airflow.

In reviewing the airflow report data, the following should be noted:

1. AHU-1 is delivering a supply airflow rate that is not within the typical 10% tolerance of the design airflow rate. If each zone is not receiving its design supply airflow rate, then we cannot ensure that those zones are receiving their design outside airflow rates, even if the outside airflow to the unit is correct. We recommend rebalancing this unit to its design supply airflow rate. The balancing contractor noted that this unit will require a sheave change to increase the airflow to the design rate.
2. AHU-2 and AHU-3 are not within the typical 10% tolerance of our recommended airflow rates. Units that are not receiving the recommended outside airflow rates are not supplying each zone the code required outside airflow rates from our calculations. The external static pressures listed in the TAB report are high compared to the scheduled design total static pressures which may be causing the lower airflow.
3. Tighe & Bond investigated AHU-2 to determine the cause of low airflow. We did not find any obvious obstructions in the ductwork. Based on our investigation, we recommend cleaning the coils and adjusting the sheave to return the unit to design airflow.
4. Tighe & Bond investigated AHU-3 to determine the cause of low airflow. We did not find any obvious obstructions in the ductwork. Based on our investigation, we recommend cleaning the coils and replacing the sheave to return the unit to design airflow.
5. RTU-2 is receiving an outside airflow rate that is above the typical 10% tolerance of our recommended airflow rate. This unit may be expending more energy than is necessary to heat/ cool the excess outside air. We recommend adjusting the outside air damper in order to rebalance the outside airflow rate to our recommendation.
6. Toilet exhaust fans EF-1, EF-2, EF-4, and EF-6 are not performing within acceptable range. We recommend rebalancing these exhaust fans to their design

exhaust airflow rates. EF-4 may need to be replaced considering the large different in the actual flow rate vs. the design.

7. Tighe & Bond went to the site to investigate EF-4 issues and discovered that there were no obvious duct blockages and that EF-4 is operating at 100% speed. Due to the hard ceilings below the fan, there is no access to the volume dampers in the ductwork which are shown on the 1994 building plans. We recommend installing access hatches for the volume dampers to ensure they are properly positioned. If that does not fix the low airflow issue, the fan should be replaced.
8. The hot water system is performing within an acceptable range of the design waterflow rates.
9. The chilled water system was not tested because the building was in heating mode at the time of the balancing contractors visit. We recommend the balancer return to test the chilled water system when the building is in cooling mode.