DEDHAM DISTRICT COURT
HVAC SYSTEM EVALUATION SUMMARY

Visited July 6, 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 & Bond received mechanical drawings for half of the courthouse from a renovation in 2001. There are three other rooftop units that we do not have any mechanical drawings for. It is unknown what type of system (VAV, Single Zone, Multi Zone, etc.) these rooftop units are, what areas they serve, or what the design values may be for supply air, outside air and return air. Therefore, it is not possible for Tighe & Bond to calculate the code required minimum outside air for these systems. Our analysis is based on the information from the mechanical drawings we received and our site visit.

1.0 Airflow Rate Per Person (Reduced Occupancy)

	Total People (reduced occupancy)	*Total Air*		*Outdoor Air*	
Courtroom		*Supply Airflow (CFM)*	*Airflow Rate (CFM/Person)*	*Outside Airflow (CFM)*	*Airflow Rate (CFM/Person)*
Courtroom 1	17	4,000	35	1,200	71
Courtroom 2	15	Unknown	Unknown	Unknown	Unknown
Courtroom 3	14	Unknown	Unknown	Unknown	Unknown
Courtroom 4	8	1,500	188	527	66
Courtroom 5	8	1,500	188	527	66

2.0 Recommendations

Section	Recommendation/Finding	Action
2.1	**Filtration Efficiency**	
RF-1	Replace filters with MERV-13 filters	Can only support MERV-10
RF-3	Install a differential pressure sensor with a display across the filter bank	In Progress
2.2	**Testing and Balancing**	
RTB-1	Test and balance air handling unit supply air and minimum outdoor air flow rates	In Progress
RTB-2	Rebalance system return air flow rate	In Progress
RTB-4	Test and balance VAV box flow rates	In Progress
RTB-5	Test and balance all air inlets and outlets	In Progress
RTB-6	Test and balance all air handler and fan coil unit dx and hot water coils	In Progress
2.3	**Equipment Maintenance and Upgrades**	
RE-1	Test existing air handling system dampers and actuators for proper operation	In Progress

RE-2	Clean air handler coils and drain pens	In Progress
RE-4	Inspect VAV boxes and controllers	In Progress
RE-7	Test the existing air handler and fan coil unit control valves ad actuators for proper operation	In Progress
2.4	Control System	
RC-1	Implement a pre and post-occupancy flush sequence	N/A
RC-4	Confirm the economizer control sequence is operational	In Progress
2.5	Additional Filtration and Air Cleaning	
RFC-1	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.	In Progress
2.6	Humidity Control	
	No actionable items	N/A
2.7	Other Recommendations	
2.7.1	Document As-Built Conditions and Recalculate Outdoor Air Requirements	In Progress
2.7.2	Capital Planning for Replacement of Mechanical Equipment	Deferred
2.7.3	Install a Building Management System	Deferred

Dedham District Court
Dedham, MA

HVAC SYSTEM EVALUATIONS COVID-19

Office of Court Management

July 13, 2021

Tighe&Bond

100% Recyclable

Section 1
Existing Conditions & Site Observations

Tighe & Bond visited the Dedham District Courthouse on May 5, 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 & Bond received mechanical drawings for half of the courthouse from a renovation in 2001. There are three other rooftop units that we do not have any mechanical drawings for. It is unknown what type of system (VAV, Single Zone, Multi Zone, etc.) these rooftop units are, what areas they serve, or what the design values may be for supply air, outside air and return air. Therefore, it is not possible for Tighe & Bond to calculate the code required minimum outside air for these systems. Our analysis is based on the information from the mechanical drawings we received and our site visit.

Site Visit Attendees:

- *Office of Court Management:*
  - John McGowan, Courthouse Facilities Staff
- *Tighe & Bond*
  - Ryan Ablondi, PE, Senior Mechanical Engineer
  - Tim Bill, Staff Mechanical Engineer

1.1 Existing Ventilation System

The Dedham District Courthouse was constructed in 1938 and is approximately 26,000 square feet in size. It has had several renovations over the years including a large addition on the back of the building as well as an air quality improvements project in 2001 which included the installation of the mechanical equipment assessed in this report. A constant volume, single zone rooftop air handling unit (RTU) with heat pump serves the main courtroom. The unit contains a supply fan, 2" MERV 10 Filters and refrigerant (DX) cooling/heating coil and is in fair condition. It is unknown whether the supply fan continues to run to provide ventilation air when the space temperature is satisfied.

One variable air volume (VAV) air handling unit (AHU) in the attic serves two courtrooms and associated office space on the second floor. The unit contains a DX cooling coil, supply fan, and a 2" MERV 10 filter and is in fair condition. There is a dedicated return fan serving the unit. Supply air is distributed to each zone via VAV boxes. All VAV boxes are equipped with electric heating coils.

As mentioned above, there are three rooftop units that Tighe & Bond did not receive any mechanical drawings for. Two of the three RTUs are mounted on the high rear roof over the addition on the back of the building. The third is mounted toward the center of the roof. It is assumed that all three of these units are serving areas in the addition at the rear of the building.

The two units mounted on the high roof are Carrier model 50HC cooling only RTUs. Based on the nametag on the unit, these units do not have any factory provided heat and it is unknown whether there is any auxiliary heat such as a duct mounted electric heating coil

in either of these systems. If there is not any auxiliary heat, the system can not operate in winter and the areas served by these units would not have any ventilation at that time. The unit includes a supply fan, 2" MERV 10 filter and a DX cooling coil.

The third unit mounted toward the middle of the roof is a Bryant 558F cooling only RTU. Similar to the carrier units, there is no factory mounted heat option for this unit and it is unknow if there are any auxiliary heater in the system. If the system does not run in the winter, the areas served with not have any ventilation. The unit includes a supply fan, 2" MERV 10 filter and DX cooling coil.

There are three fan coil units (FCU) serving the building that are in fair condition, one in the basement and two on the first floor. The FCU in the basement serves various office areas, support areas and the corridor. The basement FCU has a supply fan, DX cooling coil, 2" MERV 10 filter and integral hot water coil. Outside air is ducted from the exterior, directly to the return air inlet of the FCU. The two FCUs on the first floor serve office spaces for the clerk and probation areas. Each of these units has a supply fan, 2" MERV 10 filter and DX cooling coil. It is unknown whether the supply fans continues to run to provide ventilation air when the space temperature is satisfied. A dedicated outside air fan in the attic provides outside air ducted to the return air inlet of each FCU.

The lockup area is served by an energy recovery ventilator (ERV) which consists of a 100% outside air fan, 2" MERV 10 filters, electric preheat coil, energy wheel and an exhaust air fan. There are duct mounted DX cooling and hot water heating coils in the supply duct.

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
RTU-1	4,000	1,200	2" MERV 10	Fair
AHU-1	5,125	1,800	2" MERV 10	Fair
RTU-X	Unknown	Unknown	2" MERV 10	Fair
RTU-X	Unknown	Unknown	2" MERV 10	Fair
RTU-X	Unknown	Unknown	2" MERV 10	Fair
FCU-1	1,040	150	2" MERV 10	Fair
FCU-2	1,600	275	2" MERV 10	Fair
FCU-3	1,600	250	2" MERV 10	Fair
ERV-1	440	440	2" MERV 10	Fair

Photo 1 – Representative Air Handler

1.2 Existing Control System

The Dedham District Courthouse does not have a building management system (BMS). All of the mechanical equipment operates under local electric controls. We are not aware of any demand control ventilation sequences in use at this courthouse. RTU-1 which serves the main courtroom is noted on the drawings as having full economizer.

Section 2
Recommendations

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

Building areas without adequate ventilation and filtration significantly increase the risk of spreading viruses like Coronavirus (SARS-CoV-2), especially areas with high occupant density and where people occupy the same space for relatively long periods of time. Consider significantly reducing occupancy or relocating occupants to other areas with adequate ventilation.

2.1 Filtration Efficiency Recommendations

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

RF-1: *Replace filters with MERV-13 filters.*

The TAB Contractor and/or Engineer shall verify that the air handlers can accommodate a MERV-13 filter per Appendix A in the overview of recommendations report. Filter racks should be inspected and adjusted to ensure that filters fit tightly and that end spacers are in place to minimize filter bypass.

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

2.2 Testing & Balancing Recommendations

Based on the mechanical drawings we received, the air handling units are approximately 20 years old. The age of the units we did not receive drawings for is unknown. It is unknown to Tighe & Bond when the last time the any of 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.

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 all air handling units 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	585	**1,200**
AHU-1	5,125	1,800	523	**1,800**
RTU-X	Unknown	Unknown	Unknown	Unknown
RTU-X	Unknown	Unknown	Unknown	Unknown
RTU-X	Unknown	Unknown	Unknown	Unknown
FCU-1	1,040	150	144	**150**
FCU-2	1,600	275	114	**275**
FCU-3	1,600	250	83	**250**
ERV-1	440	440	279	**440**

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.

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)	134	103	31
Total Supply Air (CFM/Person)	103	68	221
Outdoor Air (CFM/Person)	31	22	60

*Values in table only based on spaces with ventilation air.

The airflow rate per person for each Courtroom 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. At times when the supply airflow for AHU-1 is reduced due to the space temperature being satisfied, the airflow rate per person will also be reduced.

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)***
Courtroom 1	80	4,000	50	1,200	16
Courtroom 2	67	Unknown	Unknown	Unknown	Unknown
Courtroom 3	67	Unknown	Unknown	Unknown	Unknown
Courtroom 4	32	1,500	47	527	16
Courtroom 5	35	1,500	43	527	15

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, 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. At times when the supply airflow is reduced due to the space temperature being satisfied, the airflow rate per person will also be reduced.

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)***
Courtroom 1	17	4,000	235	1,200	71
Courtroom 2	15	Unknown	Unknown	Unknown	Unknown
Courtroom 3	14	Unknown	Unknown	Unknown	Unknown
Courtroom 4	8	1,500	188	527	66
Courtroom 5	8	1,500	188	527	66

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

RTB-2: *Rebalance system return air flow rate.*

We recommend testing and balancing the return fan airflow rate for AHU-1 to ensure the correct quantity of return air is being delivered to the air handler.

RTB-4: *Test and balance VAV box flow rates.*

We recommend testing and balancing the VAV boxes serving AHU-1 to ensure each space is being supplied the proper quantity of air.

RTB-5: *Test and balance all air inlets and outlets.*

If the airflow to each space has not been recently tested, we recommending testing the airflow rates in the holding cells, control room, Courtrooms, Jury Pool room, and other densely occupied areas as a minimum. These systems are very old and the airflow rate delivered to and returned from these spaces may not match the original design intent.

If specific areas within the Courthouse experiences regular cooling and heating comfort complaints this may be an indication of a lack of airflow to the space. We recommend testing and balancing the air inlets and outlets serving those spaces to the designed values. Prior to rebalancing the building, we recommend verifying the boiler plant is maintaining the correct supply water temperature. Incorrect supply water temperature may be contributing to the temperature control complaints instead of a lack of airflow.

RTB-6: *Test and balance all air handler and fan coil unit dx and hot water coils.*

Testing and balancing the air handler and fan coil unit hot 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.

Confirm that the air handler and fan coil unit's refrigerant system is operating correctly to ensure the DX coil is receiving full refrigerant flow.

2.3 Equipment Maintenance & Upgrades

We recommend the following equipment maintenance and upgrades:

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-4: *Inspect VAV boxes and controllers.*

VAV boxes regulate the supply air delivered to each space. At a minimum, we recommend cycling the damper positions and testing the airflow to verify the maximum and minimum airflow rates are being delivered as designed. Consider cleaning the airflow stations and reheat coils and changing dirty filters in the fan powered VAV boxes. Any boxes not delivering the expected airflow rates should be rebalanced or replaced.

RE-7: *Test the existing air handler and fan coil unit 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-4: *Confirm the economizer control sequence is operational.*

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 Document As-Built Conditions and Recalculate Outdoor Air Requirements

As discussed in Section 1, the drawings received by Tighe & Bond do not show all of the mechanical systems in the building. If documentation of these systems cannot be found, we recommend investigating the ductwork distribution systems throughout the building and developing as-built drawings. Once this is documented, revised outdoor airflow to each RTU should be calculated by an engineer.

2.7.2 Capital Planning for Replacement of Aging Mechanical Equipment

The existing mechanical equipment including RTU-1, AHU-1, the FCUs and ERV-1 are approx. 20 years old and are approaching the end of their useful life. These units are currently in good condition however ASHRAE data shows that the median life expectancy for RTUs and packaged split DX AHUs is 15 years and Fan coil units is 20 years. While

immediate replacement is not necessary at this time, we would recommend developing a capital plan to replace these units in ~5 years.

2.7.3 Install a Building Management System

We recommend installing a Building Management System (BMS) to control and monitor HVAC equipment. Installing a modern BMS to operate and monitor the mechanical systems in the building can save energy and lower maintenance and operating costs. This recommendation is an energy saving and maintenance measure and does not affect the indoor air quality of the building.

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.

J:\M\M1671 Comm. of MA Court System\011 - COVID-19 Courthouse Evaluations\Report_Evaluation\Draft Reports\XXX Courthouse Report Template.docx