



## ESSEX COUNTY SUPERIOR COURTHOUSE HVAC SYSTEM EVALUATION SUMMARY

Visited February 23, 2021. Inspected the air-handling units and toured the occupied portions of the building to determine if the spaces generally matched usage noted on the architectural plans. The Essex County Superior Court was constructed in 1805 and is approximately 8,600 square feet in size. A significant renovation of the mechanical systems for the building was completed in 2008. Ventilation air is provided to the second floor of the building by two air handling units. One larger constant volume unit serving the large courtroom on the second floor and a smaller variable air volume (VAV) air handling unit serving the four offices on the second floor. Each unit contains a supply fan, refrigerant (DX) cooling coils, hot water heating coils and 2" MERV 8 pre filters. Supply air for the smaller unit is distributed to each zone via VAV boxes. It should be noted that due to the age of the building mechanical ventilation has not been provided to any space on the first floor or the basement.

### 1.0 Airflow Rate Per Person (Reduced Occupancy)

<i>Courtroom</i>	<i>Total People</i>	<i>Total Air</i>		<i>Outdoor Air</i>	
		<i>Supply Airflow (CFM)</i>	<i>Airflow Rate (CFM/Person)</i>	<i>Outside Airflow (CFM)</i>	<i>Airflow Rate (CFM/Person)</i>
Courtroom	29	3,600	124	720	25

### 2.0 Recommendations

Section	Recommendation/Finding	Action
<b>2.1</b>	<b>Filtration Efficiency</b>	
RF-1	Replace filters with MERV-13 filters.	In-progress
RF-3	Install a differential pressure sensor (switch) across the filter banks.	Complete
<b>2.2</b>	<b>Testing and Balancing</b>	
RTB-1	Test and rebalance air handling unit minimum outside air flow rate	In-progress
RTB-2	Rebalance system return airflow rate.	In-progress
RTB-4	Test and balance VAV box flow rates.	In-progress
RTB-6	Test and balance all air handler chilled and hot water coils	In-progress

### Essex County Superior Courthouse HVAC System Evaluation - Continued

<b>2.3</b>	<b>Equipment Maintenance and Upgrades</b>	
RE-1	Test existing air handling system dampers and actuators for proper operation.	Complete
RE-2	RE-2: Clean air handler coils and drain pans	In-progress
RE-4	Inspect VAV boxes and controllers.	Complete
RE-5	Install freeze stat or confirm the existing freeze stat is working correctly on the air-handling unit.	Complete
RE-7	Test the existing freeze stat is working correctly on each air-handling unit.	N/A

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**2.4 Additional Filtration and Air Cleaning**

<b>RFC-1</b>	Install portable HEPA filters.	Complete
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**2.5 Additional Recommendations**

<b>2.5.1</b>	Mechanical Ventilation Feasibility Study	In-progress
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<b>2.5.2</b>	Convert Chilled and Hot Water Systems to Variable Flow	In-progress
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<b>2.5.3</b>	Add Demand-Controlled Ventilation	In-progress
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<b>2.5.4</b>	Add Ventilation to the Holding Cell	In-progress
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<b>2.5.5</b>	Add Ventilation to the Law Library	In-progress
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**Essex County Superior Court  
Newburyport, MA**

**HVAC SYSTEM  
EVALUATIONS  
COVID-19**

Office of Court Management

April 10, 2021

# Section 1

## Existing Conditions & Site Observations

Tighe & Bond visited the Essex County Superior Court in Newburyport, MA on February 23, 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.

### Site Visit Attendees:

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

### **1.1 Existing Ventilation System**

The Essex County Superior Court was constructed in 1805 and is approximately 8,600 square feet in size. A significant renovation of the mechanical systems for the building was completed in 2008. Ventilation air is provided to the second floor of the building by two air handling units. One larger constant volume unit serving the large courtroom on the second floor and a smaller variable air volume (VAV) air handling unit serving the four offices on the second floor. Each unit contains a supply fan, refrigerant (DX) cooling coils, hot water heating coils and 2" MERV 8 pre filters. Supply air for the smaller unit is distributed to each zone via VAV boxes. It should be noted that due to the age of the building mechanical ventilation has not been provided to any space on the first floor or the basement.

The two air handling units were installed as part of a major mechanical renovation in 2008 and are in good condition. The large AHU shows some signs of leaking at the HW heating coil and the HW has been shut off to the unit. The dampers and actuators for both units are in good condition however, the heating and cooling coils are dirty. The hot and chilled water control valves and actuators are in good condition.

There is a large exhaust fan in the attic mechanical space serving bathrooms in the Basement, the Jury Deliberation Room, and the Judge's Chambers. A small ceiling mounted bathroom fan was installed in the new bathroom off the District Attorney's Office which was installed in 2008. Both Bathroom exhaust fans are in good condition.

There is a single small detention cell on the second floor outside the courtroom. The cell currently has no ventilation air or exhaust and is not negatively pressurized.

A 1,200 million BTU/hr, oil fired hot water boiler was installed as part of the 2008 renovation in addition to an existing 400 million BTU/hr, oil fired hot water boiler. The two boilers provide hot water to both AHUs in the attic mechanical space as well as various perimeter fin tube radiation.

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)	Pre/Final Filters	Condition
AC-1	4,000	800	MERV 8	Very Good
AC-2	1,200	200	MERV 8	Good



Photo 1 – Air Handler AC-1

## 1.2 Existing Control System

All of the mechanical systems in the courthouse are locally controlled and not connected to a building management system (BMS). All of the controls are electric and appear to be in good condition. AC-1 & AC-2 are not equipped with the mixed air dampers necessary for airside economizer or demand control ventilation.

## **Section 2**

# **Recommendations**

Below is a list of recommendations for the Essex County Superior Court. Please refer to the "Master Recommendation List" for further explanation and requirements of the stated recommendations.

Building areas without adequate ventilation and filtration significantly increase the risk of spreading viruses like COVID-19, 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**

The air handling units are approximately 13 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.

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

<b>Unit</b>	<b>Original Supply Airflow (CFM)</b>	<b>Original Design Min. O.A. (CFM)</b>	<b>Current Code Min. O.A. Requirements (CFM)</b>	<b>Recommended Minimum O.A. (CFM)</b>
AC-1	4,000	800	745	<b>800</b>
AC-2	1,200	200	50	<b>200</b>

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

	<b>All spaces</b>	<b>Courtrooms</b>	<b>Non-Courtroom Spaces</b>
Total Occupancy (People)	84	81	3
Total Supply Air (CFM/Person)	62	44	533
Outdoor Air (CFM/Person)	12	9	93

Note: Occupancy is for spaces served with mechanical ventilation only.

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.

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

<b>Courtroom</b>	<b>Total People</b>	<b>Total Air</b>		<b>Outdoor Air</b>	
		<b>Supply Airflow (CFM)</b>	<b>Airflow Rate (CFM/Person)</b>	<b>Outdoor Airflow (CFM)</b>	<b>Airflow Rate (CFM/Person)</b>
Courtroom	81	3,600	44	720	9

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)

<b>Courtroom</b>	<b>Total People</b>	<b>Total Air</b>		<b>Outdoor Air</b>	
		<b>Supply Airflow (CFM)</b>	<b>Airflow Rate (CFM/Person)</b>	<b>Outdoor Airflow (CFM)</b>	<b>Airflow Rate (CFM/Person)</b>
Courtroom	29	3600	124	720	25

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 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 to ensure each space is being supplied the proper quantity of air.

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

Testing and balancing the air handler 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'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. Any boxes not delivering the expected airflow rates should be rebalanced or replaced.

**RE-5:** *Confirm the existing freeze stat is working correctly on each air handling unit.*

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

## **2.4 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 areas without mechanical ventilation and 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.

## **2.5 Other Recommendations**

### **2.5.1 Mechanical Ventilation Feasibility Study**

The first floor and basement of the Courthouse is not mechanically ventilated. Operable windows do exist on the first floor, and natural ventilation is acceptable per code, however windows are typically not opened during cold or hot outdoor air temperatures. We recommend a study of the Courthouse to determine how feasible it is to install mechanical ventilation in all occupied spaces.

### **2.5.2 Convert Chilled and Hot Water Systems to Variable Flow**

The hot water pumps are constant flow systems. Constant flow pumps circulate the same volume of water to air handling units and fin tube radiation regardless of whether the water is required or not. If air handlers do not require this water, the three-way valves serving the air handler coils bypass the coil, which allows the water to return back to the chiller or boiler plant. We recommend investigating the possibility of converting these systems to variable flow. The three-way air handler valves would have to be replaced with two-way valves, as well as any other three-way valves that are in the system. Variable frequency drives (VFD) may be able to be connected to the existing hot water pumps, allowing the pumps to vary the flow rate to match the demand. This recommendation is an energy saving measure and does not affect the indoor air quality of the building.

### 2.5.3 Add Demand-Controlled Ventilation

Consider adding demand-controlled ventilation (DCV) to the AHU serving the courtroom. The outdoor airflow rate is relatively high and the use of DCV can reduce operating costs by reducing outdoor air when the occupancy in the space is low. This measure will require the installation of a CO2 sensor in the courtroom and new modulating damper actuators and controls in the AHU. If DCV is incorporated, per ASHRAE recommendations, it should not be enabled until the Pandemic has subsided. This recommendation is an energy saving measure and does not increase the indoor air quality of the building.

### 2.5.4 Add Ventilation to the Holding Cell

The existing holding cell on the second floor does not have any ventilation. Consider adding ventilation in the form of a small exhaust fan to, at a minimum, provide negative pressurization to the cell. Consideration could also be given to tying in a small duct to the large bathroom exhaust fan in the attic directly above the holding cell.

### 2.5.5 Add Ventilation to the Law Library

The Law Library is a 645 SF space on the second floor Mezzanine and currently does not have any mechanical ventilation or operable windows. Consider adding ventilation to the space by tapping into the 10x10 duct passing through the space from AC-1. Consideration could also be given to tying into the 18x6 exhaust duct in the wall from the bathrooms below.

## Disclaimer

Tighe and Bond cannot in anyway 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.

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