EASTERN HAMPSHIRE DISTRICT COURT
HVAC SYSTEM EVALUATION SUMMARY

Visited February 24, 2021. While on site we inspected the rooftop air handling equipment and toured the facility to determine if the spaces generally matched usages noted on the architechral plans. The courthouse is a leased building that was constructed in 2006, is a single story on a slab, and is approximately 30,000 square feet in size. Ventilation air is provided by eight constant-volume, single zone packaged rooftop units.

1.0 Airflow Rate per Person (Reduced Occupancy)

		Total Air		*Outdoor Air*	
Courtroom	*Total People*	*Supply Airflow (CFM)*	*Airflow Rate (CFM/Person)*	*Outside Airflow (CFM)*	*Airflow Rate (CFM/Person)*
Jury Deliberation 181	6	400	67	100	17
Jury Deliberation 182	6	400	67	100	17
Jury Pool 187	12	1,100	92	275	23
Courtroom 1	24	3,800	158	950	40
Courtroom 2	24	3,740	156	935	39

2.0 Recommendations

Section	Recommendation/Finding	Action
2.1	**Filtration Efficiency**	
RF-1	Replace filters with MERV 13	Complete
RF-3	Install a differential pressure sensor across the filter banks	In-progress
RF-3a	Connect the pressure sensor to a local alarm	
2.2	**Testing and Balancing**	
RTB-1	Test and rebalance air handling unit supply air and minimum outside air flow rates	Complete
RTB-5	Test and balance all air inlets and outlets	N/A
2.3	**Equipment Maintenance and Upgrades**	
RE-2	Clean air handler coils and drain pans	Complete
2.4	**Control System**	
RC-1	Implement a pre and post-occupancy flush sequence	Complete
RC-4	Confirm the economizer control sequence is operational	Complete
2.5	**Additional Filtration and Air Cleaning**	
RFC-1	Install portable HEPA filters in high traffic areas – *if courthouse is to operate at a high occupancy (i.e. 50-75% or greater), install portable HEPA filters in high traffic areas.*	In-progress
2.6	**Humidity Control**	To be evaluated

2.7	Other Recommendations	
2.7.1	Run supply fans continuously during occupied hours	Complete
2.7.2	Repair or replace controls for exhaust fans	In-progress
2.7.3	Replace rooftop air handling units	Deferred – added to 5-year Capital Plan
2.7.4	Add ventilation to all occupied areas	Deferred – added to 5-year Capital Plan

Eastern Hampshire District Court
Belchertown, MA

HVAC SYSTEM EVALUATIONS COVID-19

Office of Court Management

March 10, 2021

Tighe&Bond

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Section 1
Existing Conditions & Site Observations

Tighe & Bond visited the Eastern Hampshire District Court in Belchertown, MA on February 24, 2021. While on site we inspected the rooftop air handling equipment and toured the facility to determine if the spaces generally matched usages noted on the architectural plans.

Site Visit Attendees:

- *Office of Court Management:*
  - Alfred Benoit, Court Facilities Staff
- *Tighe & Bond*
  - Todd Holland, PE, Senior Mechanical Engineer
  - Matt Mancini, Staff Mechanical Engineer

1.1 Existing Ventilation System

The Eastern Hampshire District Court is a leased building that was constructed in 2006, is a single story on a slab, and is approximately 30,000 square feet in size. There have been no significant changes or additions to the building or its systems since construction.

Ventilation air is provided by eight constant-volume, single-zone packaged rooftop units. Each unit consists of a mixing box with 100% outdoor air economizer, 2" MERV-13 filters, constant-speed supply fan, direct-expansion (DX) cooling coil, gas-fired furnace, refrigeration compressor(s) and condenser. There are no return or exhaust fans in the air handlers, just barometric relief dampers for when the units are in economizer mode. Supply air is distributed through metal ductwork with ceiling-mounted diffusers and return grilles.

The toilet rooms that serve the public and jury deliberation rooms are served by roof-mounted exhaust fans. Small toilet rooms are served by individual ceiling-mounted exhaust fans.

The mechanical plans we reviewed do not show a separate exhaust fan serving the holding cells, they show return air ducted back to the rooftop unit. However, there is a rooftop exhaust fan located above the area, which most likely serves the holding cells. It was not operating at the time of our visit, and the exhaust grilles in the holding cells were not active, although dust on the grill faces indicates they are or may have been active. The snow melt pattern around this fan also indicates that it runs, see Photo 2 and the explanation that follows.

A small split-system serves the tel/data room. Electric-resistance wall heaters serve vestibules and the public toilet rooms.

Photo 1 – Representative Rooftop Air Handlers

Photo 2 – Representative Exhaust Fans

The exhaust fan in the background, upper left corner of Photo 2, serves the toilet rooms in the Jury Deliberation area, and was running at the time of our site visit. We suspect that the unit in the foreground serves the holding cells. We observed that it was not running, but the snow melt pattern indicates that it has run recently.

All HVAC units are from the original construction and appear to be in fair condition, although at or near the end of their expected service lives. There are comfort issues throughout the building that were noted by staff, which we feel may be due to the limited zoning of the rooftop units, and the coarse staging of cooling and heating (which is largely just on or off).

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

TABLE 1
Existing Air Handling Units

Unit	Original Design Airflow (CFM)	Original Design Min. O.A. (CFM)	Pre/Final Filters	Condition
RTU-1	3,400	Unknown	2" MERV-13	Fair
RTU-2	5,000	Unknown	2" MERV-13	Fair
RTU-3	4,000	Unknown	2" MERV-13	Fair
RTU-4	3,000	Unknown	2" MERV-13	Fair
RTU-5	3,400	Unknown	2" MERV-13	Fair
RTU-6	2,400	Unknown	2" MERV-13	Fair
RTU-7	5,000	Unknown	2" MERV-13	Fair
RTU-8	5,000	Unknown	2" MERV-13	Fair

The filters in these units were recently upgraded to MERV-13 by an outside contractor.

1.2 Existing Control System

Rooftop units are controlled by programmable thermostats with 7-day schedules. All units were set to run the fan in "auto" mode, which runs the supply fan only when the unit is actively heating or cooling. This may have changed recently when new filters were installed. Units that serve the office areas are controlled by a central thermostat and four remote temperature averaging sensors. Units that serve the courtrooms and lockup areas are controlled by individual thermostats (single location used for heating or cooling call).

We noted that the thermostat that controls the lockup area is located in the guard office, which has a substantial amount of heat-generating electronics. According to staff the holding cells are often cold, and the temperature must be adjusted manually.

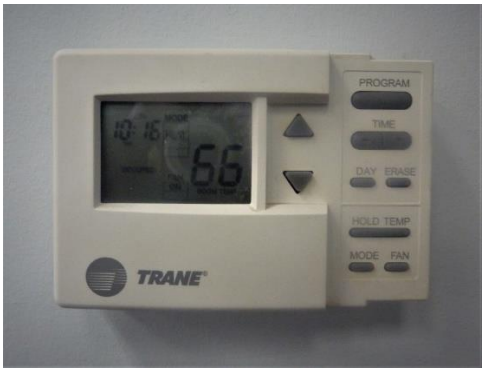

Photo 3 – Representative Thermostat

The exhaust fans serving the toilet rooms in the main lobby and jury deliberation areas are served by roof-mounted controlled by 24-hour timeclocks. The grilles in the main lobby toilet rooms were observed to be operating at the time of the visit. We suspect that the exhaust fan above the holding cells is also controlled by a 24-hour timeclock, which is not adjusted properly due to power failures.

The ceiling-mounted exhaust fans that serve small toilet rooms are controlled by occupancy sensors that also control the lighting.

Section 2
Recommendations

Below is a list of recommendations that we propose for the Eastern Hampshire District Court. Please refer to the "Master Recommendation List" for further explanation and requirements of the stated recommendations.

2.1 Filtration Efficiency Recommendations

We recommend the following measures be implemented for the existing air handling units that serve occupied areas:

RF-1: *Replace filters.*

We recommend the continued use of MERV-13 filters which meet the ASHRAE recommendation. Existing filters should be checked in March and April to ensure they are within their service lives and installed properly. The filter racks should be inspected to ensure that filters fit tightly and that end spacers are in place to minimize filter bypass.

RF-3: *Install differential pressure sensors across the filter banks.*

RF-3a: *Connect the pressure sensor to a local alarm.*

Maximum differential pressure should be set per manufacturer's recommendation based on air velocity to ensure filters are within their service lives. Typically this is not more than 1.0" w.g.

2.2 Testing & Balancing Recommendations

The air handling units are approximately 15 years old and have not been tested and balanced since construction.

We recommend the following testing and balancing measures be implemented:

RTB-1: *Test and balance air handling unit supply air and minimum outside 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	3,400	Unknown	404	**600**
RTU-2	5,000	Unknown	782	**1,250**
RTU-3	4,000	Unknown	520	**520**
RTU-4	3,000	Unknown	373	**373**
RTU-5	3,400	Unknown	563	**680**
RTU-6	2,400	Unknown	268	**420**
RTU-7	5,000	Unknown	1,102	**1,250**
RTU-8	5,000	Unknown	1,105	**1,250**

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.

Our ventilation air analysis discovered a few spaces that would not be able to receive the correct quantity of outdoor air based on today's code requirements at full occupancy. Our calculations showed that the additional outdoor air required would exceed the capacity of the gas furnaces. We recommend temporarily reducing the occupancy of the spaces that are not receiving the code required ventilation air. Table 3 lists the spaces that would require a reduced occupancy. The recommended outdoor air flow rates listed in Table 2 reflect the outdoor air requirements based on the reduced occupancy shown in Table 3.

TABLE 3
Recommended Maximum Occupancy During COVID-19 Pandemic

Room & Associated AHU	***2015 IMC Default Occupancy (# of People)***	***Recommended Occupancy (# of People)***
RTU-1		
Conference Room 173	9	4
Conference Room 165	8	4
RTU-3		
Conference Room 105	7	2
RTU-4		
Staff Lounge	19	10
RTU-5		
Prisoner Visit 143	3	1
Attorney 144	3	2
RTU-6		
Conference Meeting 162	4	2
Conference Room 160	8	5
RTU-7		
Courtroom 1	139	120
Jury Deliberation 182	15	12
Conference 189	8	5
Conference 191	8	5
RTU-8		
Courtroom 2	139	120
Jury Deliberation 182	15	12
Conference 189	8	5
Conference 191	8	5

Our recommendations on outdoor airflows depend on each unit's specified heating capacity (low, medium, or high) and whether they serve perimeter zones with a higher heat load. The design documents do not specify a minimum outdoor air damper position for the units, and we were unable to determine the settings by visual inspection.

RTU-3 and RTU-4, which serve office areas on the west side of the building, were specified with low-capacity gas heat. Our recommendation is to set the outdoor air dampers at the code minimum, about 12.5% open.

RTU-1 and RTU-6, which serve office areas on the east side, and RTU-5 which serves the lockup area, were specified with medium-capacity gas heat. Our recommendation is to set

the outdoor air dampers at approximately 20% open, which should enable the units to maintain a 95°F discharge temperature in peak winter conditions.

RTU-2, RTU-7, and RTU-8 were specified with high-capacity gas heat. These units are on the upper roof and serve interior spaces that include the courtrooms, jury rooms, and main lobby. Our recommendation is to set the outdoor air dampers at 25% open, which we believe is about the maximum where the units will be able to provide discharge air conditions similar to original design under peak outdoor air conditions, assuming the coils are clean and their performance has not degraded over time.

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 default occupancy.

TABLE 3
Average Airflow Rate per Person

	All Spaces	***Courtrooms***	***Non-Courtroom Spaces***
Total Occupancy (People)	399	195	204
Total Supply Air (CFM/Person)	78	39	116
Outdoor Air (CFM/Person)	16	10	22

The airflow rate per person for each Courtroom and Jury 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.

TABLE 4
Airflow Rate per Person (Full Occupancy)

		Total Air		***Outdoor Air***	
Courtroom	***Total People***	***Supply Airflow (CFM)***	***Airflow Rate (CFM/Person)***	***Outside Airflow (CFM)***	***Airflow Rate (CFM/Person)***
Jury Deliberation 181	15	400	27	100	7
Jury Deliberation 182	15	400	27	100	7
Jury Pool 187	32	1,100	34	275	9
Courtroom 1	139	3,800	27	950	7
Courtroom 2	139	3,740	27	935	7

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 the reduced occupancy schedule provided by the Office of Court Management, is shown below in Table 4a.

TABLE 4a
Airflow Rate per Person (Reduced Occupancy)

		Total Air		*Outdoor Air*	
Courtroom	***Total People***	***Supply Airflow (CFM)***	***Airflow Rate (CFM/Person)***	***Outside Airflow (CFM)***	***Airflow Rate (CFM/Person)***
Jury Deliberation 181	6	400	67	100	17
Jury Deliberation 182	6	400	67	100	17
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Courtroom 1	24	3,800	158	950	40
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Note: If occupancy is further reduced, the airflow rate per person will increase, assuming full airflow is being delivered to the space.

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

If specific areas within the Courthouse experience 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.

2.3 Equipment Maintenance & Upgrades

We recommend the following equipment maintenance and upgrades:

RE-2: *Clean rooftop unit coils and drain pans.*

While the cooling coils in the rooftop units may in generally good condition, they have operated for 16 years with only MERV-7 or MERV-8 filters for protection. These coils should be cleaned to maximize heat transfer and minimize pressure loss.

2.4 Control System Recommendations

We recommend the following for the control system:

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

This sequence should start all rooftop units and exhaust fans before the building is occupied, with the start time calculated to provide three air changes per hour (ACH) of ventilation air, or for two hours before people arrive.

Note that this flush period should be run after a morning warmup period, if the units have this capability. During the morning warmup, units typically operate with the outdoor air damper fully closed to bring the space to occupied temperature. The flush

period should be an extension of occupied mode, with units operating with outdoor air dampers open at or above minimum position.

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 Eastern Hampshire District Court 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 or where people congregate outside courtrooms. 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.

2.6 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 Run Supply Fans Continuously During Occupied Hours

All units were set to run the fan in "auto" mode, which runs the supply fan only when the unit is actively heating or cooling. This should be changed on each of the systems to run the supply fans continuously in occupied mode, to supply ventilation air to the spaces. Note that this may cause comfort issues because supply air temperature can fluctuate as the heating and cooling is staged on and off, and the systems may not have been designed to operate like this originally.

2.7.2 Repair or Replace Controls for Exhaust Fans

We recommend repairing or replacing the controls for exhaust fans that were not working at the time of our visit. Exhaust fans can be interlocked the rooftop units that serve the surrounding space. Small toilet rooms with individual fans can continue using controls interlocked to the lights, but we recommend using a time delay relay that runs the fans for a period after the lights are switched off, such as the Panasonic SmartExhaust AirCycler combination fan/light timer control.

2.7.3 Replace Rooftop Air Handling Units

Outdoor rooftop air handling units have a life expectancy of approximately 20 years. The rooftop units are 14 years old and are in fair condition. They use R-22 refrigerant, an ozone-depleting chemical that has been phased out of production, making it expensive to replace or replenish when a failure occurs. Consider replacing these units in the next 5 years. Replacement units will not only use a more environmentally friendly refrigerant, they will be more energy efficient, and can use heat pump technology to minimize the use of natural gas.

This recommendation is an energy saving measure and does not increase the indoor air quality of the building, although the project could also address comfort issues and the ventilation issues noted in the following measure.

2.7.4 Add Ventilation to All Occupied Areas

Several corridors and other interior spaces do not have operable windows or any mechanical ventilation. Consider adding or extending the existing ventilation systems to serve these areas.

2.7.5 Install Split System Unit for Guard Office

The thermostat that controls RTU-5 serving the lockup area is located in the guard office, which has a substantial amount of heat-generating electronics. According to staff, the temperature is often adjusted manually because the holding cells are cold. Installing a mini-split to serve the guard office and relocating the existing thermostat would help improve comfort, but would not increase the indoor air quality.

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.