LYNN DISTRICT COURTHOUSE
HVAC SYSTEM EVALUATION SUMMARY

Visited August 26, 2020. While on site, 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. The Lynn District Courthouse was constructed in 1942 and is approximately 40,800 square feet in size.

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 Pool Room	8	300	38	72	9
First Session Courtroom	25	4,200	168	1,008	40
Second Session Courtroom	23	4,200	183	1,008	44
Third Session Courtroom	13	2,100	162	504	39
Fourth Session Courtroom	16	2,100	131	504	32
Juvenile Courtroom	6	760	127	182	30

2.0 Recommendations

Section	Recommendation/Finding	Action
2.1	**Filtration Efficiency**	
RF-1	Replace filters with MERV 13	In-progress
RF-3	Install a differential pressure sensor across the filter banks	In-progress
RF-3b	Connect the pressure sensor to a local alarm	In-progress
2.2	**Testing and Balancing**	
RTB-1	Test and rebalance air handling unit supply air and minimum outside air flow rates	In-progress
RTB-2	Increase outside air flow rate beyond minimum under non-peak conditions	In-progress
RTB-4	Test and balance VAV box flow rates	Not in original TAB scope
RTB-5	Test and balance all air inlets and outlets	Not in original TAB scope
RTB-6	Test and balance all air handler hot water coils	In-progress
2.3	**Equipment Maintenance and Upgrades**	
RE-1	Test existing air handling system dampers and actuators for proper operation	Complete
RE-2	Clean air handler coils and drain pans	Complete
RE-4	Inspect VAV boxes and controllers	Complete
RE-5	Install freeze stat or confirm the existing freeze stat is working correctly on each air handling unit	Complete
RE-7	Test the existing air handler control valves and actuators for proper operation	Complete

2.4	**Control System**	
RC-1	Implement a pre and post-occupancy flush sequence	In-progress
RC-2	Install controls required to introduce outside air beyond the minimum requirements	In-progress
RC-4	Confirm the economizer control sequence is operational if such a sequence exists	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% occupancy or greater)*	Complete
2.6	**Humidity Control**	
	No actionable items listed – continuous monitoring for seasonal changes	On-going
2.7	**Other Recommendations**	
2.7.1	Replace air handling units AHU-1 and AHU-2	Deferred – included in 5 year Capital Plan
2.7.2	Install a building management system	Deferred – included in 5 year Capital Plan
2.7.3	Replace pneumatic damper and valve actuators with electronic actuators	Deferred – included in 5 year Capital Plan

Lynn District Court
Lynn, MA

HVAC SYSTEM EVALUATIONS COVID-19

Office of Court Management

January 24, 2021

Tighe&Bond

Section 1
Existing Conditions & Site Observations

Tighe & Bond visited the Lynn District Courthouse on August 26, 2020. 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:*
  - Tony Imperial, Courthouse Facilities Staff
- *Tighe & Bond*
  - Jason Urso, PE, Senior Mechanical Engineer
  - Timothy Bill, Staff Mechanical Engineer

1.1 Existing Ventilation System

The Lynn District Courthouse was constructed in 1942 and is approximately 40,800 square feet in size. Two constant volume, Trane air handling units, AHU-1 and AHU-2 are located in the penthouse mechanical room and provide ventilation air to the first and second floors. Duct mounted reheat coils serve each zone throughout the two floors. One variable air volume (VAV) Trane air handler, AHU-3, located in the basement file room provides ventilation air to the basement including the holding areas. Air to each zone is regulated with VAV boxes. All air handlers contain a supply fan, refrigerant cooling coils, hot water heating coils, and filters. AHU-1 and AHU-2 contain a MERV 6 roll filters and do not have any filter racks. AHU-3 contains a 2" MERV 8 filter. A dedicated return fan serves each unit, which are also ducted to exhaust air louvers indicating the air handlers may contain an economizer sequence.

Air handlers AHU-1 and AHU-2 appear to be from the 1969 renovation and are in fair condition. The outdoor air dampers are rusted, in fair to poor condition. The return air damper for AHU-1 was not accessible and AHU-2 return air damper is rusted. All damper actuators are old and in fair condition. The coils were not accessible, and therefore the condition and cleanliness is unknown. However, we suspect they may be dirty considering only a MERV 6 filter is used. The return fans also appear to be from the 1969 renovation and are in fair condition. The exhaust air dampers downstream of the return fan are in good condition.

AHU-3 is located in the basement file room, was installed during a 1996 renovation, and appears to be in good condition. The outdoor air damper is in fair condition, however the outdoor air damper was closed and the linkage was not connected to the actuator. We did not observe a return air damper. The coils appeared to be dusty in some spots.

Units AHU-1 and AHU-2 contain 3-way hot water valves with pneumatic actuators and a two-way hot water control valve with electronic actuator serves AHU-3.

Exhaust fan EF-1 is located in the garage and serves the holding areas. The difference between the quantity of exhaust and full supply airflow in the holding areas is only 10 to

20 CFM. According to the 1969 drawings, exhaust fan EX-3 serves all toilet exhaust throughout the building.

An air handler is also located in the garage; however this unit was not inspected since it does not serve occupied spaces. Facilities personnel did state this unit was decommissioned and not in use because the hot water coil freezes, despite a freeze pump protecting the coil.

According to the 1969 design drawings, a 3 million BTU/hr hot water boiler plant provides hot water to air handlers, perimeter radiation, and reheat coils. A dedicated air-cooled condensing unit serves each air handler, which provides refrigerant to the cooling coils.

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

TABLE 1
Existing Air Handling Units

Unit	Original Design Airflow (CFM)	Original Design Min. O.A. (CFM)	Pre/Final Filters	Condition
AHU-1	13,600	1,500	MERV 6 Roll Type	Fair
AHU-2	20,000	4,800	MERV 6 Roll Type	Fair
AHU-3	2,600	1,600	MERV 8	Good

Photo 1 – AHU-1

Photo 2 – AHU-3

1.2 Existing Control System

A pneumatic system controls the existing air handling equipment. It is an old, obsolete system and appears to be mostly original. However, the heating coil for AHU-3 is controlled by an electric hot water control valve. We are not aware of any demand control ventilation sequences in use at this courthouse.

VFDs were installed for air handling units AHU-1, AHU-2, return fan EX-1, and return fan EX-2. We could not verify if they are used to vary the airflow or were installed for fan balancing purposes. We suspect they are used for fan balancing because our understanding is that the AHU-1 and AHU-2 systems operate at constant volume.

Section 2
Recommendations

Below is a list of recommendations that we propose for the Lynn District Courthouse. 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:

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

We recommend replacing the MERV 8 filter in AHU-3 with MERV 13 filters.

Air handlers AHU-1 and AHU-2 contain roll filters and no filter racks. To our knowledge, MERV 13 roll filters are not available. We recommend investigating if filter racks can be installed within the air handling units downstream of both the outdoor and return air dampers as the first option. If this is not feasible, another option is to install MERV 13 filters in the return air ductwork downstream of the return fan. This will filter return air from the building, where the risk of the virus entering the air system is the greatest. These filters will not filter the outdoor air, however. The outdoor air louvers are located on the roof, therefore the risk of the virus entering the airstream from the roof is lower.

The TAB Contractor and/or Engineer shall verify that AHU-3 can accommodate a MERV-13 filter per Appendix A in the overview of recommendations report.

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

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

2.2 Testing & Balancing Recommendations

Air handling units AHU-1 and AHU-2 are approximately 50 years old, AHU-3 is approximately 24 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 outside air flow rates that were used to design the original system were 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 rebalance 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)
AHU-1	13,600	1,500	1,400	**1,500**
AHU-2	20,000	4,800	2,500	**4,800**
AHU-3	2,600	1,600	562	**1,600**

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.

The average airflow rate per person is shown below in Table 3. These values are based on the original design supply airflow rate and the recommended outdoor air flow 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)	479	333	146
Total Supply Air (CFM/Person)	75	40	156
Outdoor Air (CFM/Person)	16	10	32

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 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 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)	Outside Airflow (CFM)	Airflow Rate (CFM/Person)
Jury Pool Room	24	300	13	72	3
First Session Courtroom	148	4,200	28	1,008	7
Second Session Courtroom	148	4,200	28	1,008	7
Third Session Courtroom	71	2,100	30	504	7
Fourth Session Courtroom	71	2,100	30	504	7
Juvenile Courtroom	38	760	20	182	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. 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)	Outside Airflow (CFM)	Airflow Rate (CFM/Person)
Jury Pool Room	8	300	38	72	9
First Session Courtroom	25	4,200	168	1,008	40
Second Session Courtroom	23	4,200	183	1,008	44
Third Session Courtroom	13	2,100	162	504	39
Fourth Session Courtroom	16	2,100	131	504	32
Juvenile Courtroom	6	760	127	182	30

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 rebalancing the return fan airflow rate to ensure the correct quantity of return air is being delivered to the air handlers.

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

Due to the age of the units, the ability for the coils to maintain the supply air temperature is uncertain. We recommend increasing the outdoor air flow rate 30% beyond the recommended outdoor air flow rate for AHU-1 and AHU-2, and by 10% for AHU-3. We do not believe this would cause a threat of a potential coil to freeze given the amount of outside 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.

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

We recommend testing and balancing the VAV boxes associated with AHU-3 and serving the basement areas to ensure each space is being supplied the proper quantity of air.

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

Considering the age of the systems, we recommend testing and balancing all air inlets and outlets throughout the building. Prior to rebalancing the building, we recommend verifying the boiler plant is maintaining the correct supply water temperature and the refrigerant condensers are providing the correct cooling leaving air 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 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:

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.*

We could not verify if the air handler coils were clean during our site visit. We recommend these be inspected and cleaned if necessary.

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: *Install freeze stat or 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 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 outside air beyond the minimum requirements.*

The existing control system does not appear to be sophisticated enough to implement this type of sequence. Additional controls and sensors will be required.

Prior to implementing this control strategy, the TAB Contractor should verify the quantity of outside air the outdoor air louvers can accommodate without exceeding an intake air velocity of 450 feet/minute (FPM). Exceeding this air velocity through an intake air louver may result in rain or snow entering the louver.

RC-4: *Confirm the economizer control sequence is operational if such a sequence exists.*

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.

2.6 Humidity Control

Installing duct mounted or portable humidifiers can help maintain the relative humidity levels recommended by ASHRAE. The feasibility of using duct mounted humidification or portable humidifiers 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. We are not aware if this building was constructed to accommodate a humidification system.

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 Replace air handling units AHU-1 and AHU-2

We recommend replacing air handling units AHU-1 and AHU-2 within the next three years and to replace AHU-3 within the next five to 10 years. AHU-1 and AHU-2 are 50 years old and are past their expected life span. This recommendation does not affect the indoor air quality of the building, assuming the existing air handling units can deliver the proper quantity of supply and outdoor air and temper the air properly.

2.7.2 Install A Building Management System

We recommend replacing the pneumatic control system with a Building Management System (BMS) to control and monitor HVAC equipment. Pneumatic air systems are antiquated and do not offer the same benefits as a BMS. This recommendation is an energy saving and maintenance measure and does not affect the indoor air quality of the building.

2.7.3 Replace Pneumatic Damper and Valve Actuators with Electronic Actuators

We recommend replacing the existing pneumatic damper and valve actuators with electronic actuators. If the existing pneumatic system can cycle damper and valve actuators and position the valves and dampers in their correct position repeatedly, then immediate replacement is not necessary. If the system cannot cycle the actuators to correct damper or valve positions, this may cause too little or too much outdoor air flow and water flow through the units, affecting the quantity of ventilation air and heating and cooling capacity of the coils.

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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