LYNN JUVENILE COURTHOUSE
HVAC SYSTEM EVALUATION SUMMARY

Visited January 28, 2021. While on site, inspected the rooftop air handling equipment and toured the facility to determine if the spaces generally matched usages noted on the architectural plans. The Lynn Juvenile Courthouse is located in a single story building that was construicted in 1920. The building was substantially renovated in 1999 to allow it to be used as a courthouse. It is approximately 20,000 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	11	1,000	91	325	30
Courtroom #1	18	2,700	150	612	34
Courtroom #2	10	2,000	200	650	65

2.0 Recommendations

Section	Recommendation/Finding	Action
2.1	**Filtration Efficiency – RTU's have MERV 13 filters**	Complete
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-3	Increase outside air flow rate beyond minimum under non-peak conditions	In progress
RTB-5	Test and balance all air inlets and outlets	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 pans	In progress
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-3	Confirm the economizer control sequence is operational	
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	
2.7	Other Recommendations	
2.7.1	Run ventilation fans continuously during occupied hours	In progress
2.7.2	Replace toilet and holding cell exhaust fans	In progress
2.7.3	Make filter hardware adjustments	In progress
2.7.4	Test humidifiers for proper operation	NA
2.7.5	Replace RTU's	Deferred

Lynn Juvenile Court
Lynn, MA

HVAC SYSTEM EVALUATIONS COVID-19

Office of Court Management

March 15, 2021

Tighe&Bond

100% Recyclable

Existing Conditions & Site Observations

Tighe & Bond visited the Lynn Juvenile Courthouse on January 28, 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:

- *Property Management*
  - Maria Klein, Owner
- *Tighe & Bond*
  - Sean Pringle, PE, Mechanical Engineer
  - Tim Bill, Staff Mechanical Engineer

1.1 Existing Ventilation System

The Lynn Juvenile Courthouse is located in a single story building that was constructed in 1920. The building was substantially renovated in 1999 to allow it to be used as a courthouse. It is approximately 20,000 square feet in size.

Eight packaged rooftop air handling units (RTU) provide ventilation air to the building. The units appear to be original from the 1999 renovation, and are approximately 22 years old. Each unit contains a supply fan, DX cooling coils, a natural gas furnace, and a 2" MERV 13 filter. All of the RTU's have outdoor air and return air dampers with economizer function. RTU's 5 & 6 were missing exhaust stacks for the gas fired heating section. In several units, the filters had fallen out of the racks due to rusted or loose retaining hardware, and as a result these coils were somewhat dirtier than the rest. The coils were otherwise fairly clean; the owner indicated that they are cleaned twice a year. The supply fans only run when there is a heating or cooling call to the spaces served. There is no ventilation or air circulation when the space is not being heated or cooled.

The design drawings indicate that a humidifier is located in the supply duct just below the roof in each RTU zone. The owner confirmed that there were humidifiers present, and we observed humidistats in several of the spaces. She believed they were operational, as at least one had been repaired in the last few years. Due to the ceiling locations we were not able to directly observe the humidifiers.

The lockup area is served by RTU-6 and an exhaust fan. Air is supplied to the corridors and cells and is exhausted from the cells. Based on the airflows on the drawings for the individual cells, and lock-up area as a whole are negatively pressurized. However, the exhaust fan serving the lockup area was off at the time of the visit and may require repair.

In addition to the exhaust fan serving the lockup area, there are two other exhaust fans serving toilet rooms. The exhaust fan serving the employee restrooms was not operational and the exhaust fan serving the public restrooms was running at the time of the visit.

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)	Filters	Condition
RTU-1	2,900	580	2" MERV 13	Fair
RTU-2	2,000	400	2" MERV 13	Fair
RTU-3	3,000	600	2" MERV 13	Fair
RTU-4	3,000	600	2" MERV 13	Fair
RTU-5	1,800	360	2" MERV 13	Fair
RTU-6	1,800	400	2" MERV 13	Fair
RTU-7*	Unknown (2,000 est)	Unknown	2" MERV 13	Fair
RTU-8*	Unknown (3,000 est)	Unknown	2" MERV 13	Fair

*Supply Airflow estimated based on equipment nameplate cooling capacity, assuming 400 CFM/Ton.

Photo 1 – Representative Rooftop Air Handler

1.2 Existing Control System

The Courthouse does not have a building wide control system. Each RTU has local thermostatic and humidistat controls. As noted above, the RTU fans only operate when there is a call for heating or cooling. All RTU's and supplemental electric heating devices utilize local thermostats and electronic controls, without any functioning time clocks.

The economizer controllers in RTU 4 and 5 indicated an error on the controller display and may not have been working.

Section 2
Recommendations

Below is a list of recommendations that we propose for the Lynn Juvenile Courthouse. Please refer to the "Master Recommendation List" for further explanation and requirements of the stated recommendations.

2.1 Filtration Efficiency Recommendations

The filters in the RTU's were recently upgraded with 2" MERV 13 filters. The use of 2" MERV 13 meets the minimum ASHRAE recommendations for filtration during the pandemic. We recommend maintaining the current level of filtration. However, we recommend that a testing and balancing Contractor test and document the airflow and static pressure profile of all RTU's, 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.

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

This recommendation applies to the RTU's.

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

As there is no BMS, provide a local alarm. Provide a local alarm in area that will be noticed by staff.

2.2 Testing & Balancing Recommendations

The air handling units are approximately 22 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 may be different than the 2015 International Mechanical Code (IMC) and current ASHRAE Standard 62.1 requirements.

The available drawings for the areas served by RTU's 7 and 8 were limited. Ductwork routing and diffuser locations were on the drawings, but no diffusers or total airflow data was indicated. Any airflows indicated in this report for these units and areas are estimates. Further engineering review is recommended. Refer to recommendation RTB-5.

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	2,900	580	200	580
RTU-2	2,000	400	120	400
RTU-3	3,000	600	210	600
RTU-4	3,000	600	675	680
RTU-5	1,800	360	160	360
RTU-6	1,800	360	350	350
RTU-7*	Unknown (2,000 est)	Unknown	100	400
RTU-8*	Unknown (3,000 est)	Unknown	650	650

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.

*Supply Airflow estimated based on equipment nameplate cooling capacity, assuming 400 CFM/Ton.

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.

As noted in section 1.1, since all units currently operate only when there is a call for heating or cooling, ventilation air is intermittent. Code requires that ventilation be continuous during occupied periods.

We believe the outdoor air for RTU's 4, 7, and 8 can safely be increased to the recommended values with the current building operation. This may reduce comfort on extremely cold days if the controls are modified so the supply fan operates continuously during occupied periods. (see Section 2.7.1)

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. If the supply fan shuts off when the space temperature is satisfied, ventilation will be zero, and the average airflow rate per person will be zero.

TABLE 3
Average Airflow Rate per Person

	All spaces	*Courtrooms*	*Non-Courtroom Spaces*
Total Occupancy (People)	228	137	92
Total Supply Air (CFM/Person)	83	42	144
Outdoor Air (CFM/Person)	18	12	27

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. If the supply fan shuts off when the space temperature is satisfied, ventilation air will not be provided and the airflow rate per person will be zero.

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	34	1,000	29	325	10
Courtroom #1	86	2,700	31	612	7
Courtroom #2	75	2,000	27	650	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 and the Jury Pool Room, based on a reduced occupancy schedule determined 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 Pool Room	11	1,000	91	325	30
Courtroom #1	18	2,700	150	612	34
Courtroom #2	10	2,000	200	650	65

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 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 by only 10% beyond the recommended outdoor air flow rates during non-peak outdoor air conditions. This may require additional controls to implement.

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

RTU-7 and RTU-8 Areas

The drawings we were able to review did not indicate airflows for these areas. According to the owner, no additional drawings are available. If design documents showing the required airflows are not available, the required airflows should be established by an engineer and rebalanced to provide appropriate air volumes based on loads, and the code required ventilation rates for each space.

Whole Building

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.

Lockup Areas

The lockup area ventilation strategy is based on maintaining a slight negative airflow in the cells relative to the corridors in the lockup area. If the exhaust airflow is too low or if the supply air flow is too high in these areas, the likelihood of cross contamination from one cell to another increases. At the time of the visit the exhaust fan serving the lockup areas was not operational. Once the fan is repaired, the cell supply and exhaust grilles should be tested and balanced to the designed values noted on the original design drawings.

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.*

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.

RC-3: *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.

2.2 Humidity Control

This courthouse currently has humidifiers in the supply air ducts of all RTU's. We recommend these humidifiers continue to be used if they are not causing any issues within the spaces or in the building envelope.

2.7 Other Recommendations

2.7.1 Run Ventilation Fans Continuously During Occupied Hours

We highly recommend running the supply fans continuously during occupied hours, to provide mechanical ventilation at all times, as code requires.

Implementing this strategy may cause comfort issues. When the fan continuously runs, the cooling coils and furnace will turn on and off based on the space temperature. Comfort issues may arise if the existing units do not have multiple stages of heating or cooling that would otherwise handle load fluctuations better. During the winter supply air will be below room temperature when a call for heating is not present. Further system analysis and improvements are required to address these issues should they arise.

Consider adding a single electronic time clock to control RTU fans and exhaust fans from a single location in the Courthouse to simplify scheduling and operation. Alternately, the existing individual thermostats serving the RTU's could be replaced with new thermostats that include a programmable fan or an occupancy schedule function. Depending on the current wiring, new control wiring may be required between the thermostats and AHU's.

2.7.2 Replace Toilet and Holding Cell Exhaust Fans

We recommend repairing or replacing any failed toilet exhaust fans. At the time of the visit, two toilet exhaust fans serving the lockup and office restroom areas were not functioning.

2.7.3 Make Filter Hardware Adjustments

In several units the filters had fallen out of the frames due to worn or rusty hardware. Repair or replace hardware to prevent filters from falling out. Otherwise, return and outdoor air will not be filtered before being supplied to the building.

2.7.4 Test Humidifiers for Proper Operation

We were not able to access or assess the humidifiers during the site visit. We recommend they be checked for proper operation, cleaned, and repaired as necessary.

2.7.5 Replace RTU's

While generally in good condition and well maintained, the RTU's are nearing the end of their expected service life of 20-25 years. Plan to replace all RTU's over the next five years. Replacement units should have modulating heating and preferably modulating cooling as well. This will improve thermal comfort when operating the fans continuously as outlined in 2.7.1. As mentioned above, occupants may feel cold with the low supply air temperature in the winter without modulating heat to constantly temper the supply air.

This recommendation is a comfort and energy saving measure and does not affect the indoor air quality of the building.

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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