Holyoke Juvenile Court
Holyoke, MA

HVAC SYSTEM EVALUATIONS COVID-19

Office of Court Management

September 14, 2021

Tighe&Bond

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Section 1
Existing Conditions & Site Observations

Tighe & Bond visited the Holyoke Juvenile Court on May 26 and 27, 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:*
  - Lou, Court Officer
- *Tighe & Bond*
  - Todd Holland, PE, Senior Mechanical Engineer
  - Matt Mancini, Staff Mechanical Engineer

1.1 Existing Ventilation System

The Holyoke Juvenile Court is a single-story building, with a floor area of approximately 14,000 square feet. There have been no significant changes or additions to the building or its systems since its construction in 2018. The HVAC systems appear to be of good quality, in very good condition, and staff reports that space temperatures are comfortable.

Ventilation air is provided by 10 constant-volume packaged rooftop units. Each unit consists of a mixing box with 100% outdoor air economizer, 2" MERV-13 filters (Maxi Pleat 1315), constant-speed supply fan, direct-expansion (DX) cooling coil, gas-fired furnace, refrigeration compressor(s) and condenser. Seven units have power exhaust fans in the air handlers, and three have barometric relief dampers that operate when the units are in economizer mode.

Supply air is distributed through metal ductwork with ceiling-mounted diffusers and return grilles. Two of the units, RTU-1 and RTU-3, have zone dampers that vary the airflow to individual rooms, and bypass dampers that short-circuit supply air back to the return duct when supply air volume is reduced as space temperatures are satisfied. Zone dampers, which are not true variable air volume (VAV) terminals, have minimum flow settings but are often set up to fully close. The minimum airflows are not shown on the drawings or schedules, and we were unable to verify the minimum settings in the field. The other eight units have constant-volume, single-zone controls and distribution.

While bypass VAV systems do offer enhanced control over single-zone systems, they do not have the thermal flexibility of true VAV systems, and the level of control may be insufficient in multiple space applications with independent thermal load requirements.

The holding cells each have an exhaust grille over the toilet fixture, and a supply diffuser on the opposite side of the cell, served by one of the rooftop units. Airflows are balanced for neutral pressurization, and the thermostat is in the control room.

There are nine roof-mounted exhaust fans. Six of these serve toilet rooms, holding cells, locker rooms, and the sally port. Three of these units serve the two courtrooms and a hearing room and operate in concert with the rooftop units that serve those areas.

Two ductless split systems serve the tel/data and security rooms.

Photo 1 – Representative Rooftop Air Handlers

Photo 2 – Representative Exhaust Fans

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	2,400	360	2" MERV-13	Very Good
RTU-2	1,160	130	2" MERV-13	Very Good
RTU-3	3,000	500	2" MERV-13	Very Good
RTU-4	2,000	260	2" MERV-13	Very Good
RTU-5	1,200	100	2" MERV-13	Very Good
RTU-6	1,200	200	2" MERV-13	Very Good
RTU-7	1,200	200	2" MERV-13	Very Good
RTU-8	1,075	120	2" MERV-13	Very Good
RTU-9	1,130	250	2" MERV-13	Very Good
RTU-10	1,200	300	2" MERV-13	Very Good

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.

Photo 3 – Varitrac Controller

The two units with variable air volume distribution, RTU-1 and RTU-3, have Trane Varitrac controllers that interface with space temperature sensors also control the zone and bypass dampers.

The courtrooms have demand-controlled ventilation sequences that use carbon dioxide sensors mounted in the space adjacent to the thermostats.

Photo 4 – Carbon Dioxide Sensor

A mechanical timeclock controls the exhaust fans that serve toilet rooms, holding cells, and locker rooms. These fans were not operating at the time of our visit because it was approximately 17 hours behind due to time lost during power outages.

Photo 5 – Mechanical Timeclock

Section 2
Recommendations

Below is a list of recommendations that we propose for the Holyoke Juvenile 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 periodically 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 three years old, and it is not known to Tighe & Bond whether they were tested and balanced during 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	2,400	360	725	**750**
RTU-2	1,160	130	132	**230***
RTU-3	3,000	500	923	**930**

RTU-4	2,000	260	292	**400***
RTU-5	1,200	100	210	**240***
RTU-6	1,200	200	395	**400**
RTU-7	1,200	200	396	**400**
RTU-8	1,075	120	80	**215***
RTU-9	1,130	250	215	**250**
RTU-10	1,200	300	273	**300**

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.

* Minimum recommended OA is 20% of the total supply airflow.

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		
Library/Conference Room 129	17	10
RTU-3		
Employee Break 180	13	3
Conference Room 126	11	6
Hearing Room 179	16	6
RTU-6		
Courtroom 188	82	38
Pre-Trial Conference Room 175	7	4
Pre-Trial Conference Room 177	7	4
RTU-7		
Courtroom 189	87	35
Pre-Trial Conference Room 172	8	5
Pre-Trial Conference Room 174	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

During the pandemic, we recommend increasing the outdoor airflows over the original designed values, for all but two of the units, to meet or exceed the code minimums calculated by Tighe & Bond. Supplying more outdoor than required by code will provide better indoor air quality. We do not recommend increasing the OA for RTU-9 and RTU-10 because the design value was already over 20%.

Where we recommend increasing the outdoor air beyond the original design, it appears the cooling and heating coils should be able to provide leaving air conditions similar to the original design under peak outdoor air conditions. This assumes that the coils are clean and their performance has not degraded. Supply air temperatures during the heating and cooling season should be monitored to ensure they are not dropping below design values, with particular attention paid to RTU-3 in heating season. If the supply air temperature does drop below design values, the outdoor airflow rate should be reduced, but not below the originally designed outdoor air flow rates.

In Table 3, there are select rooms that we do not recommend increasing outdoor air to the current code requirements or reducing occupancy. These specific recommendations

are because it appears that the cooling and/or heating coils cannot maintain the proper leaving air temperature under peak outdoor air conditions.

The average airflow rate per person is shown below in Table 4. 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 4
Average Airflow Rate per Person

	All Spaces	***Courtrooms***	***Non-Courtroom Spaces***
Total Occupancy (People)	250	118	132
Total Supply Air (CFM/Person)	62	**17**	103
Outdoor Air (CFM/Person)	16	**6**	26

The low numbers for total supply and outdoor airflow in courtrooms is why reduced occupancy is recommended for both courtrooms in Table 3.

The airflow rate per person for each Courtroom and Jury Room is shown below in Table 5. 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 5
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)***
Courtroom 188	82	990	12	330	4
Courtroom 189	87	990	11	330	4

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)*
Courtroom 188	13	990	76	580	25
Courtroom 189	12	990	83	330	28

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

RTB-4: *Test and balance zone damper airflow rates.*

We recommend testing and balancing the zone dampers to ensure each space is being supplied the proper quantity of air. The mechanical drawings show the maximum airflows for spaces with zone dampers, but the minimum airflows are not shown on the plans or schedules. We based our ventilation calculations on 40% minimum airflow through the zone dampers. Since the building was a designed and built recently, we recommend reviewing the minimum values with the design engineer.

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 be in very good condition, it is unknown to Tighe & Bond how often the coils are cleaned. These coils should be cleaned, once a year at minimum, 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 to three 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 sequences are operational.*

RC-5: *Disable demand control ventilation sequences.*

We recommend temporarily disabling demand control ventilation systems for the duration of the pandemic.

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 Holyoke Juvenile 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.

According to EPA guidelines, units should be sized to provide 5 air changes per hour (ACH) airflow. Below is a list of specific areas where we recommend placing portable HEPA filtration units, including offices if those spaces are regularly occupied by more than one person. If any of these spaces have only a single occupant, a HEPA filter is not needed.

- Main Lobby 101
- Courtroom 188
- C.M. Office Area
- Hearing Room 179
- Courtroom 189
- Break Rm. 180
- Probation Waiting 187
- Work Area 130
- Support/Mail 128

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 Replace Timeclock Control for Exhaust Fans

We recommend replacing the mechanical timeclock that controls the exhaust fans that were not operating at the time of our visit. While this type of timer is simple and reliable, it has no battery backup and loses time during power outages. It was 16-17 hours behind at the time of our visit, shutting down the fans for much of the workday. We recommend replacing it with an electronic timeclock that has battery backup, similar to that used for exterior lighting and mounted just above this one.

2.7.3 Install Energy Recovery Units to Serve Courtrooms

We have recommended a substantial reduction in occupancy for Courtrooms 188 and 189, down to 38 and 35 people, respectively. This is based on increasing the minimum outdoor air for RTU-6 and RTU-7 to 33%, the maximum we believe they can handle in peak conditions. The design called for 17% minimum outdoor air.

In order for these units to provide the proper volume of outdoor air with full code occupancy, the outdoor air volume will have to be over 60%, which is beyond the capacity of standard rooftop units. There are energy recovery units that would potentially allow these units to properly condition up to 100% outdoor air in peak conditions, using a heat exchanger or heat wheel, and containing fans to overcome the additional pressure drop to maintain design airflow. The units would attach to the existing rooftop units, where the intake and exhaust hoods are currently. Tighe & Bond recommends investigating if this type of retrofit is available for your existing units.

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.