



CHICOPEE DISTRICT COURTHOUSE HVAC SYSTEM EVALUATION SUMMARY

Visited February 9, 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 Chicopee District Court was constructed in 1984, has two stories, and is approximately 20,300 square feet in size. There have been no significant changes or additions to the building since construction.

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 207	27	3,255	121	1,105	41
Courtroom 222	19	1,520	80	516	27

2.0 Recommendations

Section	Recommendation/Finding	Action
2.1	Filtration Efficiency	
RF-1	Replace filters with MERV-13 filters.	Complete
RF-3	Install a differential pressure sensor (switch) across the filter banks.	In-progress
RF-3a	Connect the pressure sensor to the BMS system and/or a local alarm.	In-progress
2.2	Testing and Balancing	
RTB-1	Test and rebalance air handling unit minimum outside air flow rate	Complete
RTB-2	Rebalance system return airflow rate.	Complete
RTB-4	Test and balance VAV box flow rates.	N/A
RTB-5	Test and balance all air inlets and outlets.	N/A
RTB-6	Test and balance all air handler chilled and hot water coils	Complete

Chicopee District Courthouse HVAC System Evaluation - Continued

2.3	Equipment Maintenance and Upgrades	
RE-2	Clean air handler coils and drain pans	Complete
RE-4	Inspect VAV boxes and controllers.	N/A
RE-4a	Inspect VAV reheat coils and control valves.	Complete
RE-5	Install freeze stat or confirm the existing freeze stat is working correctly on the air-handling unit.	Complete

2.4	Control System Upgrades	
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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 – <i>if courthouse is to operate at a high occupancy (i.e. 50-75% or greater), install portable HEPA filters in high traffic areas.</i>	In-progress
2.6 Humidity Control		
	No actionable items listed – continuous monitoring for seasonal changes	In-progress
2.7 Additional Recommendations		
2.7.1	Retro-commission AHU-1 and Controls	In-progress
2.7.2	Set Inlet Guide Vanes 100% Open	Complete
2.7.3	Replace air-handling units & return fans	Deferred – added to 5-year Capital Plan
2.7.4	Replace holding cell exhaust fan	In-progress
2.7.5	Replace VAV boxes	Deferred – added to 5-year Capital Plan
2.7.6	Replace controls for toilet exhaust fans	Deferred – added to 5-year Capital Plan



**Chicopee District Court
Chicopee, MA**

**HVAC SYSTEM
EVALUATIONS
COVID-19**

Office of Court Management

April 10, 2021

Section 1

Existing Conditions & Site Observations

Tighe & Bond visited the Chicopee District Court on February 9, 2021. While on site we inspected the air handling equipment located in various 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:*
 - Kevin Byrne, Court Facilities Staff
- *Tighe & Bond*
 - Todd Holland, PE, Senior Mechanical Engineer
 - Matt Mancini, Staff Mechanical Engineer

1.1 Existing Ventilation System

The Chicopee District Court was constructed in 1984, has two stories, and is approximately 20,300 square feet in size. There have been no significant changes or additions to the building since construction. The boilers were replaced as part of multi-court project in 2015.

Ventilation air is provided by a single variable air volume (VAV) air handling unit. The unit consists of a mixing box with outdoor air (OA) dampers and return air (RA) dampers, 2" MERV-8 filters, hot water preheat coil, chilled water cooling coil, and supply fan. There is a differential pressure gauge across the filters, but it is disconnected. An external return fan serves the system. The supply and return fan have variable speed drives that were installed as part of a recent upgrade. The return fan was originally controlled by inlet guide vanes, see Photo 2, that are still in place and not fully open.

Supply air is distributed to each zone via VAV boxes, with fan speed controlled by static pressure in the distribution duct. Each of the VAV boxes has a hydronic (hot water) reheat coil, sized for 60°F entering air temperature and a leaving air temperature between 90°F for interior zones and 120°F for perimeter zones.

The air handler and return fan are from the original construction. The air handler appears to be in poor condition, and the return fan, manufactured by Buffalo Forge, is of very solid construction and appears to be in good condition for its age.



Photo 1 – Representative Air Handler

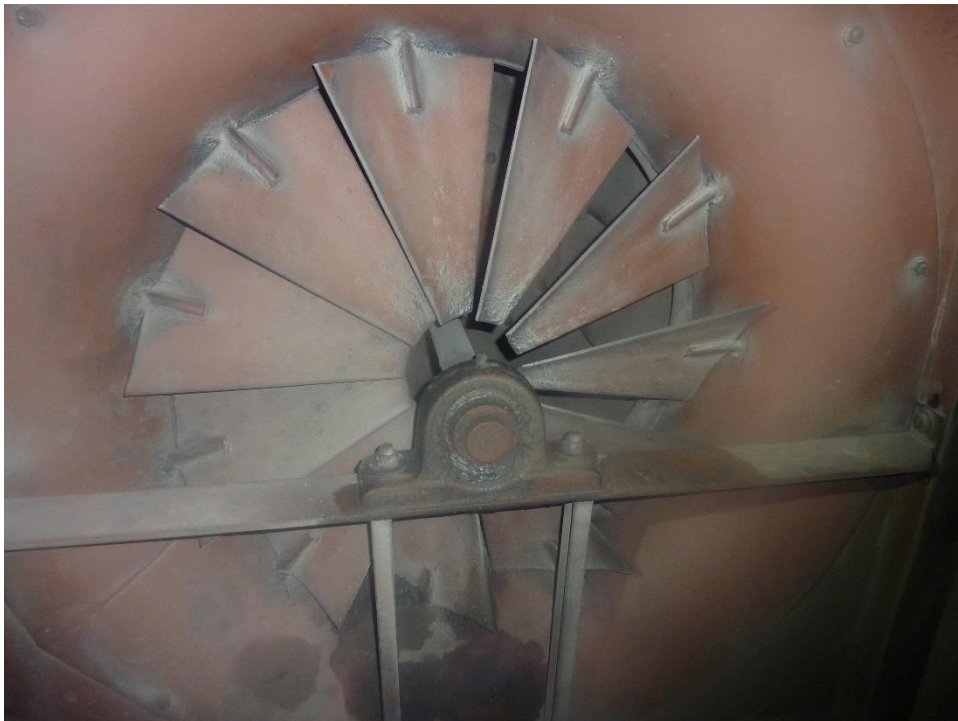


Photo 2 – Inlet Guide Vanes on Return Fan

There are three roof-mounted exhaust fans serving the public toilet rooms on the upper level, and the holding cells on the lower level. We were able to verify that these fans were

operating as commanded by the BMS during our site visit. The two roof fans serving the toilet rooms appear to be new and in excellent condition, while the unit serving the holding cells appears to be original and is in poor condition. Seven ceiling-mounted exhaust fans serve individual toilet rooms.

A pair of Lochinvar gas-fired hydronic boilers, rated at 940,000 Btu/hr output each, provide hot water to perimeter radiation, unit heaters, VAV reheat coils, and the preheat coil in the air handlers. A heat pump water heater with storage tank provides domestic hot water to the facility. These units, along with the primary circulator pumps, were installed in the 2015 upgrade.

A reciprocating chiller provides chilled water to the handlers. This unit, original to the building, has an air-cooled condenser mounted on the roof, uses R-22 refrigerant, and appears to be in poor condition. The cooling coil is drained down in winter for freeze protection.

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

TABLE 1

Existing Air Handling Unit

Unit	Original Design Airflow (CFM)	Original Design Min. O.A. (CFM)	Pre/Final Filters	Condition
AHU-1	21,200	3,180	2" MERV-8	Fair to Poor

1.2 Existing Control System

The systems are controlled by a Schneider Electric building management system (BMS), with a typical control screen shown below.

The BMS is tied to the existing boiler & chiller systems, AHU, VAVs, perimeter heating, and exhaust fans. While on site, Tighe & Bond was able to observe various control system screens and setpoints.

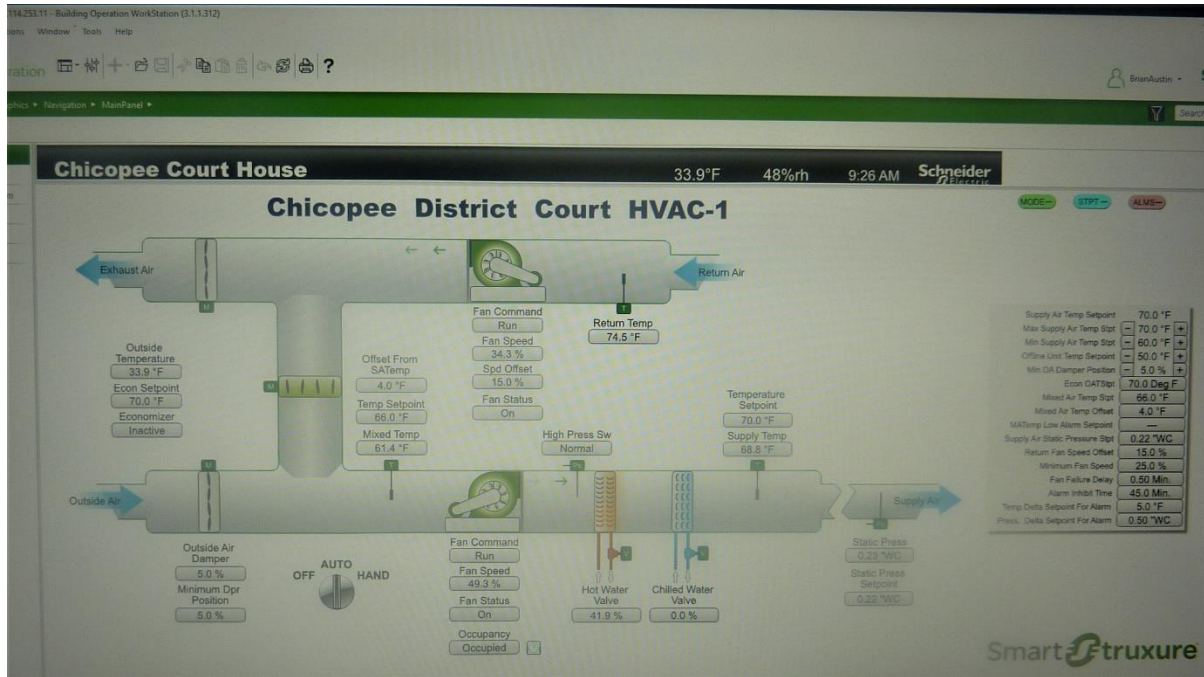


Photo 3 – Representative BMS Screen

The system has economizer controls, with a dry-bulb sequence that supplies 100% outdoor air when cooling is required and outdoor air is below 70°F.

While the supply fan speed is modulated to maintain static pressure in the discharge ducts, return fan speed follows at an offset, currently set to 15% below. While the minimum outdoor air damper position is currently set to 5%, and was at this position during our site visit, the mixed air temperature suggests the outdoor air volume at this setting is slightly over 30%.

The control valve for the preheat coil was set at 42% open, but there was a temperature rise of only 7°F, which indicates the valve was closed farther or there could be a capacity issue with the coil. The coil selection was based on 200°F entering water temperature, but the hot water supply temperature was approximately 150°F at the time of our visit. Although this reduction in water temperature is a valid operational strategy for energy conservation, a reset based on outdoor air temperature may affect the capacity of the preheat and reheat coils if the peak temperature has been reduced.

We also observed that many of the VAV boxes have very low minimum airflows, below 15%, and court staff indicated that some can be fully closed when space temperatures are satisfied, to keep from overcooling when the reheat valves are closed. This potentially

reduces or interrupts mechanical ventilation to those areas. The design drawings do not show minimum airflows for the VAV boxes, only maximums on the original drawings. The terminal reheat boxes were likely constant volume originally, and converted to VAV when the BMS was installed.

Several of the VAV boxes were observed to have a substantial temperature rise, even when the reheat valves were fully closed. This suggests that some control valves do not shut tightly, which can indicate a problem with worn valve seats and/or improper sizing of the control valve.

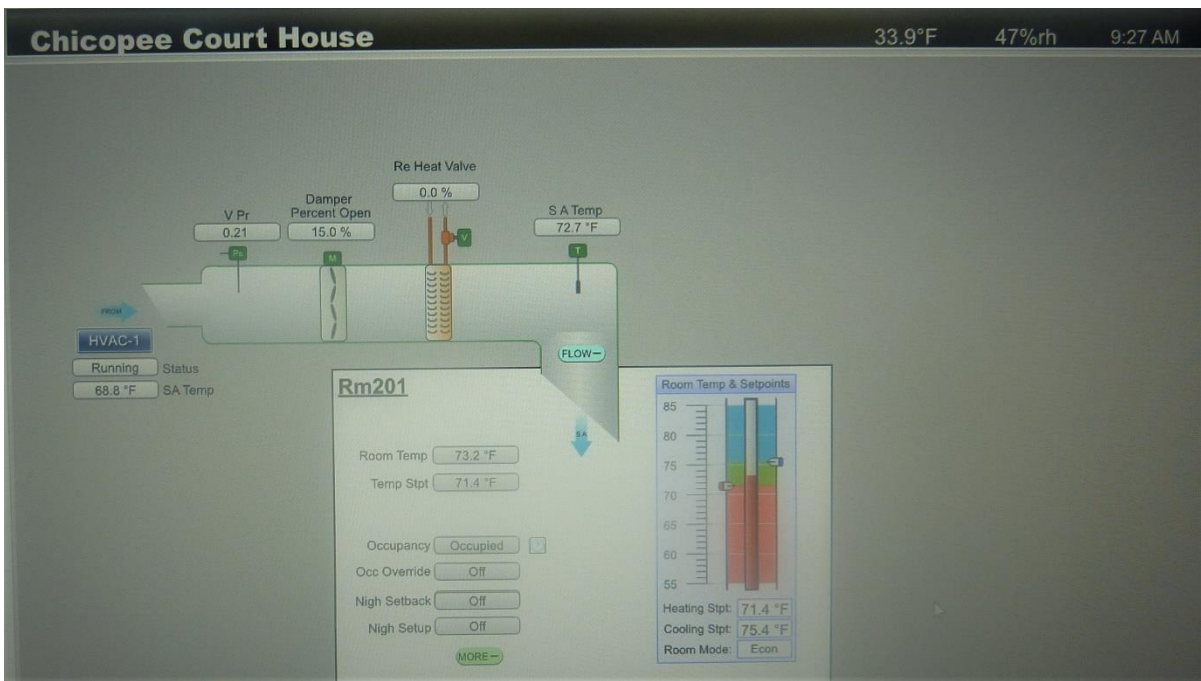


Photo 4 –BMS Screen Showing Air Temperature Rise with Reheat Valve Fully Closed

Section 2

Recommendations

Below is a list of recommendations that we propose for the Chicopee 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 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.*

RF-3a: *Connect the pressure sensor to the BMS system and/or 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 unit is over 35 years old and it is unknown to Tighe & Bond when the last time the unit was tested and balanced. It is not known if the units were rebalanced as part of the more recent controls upgrade. 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 outside air flow rates.*

We recommend testing and balancing the outdoor air flow rates for the air handling unit to the recommended minimum O.A. rates listed in Table 2. While the recommended rate is roughly double the design value, it is only marginally higher than what we observed the actual minimum to be, based on the temperatures of return, outdoor, and mixed airflows.

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	21,200	3,180	7,170	7,200

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 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)	231	131	100
Total Supply Air (CFM/Person)	92	36	164
Outdoor Air (CFM/Person)	31	12	56

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. 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)

<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 207	112	3,255	29	1,105	10
Courtroom 222	75	1,520	20	516	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, 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)

<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 207	27	3,255	121	1,105	41
Courtroom 222	19	1,520	80	516	27

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 handler. This should be done at two points to determine the proper offset value for the BMS, which sets return fan speed based on supply fan speed.

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. Maximum and minimum airflows should be set, and reheat coil water flow rate and temperature should be tested as well.

The VAV minimum position used in the ventilation calculations was 40%. The actual minimum position for many zones is much lower, and zero in some zones. This means that many zones will not be provided adequate ventilation air when space temperatures are satisfied. While 40% is a good starting point, it may result in overcooling some spaces when occupancy is low and temperature is satisfied. A more rigorous ventilation analysis can determine the appropriate minimum for each zone.

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

As a minimum effort, we recommend testing the airflow rates in the holding cells, courtrooms, jury rooms, and other densely occupied areas. The system is relatively old, and the airflow rate delivered to these spaces may not match the original design intent.

If specific areas experience regular cooling and heating comfort complaints, this may indicate a lack of airflow. We recommend testing and balancing the air inlets and outlets serving those spaces to the designed values. Prior to rebalancing, we recommend verifying the boilers and chiller are maintaining the correct supply water temperatures. Incorrect supply water temperature may be contributing to the temperature control complaints instead of a lack of airflow.

RTB-6: *Test and balance air handler chilled and 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-2: *Clean air handler coils and drain pans.*

According to facilities personnel, the heating and cooling coils in the air handlers have not been cleaned since they were installed. While they are in generally good condition, there was visible dirt and debris on some of the coils. These should be cleaned to maximize heat transfer and minimize pressure loss.

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 to the Courtrooms in Tables 4 and 4a and other spaced with multiple occupants such as the Jury Deliberation rooms. Any boxes not delivering the expected airflow rates should be repaired and rebalanced as required.

RE-4a: *Inspect VAV reheat coils and control valves.*

Reheat coils regulate the temperature of the supply air delivered to each space. Control valves that are improperly sized can have the valve seats wear so they no longer shut tight, which can lead to overheating even at minimum airflows. At a minimum, we recommend cycling the valve positions and testing the water flow to verify full shutoff and maximum supply air temperatures are being delivered as designed. Any coils and control valves not behaving as expected airflow rates should be repaired or replaced.

RE-5: *Install freeze stat or confirm the existing freeze stat is working correctly on the air handling unit.*

The air handler has a mixed air temperature sensor and a low temperature alarm on the BMS which is not enabled. Since we are recommending a significant increase in minimum outdoor air, we recommend checking to see whether this is an averaging-type sensor, and enabling the alarm.

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 air handlers 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. Systems should be run in occupied mode while cleaning staff are in the building.

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 Chicopee 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 Retro-commission AHU-1 and Controls

Several of the measures recommended in this report will have strong interactive effects. For example, increasing outdoor air at the same time as raising the minimum airflows through VAV boxes could lead to comfort complaints in winter. Additionally, VAV minimum airflows cannot be properly set if the reheat coil control valves are not shutting tightly. We recommend implementing these changes concurrently as part of a retro-commissioning process, to ensure that the original hardware, such as the air handler and coils, performs properly with the newer VAV controls.

2.7.2 Set Inlet Guide Vanes 100% Open

The inlet guide vanes (IGVs) on the return fan are partially closed, see Photo 2. This reduces the airflow through the fan and reduces the fan energy, but not as efficiently as reducing the flow by slowing the fan speed. We recommend locking the IGVs fully open, and rebalancing the return air stream to determine the proper offset from supply fan speed to maintain building pressurization. Note that this recommendation is an energy saving measure and does not increase the indoor air quality of the building.

2.7.3 Replace Air Handling Units & Return Fans

Indoor air handling units have a life expectancy of 35-45 years. The air handler is approximately 37 years old and in poor condition. Consider replacing this units in the next 2-5 years. Replacing the return fan controls should also occur in conjunction with the replacement of the air handling unit to provide an overall positive building pressure to reduce infiltration. This recommendation is an energy saving measure and does not increase the indoor air quality of the building.

2.7.4 Replace Holding Cell Exhaust Fan

We recommend replacing the exhaust fan serving the holding cell area. This unit appears to be from the original construction, is approximately 37 years old, and is in poor condition. The expected life of a rooftop exhaust fan is 20 years.

2.7.5 Replace VAV Boxes

We also recommend the replacement of the reheat VAV boxes as part of a capital improvement plan. Assuming the existing VAV boxes are original, they are 37 years old and are past their normal life expectancy of 20-25 years. VAV box replacement should occur at the same time as the air handler replacement so the air handler can be properly sized.

2.7.6 Replace Controls for Toilet Exhaust Fans

We recommend replacing the controls for small toilet rooms served by individual exhaust fans. These 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.

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.

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