



PEABODY DISTRICT COURT HVAC SYSTEM EVALUATION SUMMARY

Visited March 2, 2021. While on site, inspected the air handling equipment located in the mechanical rooms and on the roof and toured the facility to determine if the spaces generally matched usages noted on the architectural plans. The Peabody District Courthouse was constructed in 1976 and is approximately 40,000 square feet in size. The

building core is served by a constant volume system consisting (2) roof top air handling units with DX cooling only and no heat, which were installed in 2006.

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>
Jury Pool Room	6	1,600	267	400	67
Court Session 1	40	3,080	77	770	10
Court Session 2	22	980	45	210	10
Court Session 3	35	1,860	53	399	11

2.0 Recommendations

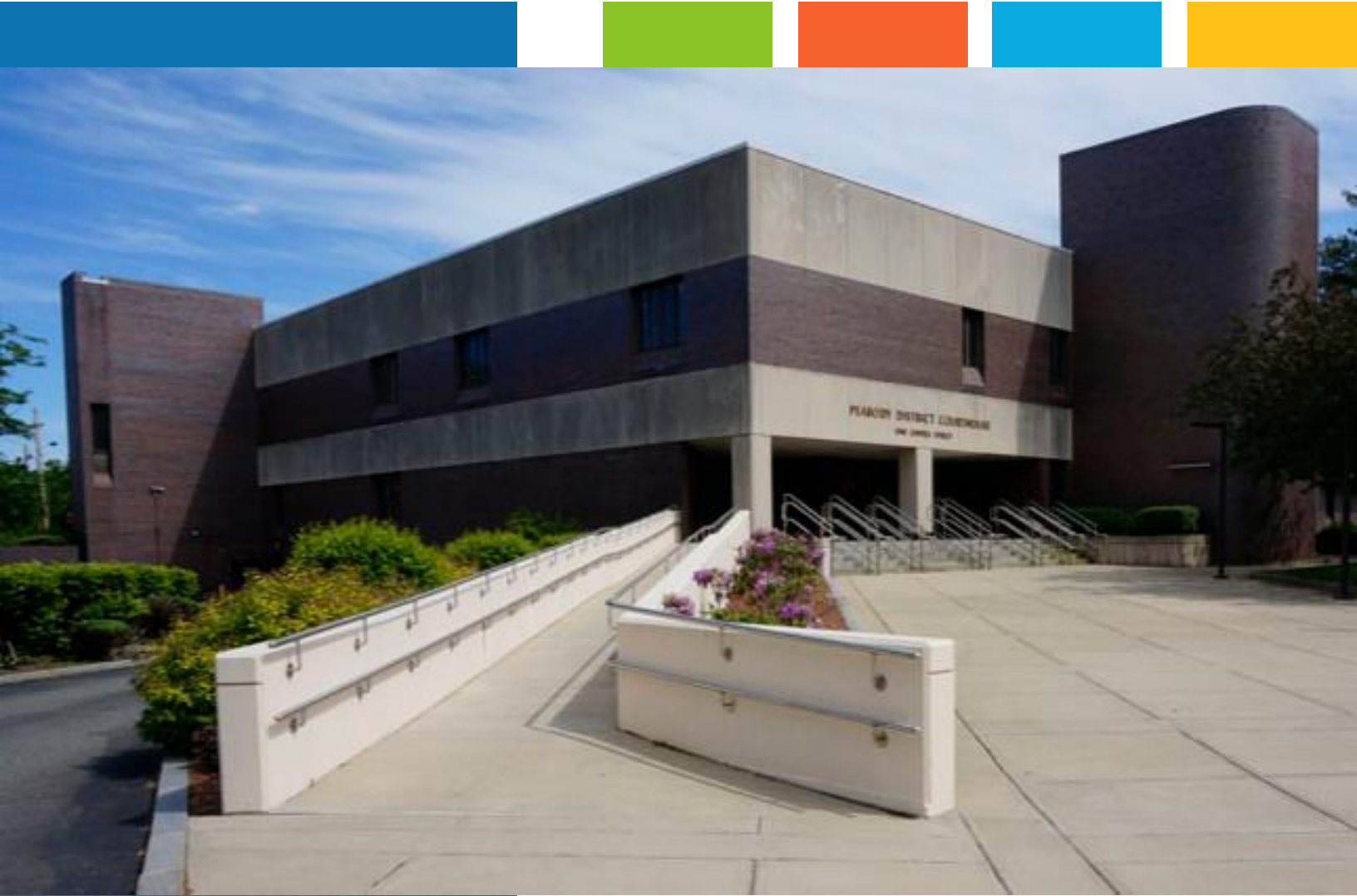
Section	Recommendation/Finding	Action
2.1	Filtration Efficiency	
RF-1	Replace filters with MERV-13 filters	Complete
RF-3	Install a differential pressure sensor with a display across the filter bank	Complete
2.2	Testing and Balancing	
RTB-1	Test and rebalance air handling unit supply air and minimum outside air flow rates	Complete
RTB-3	Increase outside air flow rate beyond minimum under non-peak conditions	Complete
RTB-5	Test and balance all air inlets and outlets	Complete
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
2.4	Control System	
RC-1	Implement a pre and post-occupancy flush sequence	Complete
RC-2	Install controls required to introduce OA beyond the minimum requirements	Complete
RC-4	Confirm Economizer control sequence is operational	In-progress
2.5	Additional Filtration and Air Cleaning	
RFC-1	Install portable HEPA filters in high traffic areas if the courthouse is to operate at a high capacity (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	Repair the dual temp piping system	Deferred – included in 5 year Capital Plan
2.7.2	Replace fan coil units	Deferred – included in 5 year Capital Plan
2.7.3	Install a building management system	Deferred – included in 5 year Capital Plan
2.7.4	Convert hot and chilled water system to variable flow	Deferred – included in 5 year Capital Plan
2.7.5	Replace pneumatic damper and valve actuators with electronic actuators	Deferred – included in 5 year Capital Plan



**Peabody District Court
Peabody, MA**

**HVAC SYSTEM
EVALUATIONS
COVID-19**

Office of Court Management

April 19, 2021

Section 1

Existing Conditions & Site Observations

Tighe & Bond visited the Peabody District Courthouse on March 2, 2021. While on site we inspected the air handling equipment located in the mechanical rooms and on the roof and toured the facility to determine if the spaces generally matched usages noted on the architectural plans.

Site Visit Attendees:

- *Office of Court Management:*
 - Dawn Tape, Courthouse Facilities Staff
- *Tighe & Bond*
 - Ryan Ablondi, Sr. Mechanical Engineer
 - Matt Mancini, Staff Mechanical Engineer

1.1 Existing Ventilation System

The Peabody District Courthouse was constructed in 1976 and is approximately 40,000 square feet in size. The building core is served by a constant volume system consisting (2) roof top air handling units with DX cooling only and no heat, which were installed in 2006. Each interior zone served by these RTUs has a duct mounted hot water heating coil with a pneumatic 3-way control valve which are original to the building. The perimeter spaces are served by fan coil units which appear to be original to the building and well beyond their useful life. Each fan coil unit has a single, dual temp coil that is served with hot water in heating season and switched over to chilled water in cooling season.

Hot water is provided by a 2,695 MBH, oil fired modular boiler with 7 modules installed in 2006. Chilled water is provided by a 30 ton air-cooled chiller installed on the roof in 2006. During the site visit facilities personnel mentioned that two of the seven modules are currently not operating due to mechanical deficiencies. Until recently only three modules had been operating but they were able to get two more back up and running. While this does not impact the COVID readiness of the building, this boiler is the only source of heat for the building and as such, is a critical piece of mechanical infrastructure. Tighe & Bond recommends investigating and addressing the deficiencies with the boiler system prior to the next heating season in Fall 2021.

HW & CHW is pumped throughout the building by a set of (3) end suction pumps which are headered together. One pump distributes hot water to the heating system for reheat coils and fin tube radiation while the other serves the dual temp system for the fan coil units around the building perimeter. The pump in the middle is a standby pump which can serve either system as needed. These pumps are original to the building and well beyond their useful life.

According to staff the dual temp system which serves all the FCUs throughout the perimeter of the building has been isolated and shut off due to leaking pipes which would cause flooding throughout the building. These fan coil units are the main source of heating, cooling and ventilation for the perimeter offices, conference rooms and open work areas which are regularly occupied by the staff in the building. Building facilities has placed portable heat pumps throughout these spaces which provide some heating and

cooling but do not provide any ventilation air. These units have a heating capacity of 11 MBH and are in spaces where the original fan coil units had heating capacities ranging from 20-35 MBH. It is noticeably cold in many of these spaces and it was reported that building staff often wear jackets in order to stay warm throughout the workday. In order to restore basic comfort as well as recommend ventilation to these normally occupied areas, we recommend addressing this issue as soon as possible. See the Other Recommendations section below for more information.

The jury pool room on the second floor has a dedicated unit ventilator (UV-1) which draws outside air directly from a hood on the roof above. It has a single dual temp coil which runs hot water in heating season and chilled water in cooling season from the dual temp system serving all the fan coil units.

Heating and ventilating unit (HV-1) is a mixed air unit with a HW coil with face & bypass dampers which serves the holding cells and maintenance office area in the basement. The holding cell area is negatively pressurized with exhaust from each cell. Each cell is also provided with ventilation air from HV-1. This unit provides no cooling to these spaces.

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

TABLE 1

Existing Air Handling Units

Unit	Original Design Airflow (CFM)	Original Design Min. O.A. (CFM)	Filters	Condition
RTU-1	12,000	3,000	MERV 8	Good
RTU-2	10,500	2,250	MERV 8	Good
UV-1	1,600	400	Unknown	Good
HV-1	1,600	400	MERV 8	Good
FCUs (Combined)	11,450	2,863	Unknown	Poor



Photo 1 – Boiler



Photo 2 – Pumps

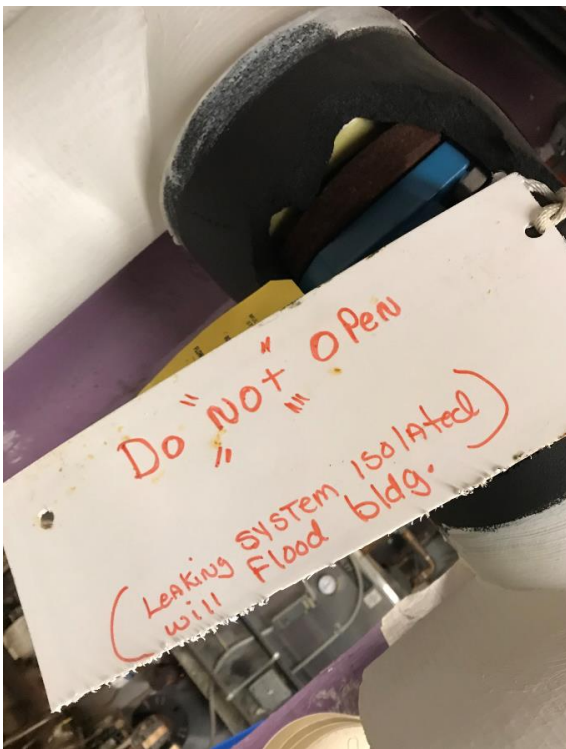


Photo 3 – Sign in MER



Photo 4 – Typical FCU / Portable Heat Pump

1.2 Existing Control System

The Peabody District Courthouse does not have a Building Management System (BMS) for controlling the mechanical systems. All the mechanical equipment is controlled using local controls. A large amount of the controls, including control valves, damper actuators, thermostats, etc. are pneumatic. These pneumatic controls are original to the building and beyond their useful life to the point of becoming obsolete. The air compressor serving the pneumatic system is original to the building and well beyond its useful life.

As renovations have happened over the years, particularly the 2006 HVAC renovation, electric valves, damper actuators and thermostats have replaced some of the pneumatics, however, a large portion of the systems still use pneumatic controls.



Photo 5 – Pneumatic Control Panel



Photo 6 – Air Compressor

Section 2

Recommendations

Below is a list of recommendations for the Peabody District Courthouse. Please refer to the "Master Recommendation List" for further explanation and requirements of the stated recommendations.

Building areas without adequate ventilation and filtration significantly increase the risk of spreading viruses like COVID-19, especially areas with high occupant density and where people occupy the same space for relatively long periods of time. Consider significantly reducing occupancy or relocating occupants to other areas with adequate ventilation.

2.1 Filtration Efficiency Recommendations

Currently, MERV 8 filters are installed in the main air handling units and smaller units serving the Holding area and Jury Pool Room. Facilities staff has purchased 2" MERV 13 filters and has a plan to replace the existing MERV 8 filters.

The use of 2" MERV 13 meets the minimum ASHRAE recommendations for filtration during the pandemic. We recommend that a testing and balancing contractor test and document the airflow and static pressure profile of all air handlers, 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.

We recommend the following measures be implemented for the existing air handling units:

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.*

2.2 Testing & Balancing Recommendations

The air handling units are approximately 15 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.

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.

Please note, there are 23 FCUs throughout the building with varying capacities and OA requirements. We simply show a range in Table 2 below because none of these units are currently operational and cannot be balanced until they are made operational or replaced. See Section 2.6: Other Recommendations for more information.

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	12,000	3,000	1,909	3,000
RTU-2	10,500	2,250	1,910	2,250
UV-1	1,600	400	173	400
HV-1	1,600	400	256	400
FC-1 thru FC-23	300-1000	75-250	15-175	75-250

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.

As mentioned in section 1 above, during our site visit it was discovered that none of the fan coil units are currently in operation due to a leaking piping system serving all of the fan coils. As a result, the areas with fan coil units are not receiving any ventilation air at all. Many of these areas are regularly occupied by courthouse employees. We highly recommend addressing this issue as soon as possible. See the Other Recommendations section below for more information.

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.

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, assuming the coils are clean and their performance has not degraded significantly over time. Supply air temperatures during the heating and cooling season should be monitored to ensure they are not dropping below design values. 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.

Where we do not recommend increasing outdoor air to the current code requirements, it appears 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 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.

TABLE 3
Average Airflow Rate per Person

	<i>All spaces</i>	<i>Courtrooms</i>	<i>Non-Courtroom Spaces</i>
Total Occupancy (People)	425	330	96
Total Supply Air (CFM/Person)	87	18	329
Outdoor Air (CFM/Person)	21	4	79

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. The airflow rate per person assumes the full supply airflow is being delivered to the room.

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>
Jury Pool Room	28	1,600	57	400	14
Court Session 1	181	3,080	17	770	4
Court Session 2	72	980	14	210	3
Court Session 3	77	1,860	24	399	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.

TABLE 4a
Airflow Rate per Person (Reduced Occupancy)

Courtroom	Total People	Total Air		Outdoor Air	
		Supply Airflow (CFM)	Airflow Rate (CFM/Person)	Outside Airflow (CFM)	Airflow Rate (CFM/Person)
Jury Pool Room	6	1,600	267	400	67
Court Session 1	40	3,080	77	770	10
Court Session 2	22	980	45	210	10
Court Session 3	35	1,860	53	399	11

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 to the values in Table 5 during non-peak outdoor air conditions during the pandemic only. This may require additional controls to implement. 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. If there is no existing freeze stat, we recommend installing one.

TABLE 5
Recommended Air Handler O.A. Flow Rates During Non-peak Conditions

Unit	Original Supply Airflow (CFM)	Recommended Min. O.A. (CFM)	Recommended Min. O.A. Under Non-Peak O.A. Conditions (CFM)
RTU-1	12,000	3,000	4,000
RTU-2	10,500	2,250	3,500

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

If the airflow to each space has not been recently tested, we recommend testing the airflow rates in the holding cells, Courtrooms, Jury Pool room, and other densely occupied areas as a minimum. These systems are very old and the airflow rate delivered to and returned from these spaces may not match the original design intent.

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. Prior to rebalancing the building, we recommend verifying the boiler plant is maintaining the correct supply water temperature. Incorrect supply water temperature may be contributing to the temperature control complaints instead of a lack of airflow.

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.

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.*

Replace control components, such as outdoor and return air temperature and/or humidity sensors, as required.

2.5 Additional Filtration and Air Cleaning

We recommend the installation of the following air cleaning devices:

RFC-1: *Install portable HEPA filters.*

Due to the fact that the perimeter offices and conference room do not currently have proper ventilation, we recommend installing portable HEPA filters in these areas. During our site visit, it appeared some spaces were shared by multiple people. Below is a list of these specific areas where we would recommend HEPA filters if those spaces are regularly occupied by multiple people. If any of these spaces have only a single occupant, a HEPA filter is not needed.

- Security Office 122B
- Clerk of Courts Secretarial Pool 129
- Asst. Clerk 136
- Asst. Clerk 137
- Asst. Clerk 135
- Clerk of Courts 131
- Juvenile Hearing 120
- Juvenile Probation 114
- Adult Male Probation 112
- Adult Male Probation 109
- Adult Female Probation 107
- Chief Probation 105
- Assistant Chief Probation 104
- Break Room 102
- Jury Deliberation Room 201
- Jury Pool Room 208
- Judges Lobby 212
- Judges Lobby 216
- Judges Lobby 218
- Judges Lobby 220
- Office Space 221
- Peabody Police 226

Additionally, 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 Other Recommendations

2.6.1 Repair the Dual Temp Piping System

As mentioned in Section 1.1, the dual temp system which serves all of the fan coil units around the perimeter of the building as well as the unit ventilator in the Jury Pool Room has been shut off due to leaking which causes flooding in the building. These FCUs serve offices, conference rooms and open work areas which are regularly occupied by the staff in the building. This leaking issue should be investigated and repaired as soon as possible in order to restore basic comfort and ventilation to these areas of the courthouse.

2.6.1 Replace Fan Coil Units

As mentioned in Section 1.1, the fan coil units are well beyond their useful life at 45 years old. These units should be considered for replacement either with similar window mounted fan coil units or with a new overhead system. We recommend performing a study to determine a feasible, cost effective and efficient system to replace these fan coil units and restore basic comfort and ventilation to these areas.

2.6.3 Install a Building Management System

We recommend replacing the pneumatic control system with a Building Management System 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.

2.6.4 Convert Hot and Chilled Water System to Variable Flow

The hot and chilled water pumps are constant flow systems. Constant flow pumps circulate the same volume of water to air handling units regardless of whether the water is required or not. If air handlers do not require this water, the three-way valves serving the air handler coils bypass the coil, which allows the water to return back to the chiller or boiler plant. We recommend investigating the possibility of converting these systems to variable flow. The three-way reheat and chilled water valves would have to be replaced with two-way valves, as well as any other three-way valves that are in the system. As noted above, the HW and CHW pumps are beyond their useful life and should be considered for replacement with new pumps including Variable frequency drives (VFD). VFDs allow the pumps to vary the flow rate to match the demand. This recommendation is an energy saving measure and does not affect the indoor air quality of the building.

2.6.5 Replace Pneumatic Damper and Valve Actuators with Electronic Actuators

We recommend replacing pneumatic damper and valve actuators with electronic actuators and tying them into the Building Management System. Pneumatic controls is an old and obsolete technology. These systems tend to leak air, may result in poor control of the HVAC equipment, cause the air compressor to run more frequently and increase energy usage. A BMS can monitor the position of electronic valves, trend valve position data, and report alarms.

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.