BARNSTABLE COUNTY SUPERIOR COURT
HVAC SYSTEM EVALUATION SUMMARY

Visited September 18, 2020. While on site, inspected the air handling units and other associated heating and cooling equipment and toured the occupied portions of the building to determine if the spaces generally matched usage noted on the architectural plans. The courthouse is a three-story building (including basement), constructed in 1832, with a floor area of approximately 32,000 gross square feet. Upgrades appear to have been performed in a piecemeal fashion from 1961 to present; however, it appears there have also been many modifications and upgrades between 1971 and 2019, including wall mini splits in most areas, air conditioning for the courtroom, and several small AHU's serving basement areas.

1.0 Airflow Rate per Person (Reduced Occupancy)

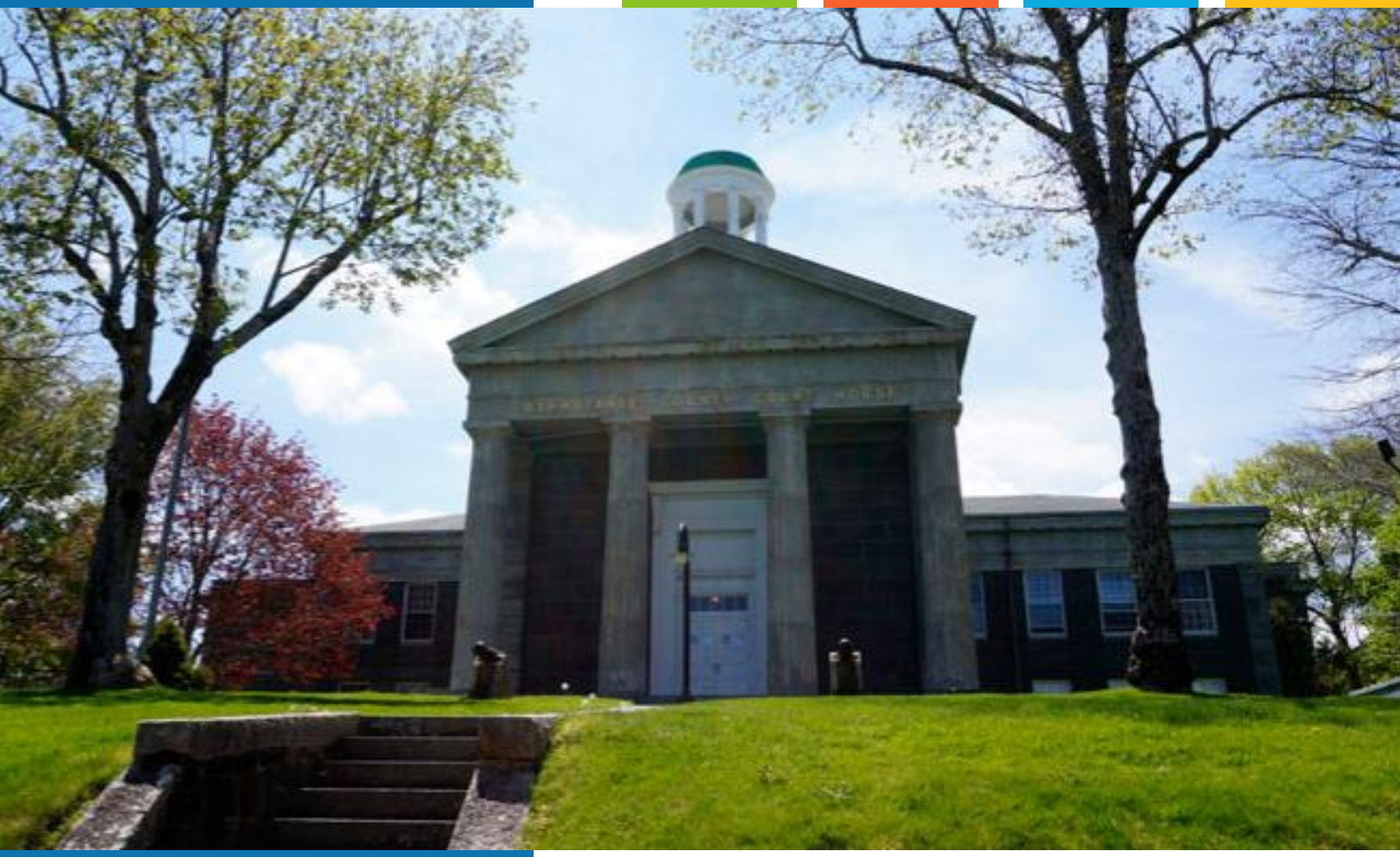
		Total Air		*Outdoor Air*	
Courtroom	*Total People (Reduced Occupancy)*	*Supply Airflow (CFM)*	*Airflow Rate (CFM/Person)*	*Outside Airflow (CFM)*	*Airflow Rate (CFM/Person)*
Jury Pool Room*	18	0	0	0	0
Main Courtroom	24	2,800	117	1,400	58
Small Courtroom 218***	11	0	0	0	0
Small Courtroom 234**	17	1,250	74	625	37

*The AHU serving this space is not functional
**The unit ventilator serving this space is not functional
***this courtroom is unventilated

2.0 Recommendations

Section	Recommendation/Finding	Action
2.1	**Filtration Efficiency**	
RF-1	Replace filters with MERV 13	Complete
RF-3	Install a differential pressure sensor across the filter banks	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 and/or exhaust flow rate	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	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	Complete

RE-5	Install freeze stat on the hot water coil and provide an alarm tied into the BMS	Deferred – included in 5- year Capital Plan
RE-5a	Install a local freeze stat alarm	Complete
2.4	Control System	
RC-1	Implement a pre and post-occupancy flush sequence	In-progress
RC-2	Install controls to introduce outside air beyond the minimum requirements	In-progress
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. 50-75% or greater), install portable HEPA filters in high traffic areas.*	In-progress
2.6	Humidity Control	
	No actionable items listed – continuous monitoring for seasonal changes	On-going
2.7	Other Recommendations	
2.7.1	Run ventilation fans continuously during occupied hours	In-progress
2.7.2	Replace all heating, cooling, and ventilation systems	Deferred – included in 5 year Capital Plan
2.7.3	Install DX cooling in AHU1 supply duct	In-progress
2.7.4	Replace all failed toilet exhaust fans and controls	Complete



Barnstable County Superior Court
Barnstable, MA

HVAC SYSTEM EVALUATIONS COVID-19

Office of Court Management

January 13, 2021

Tighe&Bond

100% Recyclable

Section 1
Existing Conditions and Site Observations

Tighe & Bond visited Barnstable Superior Court on September 18, 2020. While on site, we inspected the air handling units and other associated heating and cooling equipment and toured the occupied portions of the building to determine if the spaces generally matched usage noted on the architectural plans.

Site Visit Attendees:

- Office of Court Management:
    - Donald Reynolds, Facilities Director
    - Adam Alati, Facilities Technician
- Tighe & Bond:
    - Sean Pringle, PE, Project Mechanical Engineer
    - Caitlin DeWolfe, Staff Engineer

1.1 Existing Ventilation System Description

The courthouse is a three-story building (including basement), constructed in 1832, with a floor area of approximately 32,000 gross square feet.

Upgrades appear to have been performed in a piecemeal fashion from 1961 to present. We were provided with plan sets from 1961 (heating system), 1971 (current courtroom air handling units and some ventilation), and 2019 (new lockup area). However, it appears there have also been many modifications and upgrades between 1971 and 2019 that we were not provided plans for, including wall mini splits in most areas, air conditioning for the courtroom, and several small AHU's serving basement areas.

Most areas of the building (excluding rooms with unit ventilators and the lockup area) do not have any mechanical ventilation. The main courtroom is only ventilated in the heating season. While the wall AC units in many rooms do re-circulate air to provide heating and cooling, they do not provide any outdoor ventilation air, and the filtration provided by these units is minimal. Building areas without ventilation 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.

The first and second floor perimeter rooms have large windows with operable sashes in good condition. The basement windows are much smaller.

The building is heated with a pair of 650 MMBH steam boilers. Most areas, aside from the main courtroom and lockup area, are heated with steam radiators controlled by local pneumatic thermostats. The basement steam distribution piping network is extensive and according to staff, causes high temperature issues in the occupied portions of the basement.

Cooling is provided with various wall or window AC units in areas not served by air handling units (AHU's). Many condensing units are located in interior basement storage areas and the attic. Others are located on the roof or outside on grade.

The main courtroom is heated, cooled, and ventilated by a constant volume air handling unit (AHU-1) located in the attic. This AHU has steam heat, an associated external exhaust fan and pneumatic controls. We understand that most of the pneumatic controls for the AHU are no longer operational. The drawings indicate that the unit was installed in 1971, and the unit appears to be original. The unit is in very poor condition but operational. The pneumatic actuator for the linked outside air and return air damper is no longer functional. Facilities staff indicated that they have recently manually shifted the damper to a higher outside air percentage. The fans for this unit only operate during the heating season. During the cooling season, a pair of residential-type air handlers provide cooling through the same ductwork distribution system. No ventilation air is provided during the cooling season.

There is a large exhaust fan in the attic (EF-1) which operates continuously during occupied periods. This fan exhausts air from the main courtroom exhaust grilles, and is also connected to return air ductwork associated with AHU-2.

An air handler in the attic (AHU-2) originally served many first and second floor interior spaces but has been out of service for some time according to staff. Some of the ductwork has been damaged/removed, and some registers have been blocked off. It is unclear if the unit is salvageable.

There are two newer air handlers in the basement (approximately 10-20 years old) with DX cooling and steam heating coils in the supply ductwork. One serves a records area (AHU-3), and the other serves the break room and an "old lab" area (AHU-4). Both have electronic controls and appear to have the ability to draw in outdoor air, although the outside air dampers appeared to be fully closed at the time of our site visit. The steam coil is disconnected on the AHU serving the break room.

There is also a 100% outdoor air makeup air unit (MAU-1) that supplies air to the basement corridor. This unit originally had a steam heating coil, but the coil is no longer functional. This makeup air unit is operated during the winter in conjunction with an exhaust fan in a separate portion of the basement to control the space temperature in response to the heat gains from steam piping in the basement.

The second floor lockup area was renovated in 2019. This area is heated and cooled with ducted heat pump units concealed above a drop ceiling and ventilated with a dedicated Energy Recovery Ventilator (ERV) providing 100% outside air directly to the cells and corridor, and exhausting through the cells.

Unit ventilators are present in the small courtroom, and two small conference rooms centered on the south wall. They are operable, but in poor condition. The thermostatic controls still operate, but all other automated pneumatic functions are no longer operable. According to facilities staff, the units are often turned off by occupants because they are noisy.

There are many private toilet rooms served by rooftop exhaust fans. Several of the fans were not operational at the time of the visit and appear to have been out of service for some time. The basement public restroom exhaust fans are also not functioning, and

according to staff they have not been operational for some time. It was suggested by staff that the grilles may not have been connected to the exhaust branch ductwork during a renovation.

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

TABLE 1
Existing Air Handlers

Unit	Original Design Airflow (CFM)	Original Design Min. O.A. (CFM)	Filters	Condition
AHU-1 (Main Courtroom)	2,800	1,400	2" MERV 8	Poor
AHU-2 (Interior Zones)	2,500	1,250	2" MERV 8	Non-Functional
AHU-3 (Records)	Unknown	Unknown	Not Observed	Fair
AHU-4 (Lab/Break Area)	Unknown	Unknown	Not Observed	Poor
MAU-1 (Bas Corridors)	Unknown	Unknown	2" MERV 8	Poor
ERV-1 (Lockup)	1,600	1,600	Not Observed	Good

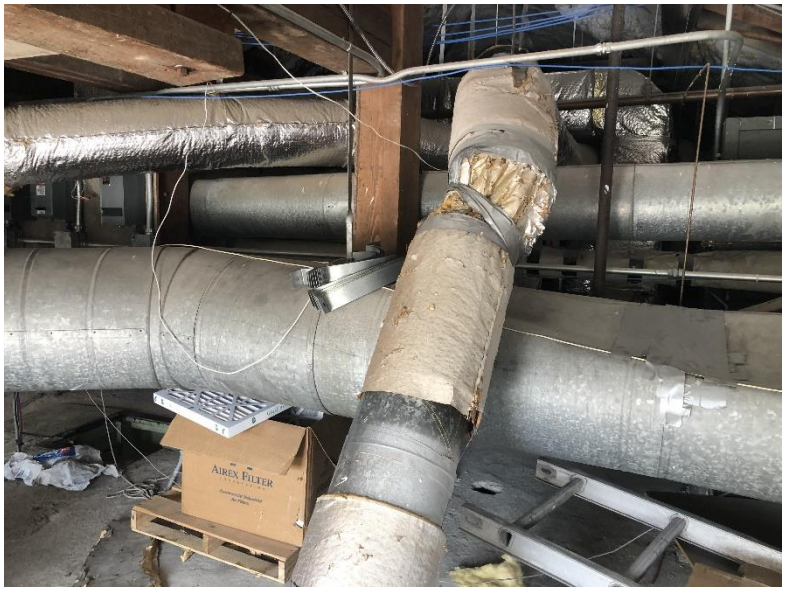


Photo 1 – Representative Attic Conditions

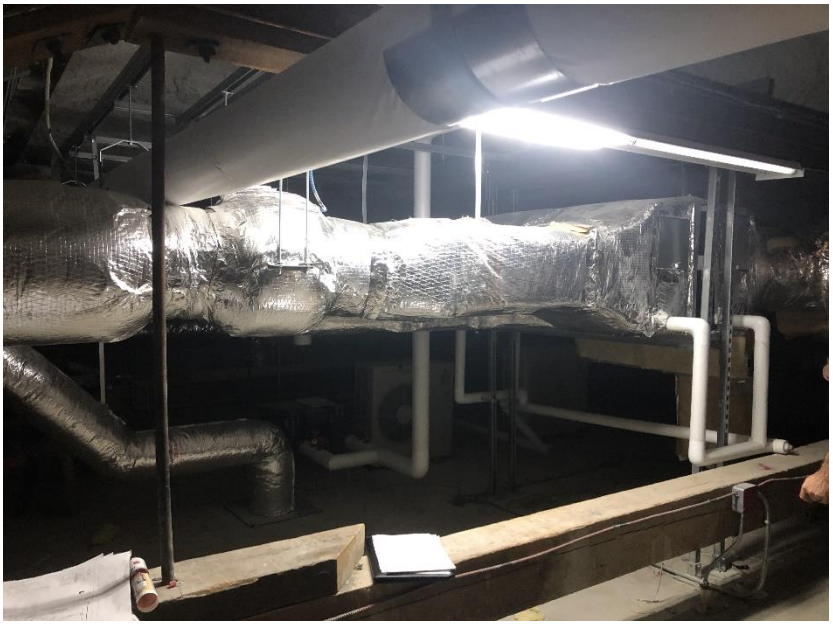


Photo 2 – Lockup ventilation system

1.2 Existing Control System

The Courthouse does not have a building-wide control system. The attic AHU's, steam heat, and unit ventilators all utilize pneumatic controls, including pneumatic thermostats. The courtroom AC air handlers and other AC equipment use local electric thermostats. There are no functioning time clocks. According to staff, all ventilation equipment is turned on manually each day.

The basement AHU's and new lockup area utilize local electronic controls, but they do not connect to any BMS system.

Section 2
Recommendations

Below is a list of recommendations that we propose for the Barnstable Superior 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 the existing air handling units

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

TAB Contractor and Engineer shall verify that the existing air handlers can accommodate MERV-13 filters. Replace filters in ERV's, AHU's, and unit ventilators with 1" or 2" filters as applicable.

RF-3: *Install a differential pressure sensor (switch) across the filter banks.*

Wire the switch to a local alarm light at a visible location on or near AHU's.

2.2 Testing & Balancing Recommendations

Due to the condition and age of the equipment (aside from the lockup area), it is unlikely that any equipment is currently operating at the originally intended design airflow. It is unknown to Tighe & Bond when the last time the units were tested and balanced. Also, the code required outside air flow rates that were used to design the system in 1971 are different than the 2015 International Mechanical Code (IMC) and ASHRAE Standard 62.1. Prior to any rebalancing efforts, all controls including dampers, actuators, and pneumatic systems should be tested to ensure they are operating correctly.

The ASHRAE climatic data for outdoor air conditions in Barnstable states a summer design condition of 84.0°F/73.5°F DB/WB and a winter condition of 9.6°F. Based on the design capacities of the equipment, it appears that 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.

We recommend the following measures be implemented:

RTB-1: *Test and rebalance air handling unit supply air and minimum outside air flow rates.*

For the areas with operable ventilation systems, we recommend rebalancing the equipment to the values shown in Table 2. After rebalancing, the spaces should be monitored during peak heating and cooling conditions to confirm space temperature can be maintained.

TABLE 2
Recommended Air Handling Equipment 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 (Main Courtroom)	2,800	1,400	890	1,400
AHU-2 (Non-Functional)	2,500	1,250	N/A	N/A
Unit Ventilator (Small Courtroom)	1,250	625	350	625
Unit Ventilator (Conf. Rooms)	500	250	62	250
AHU-3 (Storage)	Unknown	Unknown	0	0
AHU-4 (Break Area)	Unknown	Unknown	250	250
MAU-1 (Basement Corridors)	Unknown	Unknown	N/A	2,000
ERV-1 (Lockup)	1,600	1,600	300	1,600

The discrepancies in the calculated ventilation rates are likely due to variations in assumptions in the expected occupant concentration, airflow per person, and calculation methodology. We recommend maintaining the outdoor airflows at the original designed values, as these exceed the code minimums calculated by Tighe & Bond and will likely result in improved indoor air quality (IAQ).

The original outdoor air ventilation rates for the air handlers and the unit ventilators located in the attic and 2nd floor are relatively high (50% outdoor air) compared to the current code requirements. According to staff, the pneumatic controls have been altered significantly over time and the coil protection circuits may not be operational. We it will be necessary to repair or upgrade the AHU and Unit ventilator controls to safely provide this level of outdoor air.

We recommend balancing the outdoor air damper serving AHU-4 to 250 CFM and setting the equipment to "fan on" during occupied periods to allow ventilation air to be provided during occupied periods, to provide adequate outdoor air. We understand that this system provides cooling most of the year due to the steam piping in the room, so we do not expect the slightly lower supply air temperature to cause any comfort issues.

The airflow rate per person is shown below in Table 3. These values are based on the recommended outdoor airflow and the original design supply airflow rates shown in Table 2 above. Only the areas with ventilation are shown.

TABLE 3
Courthouse - Airflow Rate Per Person

	Main Courtroom	***Courtroom 234***	***Conference rooms***	***Break Room***
Total Occupancy (People)	87	43	21	11
Total Supply Air (CFM/Person)	32	29	48	145
Outdoor Air (CFM/Person)	16	15	24	23

The airflow rate per person for each Courtroom and the Jury Pool 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 and outdoor airflow is being delivered to the room, and the equipment is operational.

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*	30	0	0	0	0
Main Courtroom	87	2,800	32	1,400	16
Small Courtroom 218***	35	0	0	0	0
Small Courtroom 234**	43	1,250	29	625	15

Note: Courtroom occupant density is based on 70 people/1,000 square feet, per the 2015 International Mechanical Code
*The AHU serving this space is not functional.
**The unit ventilator serving this space is not functional.
***This courtroom is unventilated.

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 and outdoor airflow is being delivered to the room, and the equipment is operational.

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*	18	0	0	0	0
Main Courtroom	24	2,800	117	1,400	58
Small Courtroom 218***	11	0	0	0	0
Small Courtroom 234**	17	1,250	74	625	37

Note: If occupancy is further reduced, the airflow rate per person will increase, assuming full airflow is being delivered to the space.
*The AHU serving this space is not functional.
**The unit ventilator serving this space is not functional.
***This courtroom is unventilated.

RTB-2: *Rebalance system return and/or exhaust flow rate*

After all toilet exhaust fans have been replaced, rebalance toilet room exhaust airflow rates. Where existing registers do not have balancing dampers, install similar registers with integral opposed blade dampers.

After all repairs are made and equipment providing ventilation air has been balanced, re-balance EF-1 so that the 1st floor is neutral to slightly positive with all equipment operating. Re-balance the courtroom exhaust ducts to match the courtroom outside air flow rate.

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

This measure is recommended for AHU-3 only.

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

This measure is recommended for the lockup areas only. The lockup ventilation strategy is based on maintaining a slight airflow deficit in the cells relative to the corridors in the lockup area. To minimize the risk of one prisoner infecting others, it is important that the air balance is correct. If any exhaust grilles have been accidently closed or if the supply air flow is too high in these areas, the likelihood of cross contamination increases.

The design documents indicate a very small (5 CFM) differential between the supply and exhaust air in each of the cells. This is below the margin of error during balancing and does not provide adequate differential between supply and exhaust. We recommend balancing each cell to 75 CFM of supply air and 100 CFM of exhaust air. Increase the total supply airflow to the circulation corridor by 75 CFM. Refer to the 2019 as-built drawings.

2.3 Equipment Maintenance & Upgrades

RE-1: *Test existing air handling system dampers and actuators for proper operation*.

Replace dampers and actuators that are not functioning.

RE-2: *Clean air handler coils.*

RE-5: *Install freeze stat on the (heating) coils.*

If the freeze stat trips, close the outside air and shut the unit down. This may not be possible unless controls improvements are made. This applies to all equipment with steam heating coils.

RE-5a: *Install a local freeze stat alarm.*

2.4 Control System

We recommend the following control system strategies be implemented into the existing control system:

RC-1: *Implement a pre- and post-occupancy flush sequence.*

Adjust schedules in thermostats and local controls where possible. For manually operated equipment, turn on three hours prior occupancy, and off three hours after occupancy.

RC-2: *Install controls required to introduce outside air beyond the minimum requirements.*

We recommend this be implemented for AHU-3 only. This will only be possible with significant control system improvements.

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 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.

The lockup area may present an increased risk and benefit from local humidification. The lockup area is a 100% outside air system. This lockup area has a relatively high ventilation rate and will tend to have a lower humidity than other areas. Studies indicate that as relative humidity is reduced below 40%, susceptibility to viruses such as COVID-19 progressively increases.

2.7 Other Recommendations

2.7.1 Run Ventilation Fans Continuously During Occupied Hours

For systems where the fans cycle in response to thermal demand, we strongly recommend running the supply fans continuously during occupied hours to provide mechanical ventilation at all times, as code requires. Implementing this strategy may or may not cause comfort issues. When the fan continuously runs, the heating and cooling coils 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. Further system analysis and improvements are required to execute this recommendation.

2.7.2 Replace All Heating, Cooling, and Ventilation Systems

The existing heating, cooling, and ventilation systems serving the Courthouse are in various states of disrepair. Much of the building is without mechanical ventilation. During the summer, there is no ventilation air being provided to the main courtroom. The unit ventilators and AHU's that use extensive pneumatic controls are very difficult to maintain. The existing steam heating is also less efficient and more difficult to control than modern heat pump or hot water heating systems. There are condensing units located in the basement and attic that should be relocated to the outdoors.

A full replacement of the existing HVAC systems will require a substantial and invasive construction project. New ductwork would be required to serve perimeter rooms. Due to the constraints of the existing building construction, adding new ductwork may be difficult.

2.7.3 Install DX Cooling in the AHU-1 Supply Duct

The current configuration of AHU-1 and the associated air conditioning units prevent ventilation air from being provided during the cooling season. As a quick fix, we recommend installing a DX cooling coil and dedicated condensing unit in the supply air duct of AHU-1. This will allow ventilation air to be provided year-round. This will also require new controls and some reconfiguration of the existing ductwork. Further system analysis and design will be required to determine the feasibility of this recommendation. Another option is to replace AHU-1 with a new unit.

This is only recommended as a stop gap measure in the absence of adequate ventilation throughout the building, to allow the courtroom to continue operation through the summer. This does not address other areas without mechanical ventilation.

2.7.4 Replace Toilet Exhaust Fans and Controls

We recommend replacing all failed toilet exhaust fans.

If all new ventilation systems are provided for the Courthouse, a more energy efficient option is to route the toilet exhaust through a heat recovery system, if possible, and eliminate individual exhaust fans.

Section 3
Testing & Balancing Results

On November 20, 2020 Wings Testing & Balancing Co., Inc visited the Barnstable Superior Courthouse to test the airflow rates of the air handling units and the exhaust fans. A summary of the tested airflow rates versus the design airflow rates are shown below in Tables 5 and 6. Their full testing and balancing report is attached.

TABLE 5
Air Handler Testing & Balancing Results

	Design			Actual		
Unit	**Total Supply Fan Airflow (CFM)**	**Recommended Outdoor Airflow (CFM)**	**Return Airflow (CFM)**	**Supply Fan Airflow (CFM)**	**Outdoor Airflow (CFM)**	**Return Airflow (CFM)**
AHU-1 (Main Courtroom)	2,800	1,400	1,400	1,706	993	713
AHU-2 (Non-Functional)	2,500	N/A	N/A	N/T	N/T	N/T
Unit Ventilator (Small Courtroom)	1,250	625	N/S	N/T	N/T	N/T
Unit Ventilator (Conf. Rooms)	500	250	250	627	240	387
AHU-3 (Storage)	Unknown	0	N/S	N/T	N/T	N/T
AHU-4 (Break Area)	Unknown	250	N/S	1,196	0	1,196
MAU-1 (Basement Corridors)	Unknown	2,000	N/A	942	942	N/A
ERV-1 (Lockup)	1,600	1,600	1600	723	723	1517

N/S: Not Specified N/T: Not Tested N/A: Not Applicable

TABLE 6
Exhaust Fan Testing & Balancing Results

Unit	Serving	Design Exhaust Airflow (CFM)	Actual Exhaust Airflow (CFM)
EF-Attic	AHU 1&2 areas	N/S	1,964
EF-Roof	Restrooms	N/S	824

In reviewing the airflow report data, the following should be noted:

1. The AHU-1 motor high / low speed selector is stuck in the "low" position resulting in the low airflow readings. The dampers are manually set in a fixed position.
2. AHU-2 is not operational and was not tested. The AHU has been out of service for an extended period.
3. The unit ventilator serving the small courtroom is not operational.
4. The unit ventilators serving the conference rooms were operational and providing the required supply and outdoor air.
5. ERV-1 supply airflow was low due to a clogged heating coil on the supply side of the fan. The air filter should be checked for proper fitment and repaired if necessary. Heating coils should be cleaned at least annually.
6. The AHU-4 outside air damper actuator is not attached or wired. This should be corrected, and the damper configured to provide the required outdoor air.
7. MAU-1 is supplying approximately half of the recommended outdoor airflow.

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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WING'S TESTING & BALANCING CO., INC.

Barnstable Justice Center
HVAC/Ventilation Survey

* * * *

Tighe & Bond
Attn: Jason Urso
53 Southampton Road
Westfield, MA 01085

November 20, 2020

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WING'S TESTING & BALANCING CO., INC.

Tighe & Bond
Attn: Jason Urso
53 Southampton Road
Westfield, MA 01085

November 20, 2020

Re: Barnstable Justice Center/HVAC Ventilation Survey

Dear Jason,

Our HVAC survey for the above referenced is complete. While onsite, we worked with Don Reynolds, the in-house technician. Through our testing we have found:

- The outside air damper for AHU-4 is not attached or wired.
- The small court room UV is not operational.
- AHU-1 has a high/low speed switch that only operates on low speed. Also, the outside air and mixed air dampers are manually set in a fixed position on AHU-1.
- ERV-1 has a heating coil clogged on the supply side of the fan.

This report has been updated to include Brake Horsepower (BHP) calculations. When a motor has a VFD, we take the amperage measurements from there. When we calculate from volts and amps, it means there has to be a nameplate on the motor. Many times, these are missing or illegible. If BHP is not listed for an individual motor, this is because we do not have enough information to calculate it. It should be noted that that the older a motor is, the less likely it is to follow the affinity laws for BHP- since the efficiency degrades over time. We have used accepted constants for efficiency and the power factor, which should result in fairly close calculations, but are not as accurate for older motors.

The following pages are your record of the tested conditions. If you have any questions or if we can be of further assistance, please do not hesitate to call.

Very truly yours,
Wing's Testing & Balancing Co., Inc.
ICB Certified Contractor for:
TABB—Commissioning—Fire/Life Safety L1&L2—Sound & Vibration

Barry Stratos
Certified TABB Technician BB996928T

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SUPPLY FAN REPORT

PROJECT: Barnstable Justice Center	**DATE:** 11/20/20
AREA SERVED: Various	**TECH:** BS

FAN DATA

FAN NUMBER	AHU-1 (1)		ERV-1 Supply		ERV-1 Exhaust	
LOCATION	Attic		Attic		Attic	
AREA SERVED	Main Courtroom		Lock-up		Lock-up	
MANUFACTURER	Audi Vent		Heat Pipe Tech		Heat Pipe Tech	
MODEL OR SIZE	HG-LPWSFYA		4H-AMG-10612		4H-AMG-10612	
	DESIGN	**ACTUAL**	**DESIGN**	**ACTUAL**	**DESIGN**	**ACTUAL**
TOTAL CFM	2800	1706	1600	723	1600	1517
RETURN AIR	1400	713	0	0	1600	1517
OUTSIDE AIR	1400	993	1600	723	0	0
DISCH. STATIC	---	-0.16"	---	-0.11"	---	-0.24"
SUCTION STATIC	---	+0.08"	---	-0.43"	---	+0.19"
TOTAL STATIC	NA	---	NA	---	NA	0.43
FAN RPM	1303	541	NA	NA	NA	NA
PULLEY O.D.	11" x 1 3/16"		NA		NA	
ESP	0.12		---		---	
VFD SPEED	No VFD		NA		NA	
O.A.D.MIN POS	(2)		NA		NA	

MOTOR DATA

MANUFACTURER	Weg		Fantech		Fantech	
MODEL OR FR.	145T		FKD-14xL		FKD-14xL	
HORSEPOWER	2	1	---	716 watts	---	716 watts
MOTOR RPM	1150	1150	---	NA	---	NA
VOLTAGE / PH.	208/3	208/3	115/1	115/1	115/1	115/1
AMPS LEG 1	3.8	2.2	6.4	3.6	6.4	6.2
AMPS LEG 2	---	2.0	---	---	---	---
AMPS LEG 3	---	2.0	---	---	---	---
SHEAVE O.D.	5 1/2" x 7/8""		DD		DD	
BELTS - QTY / SIZE	1/4L770W		DD		DD	
SHEAVE POSITION	50% Open		DD		DD	
BHP	1.1					

REMARKS

(1) Unit has a high/low speed switch but only runs on low.
(2) OA and mixed air dampers were manually set and do not modulate.
NA-Not Available
ND-No Design DD-Direct Drive

SUPPLY FAN REPORT

PROJECT: Barnstable Justice Center	**DATE:** 11/20/20
AREA SERVED: Various	**TECH:** BS

FAN DATA						
FAN NUMBER	AHU-4		MAU-1		HV-1	
LOCATION	Stairs		Basement		Conference Room	
AREA SERVED	Lab/Break		Basement Corridor		Conference Room	
MANUFACTURER	RADCO		NA		Hermen Nelson UV	
MODEL OR SIZE	FBANF048		NA		NA	
	DESIGN	**ACTUAL**	**DESIGN**	**ACTUAL**	**DESIGN**	**ACTUAL**
TOTAL CFM	NA	1196	2000	942	500	627
RETURN AIR	NA	1196	0	0	250	387
OUTSIDE AIR	250	0	2000	942	250	240
DISCH. STATIC	---	+0.16"	---	+0.08"	---	+0.09"
SUCTION STATIC	---	-0.91"	---	-0.07"	---	-0.07"
TOTAL STATIC	0.20	1.07	---	0.13	NA	NA
FAN RPM	1050	1050	---	NA	NA	NA
PULLEY O.D.	DD		NA		DD	
ESP	NA		---		NA	
VFD SPEED	DD		No VFD		No VFD	
O.A.D.MIN POS	DD		100%		NA	

MOTOR DATA						
MANUFACTURER	NA		Dayton		NA (1)	
MODEL OR FR.	NA		56		NA	
HORSEPOWER	3/4	3/4	1/2	1/2	NA	NA
MOTOR RPM	1050	1050	1725	1725	NA	NA
VOLTAGE / PH.	208/1	208/1	208/3	208/3	120/1	120/1
AMPS LEG 1	4.3	3.6	1.8	1.5	1.9	---
AMPS LEG 2	---	3.6	---	1.6	---	1.6
AMPS LEG 3	---	3.6	---	1.5	---	---
SHEAVE O.D.	DD		3 1/2" x 5/8"		DD	
BELTS - QTY / SIZE	DD		0/Linkbelt		DD	
SHEAVE POSITION	DD		75% Open		DD	

REMARKS

(1) Motor missing motor tag

NA-Not Available
ND-No Design DD-Direct Drive

EXHAUST FAN REPORT

PROJECT: Barnstable Justice Center | **DATE:** 11/20/20

AREA SERVED: Various | **TECH:** BS

FAN DATA

FAN NUMBER		EF	EF			
LOCATION		Attic	Roof			
AREA SERVED		Public Spaces	Public Spaces			
MANUFACTURER		NA	NA			
MODEL OR SIZE		NA	NA			
TOTAL CFM	DESIGN	NA	NA			
	ACTUAL	1964	824			
FAN RPM	DESIGN	NA	NA			
	ACTUAL	347	1211			
PULLEY	O.D.	19.0"	8.5"			
SERVICE		1.15				

MOTOR DATA

MANUFACTURER		CDP Motor	Dayton			
MODEL NUMBER		145T	48Y			
MOTOR HP	DESIGN	2	1/2			
	ACTUAL	2	1/2			
MOTOR RPM		1740	1725			
VOLTAGE/PHASE		208/3	208/3			
MOTOR AMPS	DESIGN	6.4	3.8			
	ACT. LEG 1	3.6	3.1			
	ACT. LEG 2	3.5	3.0			
	ACT. LEG 3	3.3	3.1			
SHEAVE		4.0"	3.25"			
BELTS-QTY/SIZE		2/4L780W	AX21			
SHEAVE POSITION		50% Open	50% Open			
BHP		1.1				

REMARKS

VELOCITY PRESSURE READINGS

PROJECT: Barnstable Justice Center | **DATE:** 11/20/20

AREA SERVED: Various | **TECH:** BS

TRAVERSE LOCATIONS	DUCT SIZE "	AREA SQ.FT.	DESIGN FPM	DESIGN CFM	CENTERLINE STATIC PRES."	TEST FPM	TEST CFM	NOTES
AHU-1 Return	40" x12"	3.33	---	1400	-0.02	214	713	
AHU-1 OA	40" x 12"	3.33	---	1400	-0.01	298	993	
AHU-4 Supply	18" x12"	1.2	---	NA	---	797	1196	
AHU-4 OA	10" x 20"	---	---	NA	---	---	---	(1)
ERV-1 Supply	18"Ø	1.76	---	1600	-0.05	411	723	(2)
ERV-1 Exhaust	18"Ø	1.76	---	1600	-0.24	862	1517	
MAU-1	24" x 12"	2.0	---	2000	+0.03	472	942	
HV-1 Supply	36" x 6"	0.96	---	NA	anometer	653	627	
HV-1 Return	54" x 4"	1.08	---	NA	anometer	358	387	
EF (Attic)	24" x 24"	4.0	---	NA	w/velgrid	491	1964	
EF (Roof)	18" x 18"	2.25	---	NA	-0.08	366	824	

REMARKS

(1) Outside air damper not attached to shaft and not wired.
(2) Coil clogged on the supply side of ERV-1.