MARLBOROUGH DISTRICT COURT
HVAC SYSTEM EVALUATION SUMMARY

Visited on November 18, 2020. While on site, inspected the air handling unit and exhaust fans, and toured the courtrooms and holding area to determine if the systems and spaces corresponded to the mechanical plans. The Marlborough District Court was constructed in 1968 and is approximately 30,000 square feet in size. pressure in the

1.0 Airflow Rate per Person (Reduced Occupancy)

		Total Air		*Outdoor Air*	
Courtroom	*Total People*	*Supply Airflow (CFM)*	*Airflow Rate (CFM/Person)*	*Outside Airflow (CFM)*	*Airflow Rate (CFM/Person)*
Jury Pool Room	6	1,200	200	239	40
Juvenile Court B2	12	1,290	108	256	21
Courtroom 103	13	1,890	145	376	29
Courtroom 130	15	70	47	139	9
Courtroom 214	13	2,100	162	418	32

2.0 Recommendations

Section	Recommendation/Finding	Action
2.1	**Filtration Efficiency**	
RF-1	Replace 2” MERV-8 filters with MERV-13 filters	Complete
2.2	**Testing & Balancing**	
RTB-1	Test and rebalance air handling unit supply, return, and minimum outside airflow rates	Complete
RTB-2	Rebalance system return and exhaust airflow rate	Complete
RTB-4	Test and balance terminal reheat box airflow rates	N/A
RTB-5	Test and balance all air inlets and outlets	N/A
RTB-6	Test and balance chilled and hot water coils	Deferred – added to the 5-year Capital Plan
2.3	**Equipment Maintenance and Upgrades**	
RE-1	Test existing air handling system dampers and actuators for proper operation	On-going
RE-2	Clean Heating and Cooling Coils and Drain Pans	Complete
2.4	**Control System**	
RC-1	Implement a pre-occupancy flush sequence	In-progress
2.5	**Additional Filtration and Air Cleaning**	
RFC-1	Install portable HEPA filters	Purchased, to be distributed upon delivery

2.6	Humidity Control	
	No actionable items listed – continuous monitoring for seasonal changes	On-going
2.7	Other Recommendations	
2.7.1	Replace Air Handling Unit	Deferred added to the 5-year Capital Plan
2.7.2	Clean supply diffusers and return grilles	Complete
2.7.3	Repair or replace roll dispenser for pre-filter	Not needed, new filter rack has been installed

Marlborough District Court
Marlborough, MA

HVAC SYSTEM EVALUATIONS COVID-19

Office of Court Management

April 6, 2021

Tighe&Bond

100% Recyclable

Section 1
Existing Conditions & Site Observations

Tighe & Bond visited the Marlborough District Court on November 18, 2020. While on site, we inspected the air handling unit and exhaust fans, and toured the courtrooms and holding area to determine if the systems and spaces corresponded to the mechanical plans.

Site Visit Attendees:

- Office of Court Management:
  - Michael Norman, Manager of Court Facilities
  - Scott Morse, Facilities
  - Frank Levey and Dave Miccille, Marlborough District Court
- Tighe & Bond:
  - Todd Holland, PE, Senior Mechanical Engineer
  - Christina Wu, Staff Engineer

1.1 Existing Ventilation System

The Marlborough District Court was constructed in 1968 and is approximately 30,000 square feet in size. Ventilation and air conditioning for most of the building is provided by a single built-up air handling unit (AHU) located in a penthouse mechanical room. The unit has a mixing box with outdoor air (OA) and return air (RA) dampers, filter section, hydronic (hot water) preheat coil, and chilled water coil. A centrifugal supply fan is belt driven by a 30-hp motor and is separate from the AHU. The supply fan is constant speed but controlled by a variable frequency drive (VFD). An inline return fan serves the AHU. The RA fan is variable speed, modulated by a VFD to maintain a differential pressure in the mixing box.

The AHU has two-stage filtration. The original configuration used is single stage of non-woven MERV-5 roll media. This now acts as a pre-filter for a bank of 2" thick pleated MERV-8 filters. The upstream face of the preheat coils had a visible accumulation of dust.

TABLE 1
Existing Air Handling Units

Unit	***Original Design Airflow (CFM)***	***Original Design Min. O.A. (CFM)***	***Filters***	***Condition***
AHU-1	27,000	Unknown	MERV-5 roll, 2" MERV-8	Poor

At the time of the site visit, the AHU had its OA dampers nearly shut and RA damper 100% open. The preheat coil was actively heating, and the chilled water valve was closed.

Photo 1 –RA (left) and OA (right) Dampers in AHU

The AHU is original to the building and in poor condition. Courthouse staff cycled the pneumatic actuators for the OA dampers, and the blades moved only a few degrees.

There is a pair of mini-split systems in the main Courtroom B1, for supplemental cooling. These do not provide ventilation air.

Each holding cell has its own ceiling supply diffuser for ventilation air. Air is removed from each cell via an exhaust grille near the toilet/sink fixture. The door to each cell is not solid, the lower half is a reinforced metal screen with what appears to be 50% free area. The exception is one small holding cell, the finish on the wall shows that the fixture was added later, and this room has only a supply diffuser and does not have an exhaust grille. The exhaust fans serving the cells are manually controlled.

Air distribution throughout the building is constant volume, through 34 terminal reheat boxes. Each box has a fixed supply air volume damper and a hydronic reheat coil with a two-way control valve modulated by a pneumatic thermostat in the space.

The building is cooled by a 100-ton Trane screw-type chiller, using R22 refrigerant, installed in 1995. Space heating loads are served by perimeter radiation and gas-fired hydronic boilers.

1.2 Existing Control System

The Marlborough District Court uses the original pneumatic control system. It is tied to the existing boilers, chillers, AHUs, exhaust fans, perimeter radiation, unit heaters, pumps, and VAV terminal boxes.

There are no digital controls or central Building Management System (BMS). HVAC systems are started manually by facilities staff arriving in the morning, at approximately 6:00 AM, and shut down by the last person leaving, usually 6:30 PM. The AHU is left on overnight in very cold weather. The exhaust fans serving the holding cells are controlled manually via wall-mounted switches. These were not running at the time of our site visit, despite the area being occupied.

We did not find evidence of an economizer sequence for the AHU. There are no demand-controlled ventilation sequences or CO_2 sensors in the building.

Photo 2 – Representative Terminal Reheat Box (Courtroom 103)

Section 2
Recommendations

Below is list of immediate recommendations that we propose for the Marlborough 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 the existing air handling units:

RF-1: *Replace 2" MERV-8 filters with MERV-13 filters.*

The TAB Contractor and/or Engineer shall verify that the air handlers can accommodate a MERV-13 filter.

2.2 Testing & Balancing Recommendations

The air handling unit is over 50 years old and it is unknown to Tighe & Bond when the last time it was tested and balanced. Also, the code requirements to determine the outside air flow rates that were used to design the original system were different than the 2015 International Mechanical Code (IMC) and current ASHRAE Standard 62.1.

Tighe & Bond does not have documentation on the originally designed entering mixed air temperatures for the preheat and chilled water coils in the AHU. We will need more data in order to determine if the AHU and zone reheat coils have the capacity to accommodate the 2015 code required ventilation air under peak conditions. Prior to rebalancing efforts, dampers and actuators should be tested to ensure they are operating correctly.

We recommend the following testing and balancing measures be implemented:

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

We recommend rebalancing the air handler outside airflow rates to the values shown in Table 2. The cooling and heating coils must be analyzed to determine if they are able to provide proper leaving air conditions under peak outdoor air conditions, assuming the coils are clean and their performance has not degraded significantly over time. The return fan will likely have to be rebalanced to accommodate the change in the outside air flow rate.

Our ventilation calculations showed two spaces that would not receive the correct quantity of outdoor air based on today's code requirements if the AHU was balanced to the recommended value in Table 2. We recommend the occupancy of these spaces, listed in Table 3, be set below the default code occupancy used in our calculations. This reduced occupancy is recommended because otherwise these two rooms would require the entire unit's OA to increase by 20%, which is beyond the coils' capacities at peak conditions. This can be implemented immediately with no cost to modify the existing HVAC systems. The recommended outdoor air flow rate listed in Table 2 reflect the OA requirements based on the reduced occupancy in Table 3.

TABLE 2
Recommended Air Handler O.A. Flow Rates

Unit	*Original Design Airflow (CFM)*	*Original Design Min. O.A. (CFM)*	*Current Code Min. O.A. Requirements (CFM)*	**Recommended Minimum O.A. (CFM)**
AHU-1	27,000	Unknown	5,400	5,400

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.

TABLE 3
Recommended Occupancy

Room & Department	*2015 IMC Permitted Occupancy (# of People)*	*Recommended Occupancy (# of People)*
Conference Room B20 (Probation)	6	4
Conference Room B21 (Probation)	6	4

The average airflow rate per person is shown below in Table 4. These values are based on the original design supply airflow rate and the recommended outdoor airflow rates as shown in Table 2 above. The airflow rate per person also assumes a diversity factor of 70%, meaning the maximum number of occupants assumed to be in all zones at any one time equates to 70% of the code default occupancy.

TABLE 4
Average Airflow Rate per Person

	All Spaces	*Courtrooms*	*Non-Courtroom Spaces*
Total Occupancy (People)	445	242	203
Total Supply Air (CFM/Person)	61	25	102
Outdoor Air (CFM/Person)	12	5	20

The airflow rate per person for each Courtroom is shown below in Table 5. These values are based on full occupancy, the original design supply airflow rate, and the code required outdoor airflow rate, without taking diversity into account. The airflow rate per person assumes the full supply airflow is being delivered to the room.

TABLE 5
Airflow Rate per Person – Courtrooms (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	28	1,200	43	239	9
Juvenile Court B2	62	1,290	21	256	4
Courtroom 103	112	1,890	17	376	3
Courtroom 130	55	700	13	139	3
Courtroom 214	116	2,100	18	418	4

The airflow rate per person for each Courtroom, based on a reduced occupancy scheduled determined by the Office of Court Management, is shown below in Table 5a. The airflow rate per person assumes the full supply airflow is being delivered to the room.

TABLE 5a
Airflow Rate per Person – Courtrooms (Reduced Occupancy)

		Total Air		Outdoor Air	
Courtroom	***Total People (Reduced Occ.)***	***Supply Airflow (CFM)***	***Airflow Rate (CFM/Person)***	***Outside Airflow (CFM)***	***Airflow Rate (CFM/Person)***
Jury Pool Room	6	1,200	200	239	40
Juvenile Court B2	12	1,290	108	256	21
Courtroom 103	13	1,890	145	376	29
Courtroom 130	15	700	47	139	9
Courtroom 214	13	2,100	162	418	32

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

To accommodate the revised outdoor air flow rates and to help provide a positive building pressure, the return fan will have to be rebalanced.

RTB-4: *Test and balance terminal reheat box airflow rates.*

To ensure the proper quantity of supply air is delivered to each zone, we recommend benchmark testing and rebalancing all terminal reheat boxes to their original airflow rates. The boxes are over 50 years old and may have fallen out of calibration.

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

If the Courthouse experiences regular cooling and heating comfort complaints, we recommend testing and rebalancing all air inlets and outlets in the spaces experiencing temperature control issues. Prior to rebalancing, we recommend verifying the chiller and boiler plants are maintaining the correct supply water temperatures. Incorrect supply water temperatures may be contributing to the temperature control complaints instead of a lack of airflow.

RTB-6: *Test and balance chilled and hot water coils.*

Testing and balancing the air handler preheat and chilled water coils, and all reheat 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 condition the supply air. Coils can become fouled over time, which degrades the performance.

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*.

Repair or replace the dampers and actuators that are not opening and closing fully, or not going to the position commanded by the controls.

RE-2: *Clean Heating and Cooling Coils and Drain Pans*

The coils in air handlers and terminal reheat boxes are over 50 years old, and Tighe & Bond does not know how regularly they have been cleaned. There was a visible accumulation of dust and debris on the AHU preheat coil.

Photo 3 – Representative Coil Condition

2.4 Control System

We recommend the following control system upgrades:

RC-1: *Implement a pre-occupancy flush sequence*

The AHU and exhaust fans are currently stopped and started manually. We recommend installing a 7-day programmable timeclock to provide automatic start and stop, with a start time to provide a pre-occupancy flush of ventilation air.

2.5 Additional Filtration and Air Cleaning

RFC-1: *Install portable HEPA filters.*

If the Courthouse is to operate at a high capacity (i.e. 50%-75% occupancy or greater), we recommend installing portable HEPA filters in high traffic areas, such as entrance lobbies or places outside courtrooms where people may congregate. 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 Replace Air Handling Unit

Replacing the air handler should be considered within 3-5 years. An indoor central station air handling unit has a life expectancy of 35-40 years. This unit is 52 years old and has components that are in poor condition, thus subject to imminent failure, which will result in immediate interruption to Court activities. Any original exhaust fans should be replaced as well.

2.7.2 Clean supply diffusers and return grilles

We noted a visible accumulation of dust on several ceiling supply diffusers and low-mounted return air grilles. According to the EPA, duct cleaning has not been shown to prevent health problems, and studies have not conclusively shown that dust levels in spaces increase because of dirty air ducts or terminals. However, they do recommend cleaning if there is an excessive buildup of dust or debris.

Photo 4 – Representative Supply Diffuser

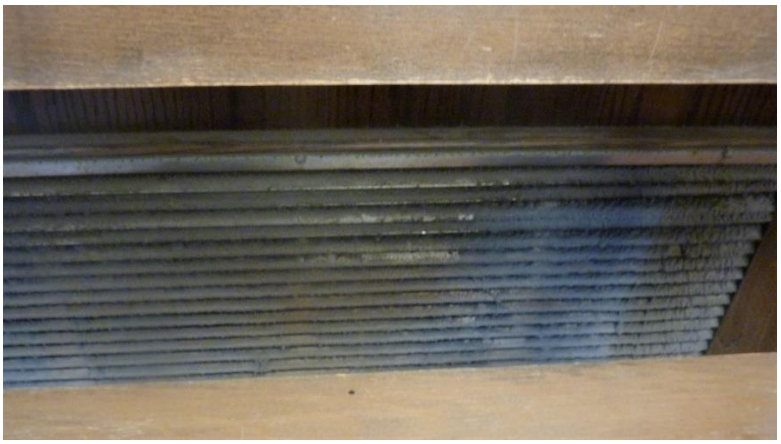
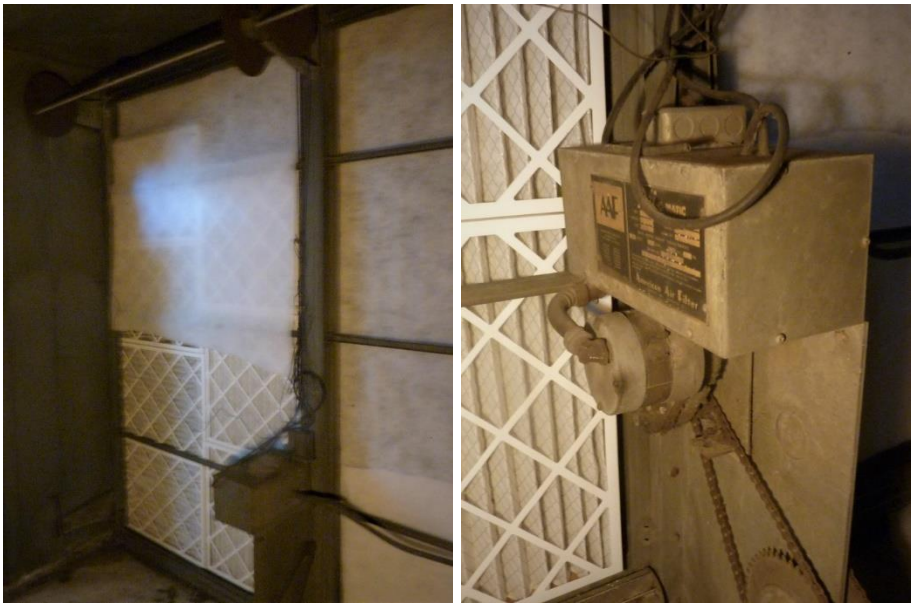


Photo 5 – Representative Return Air Grille

2.7.3 Repair or Replace Roll Dispenser for Prefilter

The AHU was modified recently to add a row of 2" thick pleated-type cartridge filters. The original filter, which uses non-woven MERV-5 roll media, is now used as a pre-filter. However, the roll dispenser no longer works which requires facilities personnel to manually cut and place the roll media. During our site visit we noted large gaps in the media and a visible accumulation of dust on the upstream face of the preheat coil. We recommend repairing or replacing the roll dispenser, so that the prefilter media will fit properly and be more easily replaced as needed.



Photos 6 and 7 – AHU Prefilter and Roll Dispenser

Section 3
Testing & Balancing Results

Wing's Testing and Balancing visited the Marlborough District Courthouse on January 25, 2021 to test the airflow rates of the air handling unit and the exhaust fan. A summary of the tested airflow rates versus the design airflow rates are shown below in Tables 6 and 7. The full testing and balancing report is attached.

TABLE 6
Air Handler Testing & Balancing Results

	Design			Actual		
Unit	Total Supply Fan Airflow (CFM)	Recommended Outdoor Airflow (CFM)	Return Fan Airflow (CFM)	Supply Fan Airflow (CFM)	Outdoor Airflow (CFM)	Return Fan Airflow (CFM)
AHU-1	27,000	5,400	21,600	27,196	5,040	22,156

TABLE 7
Exhaust Fan Testing & Balancing Results

Unit	Serving	Design Return/Exhaust Airflow (CFM)	Actual Return/Exhaust Airflow (CFM)
EF-12	Lockup	N/A	772

Typical balancing tolerance for air systems is ±10% of the design airflow. In reviewing the airflow report data, the following should be noted:

1. AHU-1 is performing within the acceptable airflow range for both total supply and outdoor airflows.
    a. Tighe and Bond does recommend increasing the outdoor airflow, since the measured flow was in the low end of the acceptable range.
    b. The outdoor air damper is not functional, and we recommend repairing or replacing this damper to ensure proper ventilation and reduce the risk of freezing the coil(s) in winter.
2. The motorized damper on the relief side of exhaust fan EF-12 is not operational, and can be opened manually about half way. Tighe & Bond recommends repairing or replacing this damper to ensure proper ventilation.

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.

Marlborough District Courthouse
HVAC/Ventilation Survey

* * * *

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

January 25, 2021

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WING'S TESTING & BALANCING CO., INC.

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

January 25, 2021

Re: Marlborough District Courthouse/HVAC Ventilation Survey

Dear Jason,

The HVAC/Fresh Air Survey for the above referenced has been completed. Through our testing we found that outside air dampers for AHU-1 are not functional. There are no circuit setters on the hot water loop and the pipe are insulated with asbestos. The entering temperatures for AHU-1's hot water coil was 118.5˚F and the leaving temperature was 87˚F. Also, the motorized damper on the relief side of the Lock-Up Exhaust Fan is not functional and is only able to be opened manually half way.

This report includes 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 current operating conditions. If you have any questions, or if we can be of further service, 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: Marlborough District Courthouse	**DATE:** 1/25/21
AREA SERVED: Various	**TECH:** BS

FAN DATA						
FAN NUMBER	AHU-1					
LOCATION	Penthouse					
AREA SERVED	Court House					
MANUFACTURER	HK Porter					
MODEL OR SIZE	445					
	DESIGN	**ACTUAL**	**DESIGN**	**ACTUAL**	**DESIGN**	**ACTUAL**
TOTAL CFM	27,000	27,196				
RETURN AIR	21,600	22,156				
OUTSIDE AIR	5,400	5,040				
DISCH. STATIC	---	+1.96"	---		---	
SUCTION STATIC	---	-1.52"	---		---	
TOTAL STATIC	NA	3.48	---			
FAN RPM	NA	576	---			
PULLEY O.D.	20 1/2" x 2 11/16"					
ESP	2.32					
VFD SPEED	60 Hz					
O.A.D. MIN POS	10% (1)					
MOTOR DATA						
MANUFACTURER	Baldor					
MODEL OR FR.	286T					
HORSEPOWER	30	30				
MOTOR RPM	1770	1770				
VOLTAGE / PH.	200/3	200/3				
AMPS LEG 1	81.0	50.6				
AMPS LEG 2	---	50.9	---		---	
AMPS LEG 3	---	50.1	---		---	
SHEAVE O.D.	12.0" x 1 3/8"					
BELTS - QTY / SIZE	3/C105					
SHEAVE POSITION	50% Open					
BHP	18.6					
FILTERS						

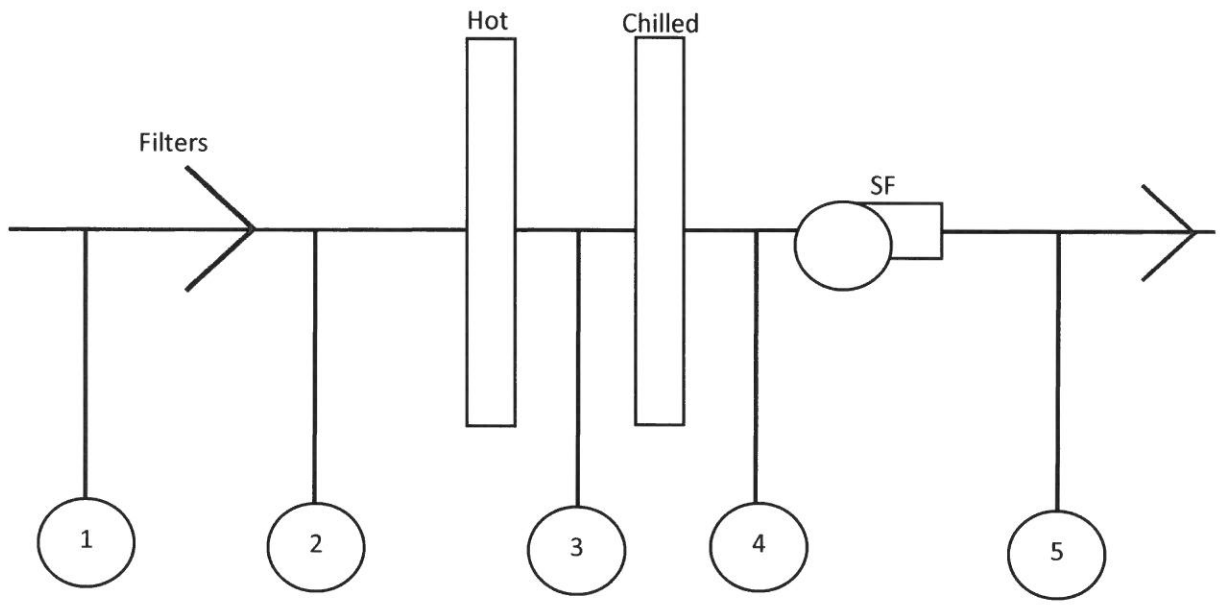
REMARKS

(1) The outside air dampers are not functional

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

SYSTEM STATIC PRESSURE PROFILE

PROJECT: Marlborough District Courthouse	**DATE:** 1/25/21
SYSTEM/AREA SERV: Various	**TECH:** BS



STATIC PRESSURE READINGS "wc

POS. (+) / NEG.(-)	1	2	3	4	5	6	7	NOTES
AHU-1	-0.36"	-0.49"	-0.90"	-1.52"	+1.96"			

REMARKS

VELOCITY PRESSURE READINGS

PROJECT: Marlborough District Courthouse | **DATE:** 1/25/21

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

TRAVERSE LOCATIONS	DUCT SIZE "	AREA SQ.FT.	DESIGN		CENTERLINE STATIC PRES."	TEST		NOTES
			FPM	CFM		FPM	CFM	
AHU-1								
Total	74" x 105"	53.96	---	27,000	w/velgrid	604	27,196	
OA	108" x 105"	78.75	---	5400	w/velgrid	64	5040	(1)
Lock Up Exhaust Fan	14" x 8"	0.78	ND	ND	+0.32	992	772	

REMARKS

(1) The outside dampers are pneumatic and are not functional

EXHAUST FAN REPORT

PROJECT: Marlborough District Courthouse | **DATE:** 1/25/21

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

FAN DATA						
FAN NUMBER		F-12/Lock Up				
LOCATION		Boiler Room				
AREA SERVED		Lock Up				
MANUFACTURER		Cook				
MODEL OR SIZE		90-SQI				
TOTAL CFM	DESIGN	NA				
	ACTUAL	772				
FAN RPM	DESIGN	NA				
	ACTUAL	NA				
PULLEY	O.D.	2 1/4" x 3/4"				
SERVICE		1.15				
MOTOR DATA						
MANUFACTURER		Leeson				
MODEL NUMBER		L556				
MOTOR HP	DESIGN	1/2				
	ACTUAL	1/2				
MOTOR RPM		1725				
VOLTAGE/PHASE		208/3				
MOTOR AMPS	DESIGN	2.2				
	ACT. LEG 1	2.0				
	ACT. LEG 2	2.2				
	ACT. LEG 3	2.1				
SHEAVE		3 1/4" x 5/8"				
BELTS-QTY/SIZE		1/Ax35				
SHEAVE POSITION		100% Closed				
BHP						

REMARKS