Barnstable Probate & Family Court
Barnstable, MA

HVAC SYSTEM EVALUATIONS COVID-19

Office of Court Management

July 15, 2022

Tighe&Bond

100% Recyclable

Section 1
Existing Conditions & Site Observations

Tighe & Bond visited the Barnstable Probate and Family Courthouse on October 15, 2020. While on site we inspected the air handling equipment located in mechanical rooms and on the roof, and toured the occupied areas of the facility to determine if the spaces generally matched usages noted on the architectural plans.

Site Visit Attendees:

- *Office of Court Management:*
  - Don Reynolds, Facilities Director, County of Barnstable
  - Tom Butler, Courthouse Facilities Staff
  - Keith Bernier, Courthouse Facilities Staff
  - Adam Alati, Courthouse Facilities Staff
- *Tighe & Bond*
  - Sean Pringle PE, Mechanical Engineer
  - Christina Wu, Staff Engineer

1.1 Existing Ventilation System

The Barnstable Probate and Family Courthouse was constructed in 1956 with a major addition and renovation in 1988. The Courthouse is approximately 29,000 square feet in size. One air constant volume air handling unit (AHU) and six constant volume rooftop air handling units (RTU) provide ventilation air to the building.

AHU-1 is located in the basement boiler room and serves the land court offices in the basement. The unit has a hot water coil, chilled water coil, hot water reheat coil, supply fan, as well as return and outside air dampers. This unit is in poor condition. The hot water coil was dirty, and the unit did not appear to be providing any outdoor air at the time of the visit based on the position of the outdoor air damper.

The RTU's have DX cooling, supply fan, as well as return, outside, and relief air dampers. There is no heating within the RTU's. The conditions vary from poor to good condition, as some appear to have been replaced at different times. The RTU fans do not operate continuously, and cycle in response to cooling needs in the spaces served. In heating mode, RTU's 1-3 run continuously to serve the multiple zones with individual hot water heating coils in the ductwork. RTU's 4-6 are single zone systems and only provide cooling, cycling the fan in response to cooling demands. Heat is provided in these areas via hot water baseboard around the perimeter. The newer RTU's (1,3,5, and 6) include economizer controls and have 3 position outdoor air dampers. The oldest RTU's (2 and 4) have fixed outdoor air dampers.

Two 780 MBH (input) hot water boilers provide hot water to the AHU, duct-mounted heating coils, and perimeter baseboard heaters. A 60 ton air-cooled chiller provides cooling to the AHU's and ducted fan coils. Staff commented that the chiller is too large for the connected load and they have operational issues as a result. Prior to the 1988 addition, the chiller also served chilled water coils in several rooftop units which are now packaged AC units.

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

TABLE 1
Existing Air Handling Units

Unit	Original Design Airflow (CFM)	Original Design Min. O.A. (CFM)	Filters	Condition
AHU-1	Unknown (3,700 est)	Unknown	2" MERV 11	Poor
RTU-1	5,000	1,000	2" Mesh	Good
RTU-2	5,760	1,150	2" MERV 11	Fair
RTU-3	2,700	540	2" MERV 11	Good
RTU-4	Unknown (3,000 est)	Unknown	2" MERV 11	Fair
RTU-5	Unknown (4,000 est)	Unknown	2" MERV 11	Fair
RTU-6	Unknown (2,000 est)	Unknown	2" MERV 11	Fair

Photo 1 – Representative Rooftop Air Handler

Photo 2 – Air handler AHU-1

At the time of the visit, the toilet exhaust fan serving the judge's lobby for Courtroom 1 was not operational. The judge's lobby restroom for Courtroom 2, and the first-floor staff restrooms did not have any toilet exhaust vents.

In the basement, there is an office area that is currently unoccupied. It is heated and cooled by a large concealed ducted fan coil. There is also perimeter baseboard heat serving this space. However, there is no source of ventilation air for the space. Staff indicated that there are plans to reuse this area.

In the first floor, there is an office area that is under construction, but currently unoccupied. Heating and cooling is provided by wall-mounted heat pump units that appear to have been recently added as part of the project. There is no source of ventilation air for the space.

The first floor Registry of Deeds and lobby areas do not have any source of ventilation air. Several concealed ducted fan coils provide cooling to these areas, but do not provide outdoor air. Heat is provided in these areas via hot water baseboard.

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 perimeter rooms generally have large windows with small operable sashes at the top and bottom of the window.

The available drawings for this building were limited. The duct system and specifications for RTU's 1-3 were available as part of the 1988 design documents. AHU-1 was originally designed to serve the photography lab in the basement. We were able to estimate the total supply airflow for this unit based on the sum of airflow values at supply outlets on ductwork drawings, but no other data was available. Because the estimated airflows are

based on use as a photography lab, they may not be accurate based on the current office use. Based on the exhaust rate from the photography lab hoods, the unit was likely originally used for 100% outdoor air operation. We were not provided with any drawings indicating the capacities or duct routing for RTU's 4-6. Staff advised us of the areas each unit serves. Any airflows indicated in this report for these units and areas are estimates. Further engineering review is recommended. Refer to recommendation RTB-5.

1.2 Existing Control System

The Courthouse does not have a building-wide control system. The AHU has local DDC controls and time clocks. All RTU's, radiant heat, and supplemental heating and cooling utilize local thermostats and electronic controls, without any functioning time clocks. According to staff, toilet exhaust fans are turned on manually each day.

Section 2
Recommendations

Below is a list of recommendations that we propose for the Barnstable Probate and Family 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 for the existing air handling units:

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

We recommend replacing the filters in the AHU and RTU's with MERV 13 filters. The TAB Contractor and Engineer shall verify that the existing AHU and RTU's can accommodate MERV-13 filters. Replace filters in AHU and RTU's with 2" MERV 13 filters.

For the fan coils providing supplementary cooling, consider the use of 1" pleated MERV 13 filters. The use of MERV ratings than the typical MERV 8 in these units may reduce the supply airflow and will require replacement at a higher frequency. The TAB Contractor shall verify that the existing fan coil airflows are not significantly reduced with the addition of MERV-13 filters.

RF-3: *Install a differential pressure sensor with a display across the filter bank.*

This recommendation applies to AHU-1 and the RTU's.

RF-3a: *Connect the pressure sensor to the BMS system and/or a local alarm.*

As there is no BMS, provide a local alarm. For the RTU's, provide a local alarm in area that will be noticed by staff.

2.2 Testing & Balancing Recommendations

AHU-1 is approximately 65 years old and the RTU's are of unknown age. The RTU's have been replaced as they failed. 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 were likely different than the 2015 International Mechanical Code (IMC) and current ASHRAE Standard 62.1 requirements.

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. We were not able to find the intended capacity, supply or outdoor airflow for RTU's 4-6 in the available design documents. The supply airflow for AHU-1 is based on the 1956 drawings when the space was used as a photography lab, which may not be accurate based on the current use.

We recommend the following testing and balancing measures be implemented:

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

We recommend testing and balancing the outdoor air flow rates for all air handling units to the recommended minimum O.A. rates listed in Table 2.

TABLE 2
Recommended Air Handler O.A. Flow Rates

Unit	Original Supply Airflow (CFM)	Design O.A. (CFM)	Current Code Min. O.A. Requirements (CFM)	Recommended Minimum O.A. (CFM)
AHU-1**	3,700	Unknown	650	900
RTU-1	5,000	1,000	380	1,000
RTU-2	5,760	1,150	700	1,150
RTU-3	2,700	540	480	540
RTU-4*	Unknown (3,000 est.)	Unknown	780	780
RTU-5*	Unknown (4,000 est.)	Unknown	160	400
RTU-6*	Unknown (2,000 est.)	Unknown	210	250

*Supply Airflow estimated based on equipment nameplate cooling capacity, assuming 400 CFM/Ton.
**Supply airflow based on 1956 documents when space was used as a photography lab.

For AHU-1 and RTU's 4, 5, and 6, we are recommending outdoor airflow rates above the code minimum ventilation rate to provide adequate makeup air for the toilet exhausts and to maintain a positive pressure in the space. Because the supply airflows in individual spaces are not known, the calculated and recommended outdoor air requirements are approximate. Further engineering review is recommended. Refer to recommendation RTB-5.

The discrepancies between the calculated code required ventilation rates and the design ventilation rates are likely due to variations in assumptions in the expected occupant concentration, airflow per person, calculation methodology, and makeup and pressurization requirements. We recommend maintaining the outdoor airflows at the original designed values where they are known and exceed the code minimums calculated by Tighe & Bond.

The average airflow rate per person is shown below in Table 3. These values are based on the original design or estimated supply airflow rate and the recommended outdoor air flow rates shown in Table 2 above. Only the areas with ventilation are shown. Areas without ventilation are not included. 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

	All spaces	***Courtrooms***	***Non-Courtroom Spaces***
Total Occupancy (People)	227	113	114
Total Supply Air (CFM/Person)	116	39	190
Outdoor Air (CFM/Person)	22	9	35

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 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 continuously.

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)***
Courtroom 1	96	2,400 (est.)	25	620	6
Courtroom 2	65	2,000	37	400	6

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 continuously.

TABLE 4a
Airflow Rate per Person (Reduced Occupancy)

		Total Air		***Outdoor Air***	
Courtroom	***Total People***	***Supply Airflow (CFM)***	***Airflow Rate (CFM/Person)***	***Outside Airflow (CFM)***	***Airflow Rate (CFM/Person)***
Courtroom 1	20	2,400 (est.)	120	620	31
Courtroom 2	17	2,000	141	400	24

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

We recommend increasing the outdoor air flow rate in AHU-1 beyond the recommended outdoor air flow rates in a stepped approach by up to 10% beyond the recommended outdoor air flow rates under non-peak conditions. We do not believe this would cause a threat of coil to freeze based on the total percentage of

outside air vs. the total amount of outside air, however cold spots on the coil may develop due to poor mixing.

With the current equipment and lack of a central BMS, we do not recommend this approach for the RTU's.

Refer to the control system upgrades section for the required controls to implement this strategy for the AHU's.

RTB-5: *Consider rebalancing all air inlets and outlets.*

Original 1956 Areas:
We were not provided with any design documents showing the ductwork in these areas, and according to staff, they are not available. We were provided with some ductwork drawings showing airflows for the AHU-1 area, but this is likely no longer accurate. If design documents showing the required airflows and ductwork are not available, the required airflows should be established by an engineer and rebalanced to provide appropriate air volumes based on loads, and the code required ventilation rates for each space.

Whole building or spaces with airflow/temperature issues
If the Courthouse experiences regular cooling and heating comfort complaints, we recommend exploring rebalancing all air inlets and outlets throughout the building. Prior to rebalancing the building, we recommend verifying the chiller and boiler plants are maintaining the correct supply water temperatures.

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

Testing and balancing the air handler hot and chilled water coils, and duct mounted hot 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-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.*

Several coils were visibly dirty at the time of the site visit.

RE-7: *Test the existing air handler control valves and actuators for proper operation.*

2.4 Control System Recommendations

We recommend the following for the control system:

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

Time clocks will need to be added to control the RTU's and exhaust fans for this measure to be implemented. Consider adding a single electronic timer to control all devices from a single location in the Courthouse. According to staff, the controls for AHU-1 already include a time clock.

RC-3: *Install controls required to introduce outside air beyond the minimum requirements.*

RC-4: *Confirm the economizer control sequence is operational.*

AHU-1 appears to have the ability to economize, and several RTU's (1, 3, 5, and 6) have built-in economizer controls. Ensure the controls are calibrated and correctly configured, and outside air dampers can open fully.

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 using duct mounted humidification or portable humidifiers 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. We are not aware if this building was constructed to handle a humidification system.

Duct mounted humidifiers must be engineered, integrated into the building control system, tested, and commissioned. They are available in many configurations, but require substantial maintenance and additional controls. They also run the risk of adversely affecting IAQ from growing microorganisms, or leaking water through poorly sealed ductwork damaging insulation and ceilings. Portable humidifiers are easier to install and require less maintenance, but still have the potential to damage the building envelope.

While active humidification is not recommended as a whole building solution due to high installation costs, operational costs, potential to damage the building envelope and adversely affect poor IAQ, it may be warranted as a temporary solution in some areas.

2.7 Other Recommendations

2.7.1 Run Ventilation Fans Continuously During Occupied Hours

For the RTU 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 cause comfort issues. When the fan continuously runs, the 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 cooling that would otherwise handle load fluctuations better. During the winter, RTU's without heating coils in the ductwork will supply air below room temperature. Further system analysis and improvements are required to execute this recommendation.

Consider adding a single electronic time clock to control AHU's, RTU's, and exhaust fans from a single location in the Courthouse to simplify scheduling and operation. Alternately, the existing programmable thermostats serving the RTU's could be replaced with new thermostats that include a programmable fan or occupancy schedule function. Depending on the current wiring, new control wiring may be required between the thermostats and RTU's.

2.7.2 Add Ventilation to All Occupied Areas

The lobby and Registry of Deeds areas on the first floor do not have any mechanical ventilation. Consider adding a ventilation system to serve these areas. If the area is currently adequately heated and cooled, consider the use of a dedicated outdoor air system (DOAS) to serve this space.

According to staff, there are plans to use the unoccupied areas in the basement and first floor in the future. We also recommend adding code-required ventilation to these areas prior to occupancy.

2.7.3 Replace Toilet Exhaust Fans

We recommend replacing any failed toilet exhaust fans. At the time of the visit, the toilet exhaust fan serving the judge's lobby restroom for Courtroom 1 was not functional.

2.7.4 Provide Exhaust for All Toilet Rooms

Add exhaust fans and ductwork to the judge's lobby restroom for Courtroom 2 and the first-floor restrooms.

2.7.5 Replace AHU-1, RTU-2, and RTU-4

AHU-1 appears to be original to the building. RTU's 2 and 4 are the oldest rooftop units. They have fixed outdoor air dampers, which do not allow for economizer function or shutting off outdoor air during unoccupied periods. Consider replacing these units within the next 5 years.

This recommendation is an energy saving measure and does not affect the indoor air quality of the building.

2.7.6 Add Heat to RTU's 4-6

RTU's 4-6 do not provide heating. As mentioned in 2.7.1, occupants may feel cold with the low supply air temperature in the winter without heat to temper supply air. Provide duct mounted heating coils or replace the RTU with a unit that provides gas or hot water heating. If gas heat is used, the furnace should be a modulating type, to mitigate fluctuations in the supply air temperature.

This recommendation is a comfort and energy saving measure and does not affect the indoor air quality of the building.

Section 3
Testing & Balancing Results

Wings Testing & Balancing visited the Barnstable Probate Courthouse on May 20, 2022 to test the airflow rates of the air handling units and the exhaust fans. A summary of the tested airflow and water flow rates versus the design airflow rates are shown below in Tables 5, 6, and 7. The full testing and balancing report is attached. The balancing report also contains the water flow rate testing results of the air handler hot water coils. The chilled water system was not operational during the time of testing, therefore chilled water coil flow rates were not tested.

TABLE 5
Air Handler Airflow 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	Unknown (3,700 est)	900	Unknown	1,190	791	399
RTU-1	5,000	4,000	1,000	3,337	400	2,937
RTU-2	5,760	4,610	1,150	5,149	1,096	4,053
RTU-3	2,700	2,160	540	1,902	366	1,536
RTU-4	Unknown (3,000 est)	780	Unknown	1,962	0	1,962
RTU-5	Unknown (4,000 est)	400	Unknown	2,495	782	1,713
RTU-6	Unknown (2,000 est)	250	Unknown	2,047	0	2,047
FCU-Basement Unoccupied	Unknown	Unknown	Unknown	1,213	0	1,202
FCU-Basement Lobby	Unknown	Unknown	Unknown	275	0	255
SF-Basement Unoccupied	Unknown	Unknown	Unknown	242	242	N/A

TABLE 6
Exhaust Fan Testing & Balancing Results

Unit	Serving	Design Exhaust Airflow (CFM)	Actual Exhaust Airflow (CFM)
EF-1	Restrooms	Unknown	0
EF-2	Restrooms	Unknown	310
EF-3	Restrooms	Unknown	391
No Tag	Judge's RR	Unknown	71

TABLE 7
Air Handler Waterflow Testing & Balancing Results

	Design			Actual		
Unit	Chilled Water Flow Rate (GPM)	Hot Water Flow Rate (GPM)	Reheat Hot Water Flow Rate (GPM)	Chilled Water Flow Rate (GPM)	Hot Water Flow Rate (GPM)	Reheat Hot Water Flow Rate (GPM)
AHU-1	Unknown	Unknown	Unknown	Not Tested	6.2	10.1

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

1. EF-1 is not operational. The fan should be repaired or replaced.
2. AHU-1 is performing well below the estimated design airflow. The mixed air damper actuator has been removed from the unit. The reheat coil in the downstream ductwork showed a very high pressure drop, indicating it is likely clogged.
    a. We recommend cleaning the reheat coil, heating coil, cooling coils, and replacing or repairing the damper actuator before retesting.
3. RTU-1 is operating at 67% of the design airflow with the motor at full load. There are also gaps in the return ductwork for the unit. The ductwork should be sealed. There are reheats in the distribution ductwork served by this unit that may need cleaning.
    a. We recommend cleaning the DX cooling and reheat coils to improve airflow before retesting.
4. RTU-2 is operating within the acceptable airflow range.
5. RTU-3 is operating at 70% of the design airflow. Adjusting the sheaves would bring the airflow close to, but not within tolerances. There are reheats in the distribution ductwork served by this unit that may need cleaning.
    a. We recommend cleaning the DX cooling and reheat coils to improve airflow before retesting.

6. RTU-4 and 5 are operating at 64% of the estimated airflow based on the unit nameplate cooling capacity. The units also do not have functional outdoor air actuators. There were also registers on this system with low or zero airflow. Note that since we do not have design documents for these systems, we cannot comment on whether the airflow meets the design intent.
    a. We recommend investigating and repairing any damaged ductwork, and cleaning the DX coils and any hot water reheat coils in the ductwork.
    b. We recommend replacing the actuators to allow the correct amount of outdoor air to be provided to the spaces served by these units.
7. RTU-6 is operating close to the estimated airflow based on the unit nameplate cooling capacity. However, the outdoor air actuator is not functional and needs to be replaced to provide the correct amount of outdoor air to the spaces served by the unit.
    a. We recommend replacing the actuator to allow the correct amount of outdoor air to be provided to the spaces served by these units.
8. Both fan coil units in the basement are operational, but do not provide any outdoor air to the spaces they serve. There is an operable supply fan and ductwork to provide some outdoor air to the open area, but this would not meet code as there is no direct ventilation to the individual areas. This system is also a comfort concern since the outdoor air is not conditioned (heated or cooled). Refer to recommendation 2.7.2.

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.

WING'S TESTING & BALANCING CO., INC.

Barnstable Probate Court

* * * *

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

May 20, 2022

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WING'S TESTING & BALANCING CO., INC.

May 20, 2022

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

Re: Barnstable Probate Court

Dear Jason,

We have conducted our HVAC/ fresh-air ventilation survey for the above-mentioned site. The water system is still in winter mode, so no chilled water was flowing during the time of our visit. Through our testing, we found that:

- The restroom EF serving Judge's toilet/ 2nd floor/ courtroom 2 is not operational.
- The flex is detached from diffuser #1 in courtroom 2 (see plan).
- The mixed air damper actuator for AHU-1 has been removed and is sitting on the floor next to the unit.
- There are several large gaps around the return air damper in RTU-1. One is 20" x 14" and the other is 2" by the width of the unit.
- The OA actuators for RTU-4, RTU-5, and RTU-6 are not functional and need replacing.
- The filters in RTU-6 are very dirty and need replacing.
- Several grills on the 2nd floor open office space and adjacent rooms have been covered over for staff comfort.
- The filters in the basement lobby are very dirty and need replacing.

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

Nick Carrano

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SUPPLY FAN REPORT

PROJECT: Barnstable Probate Court	**DATE:** May 16, 2022
AREA SERVED: Land Court	**TECH:** BS, NC

FAN DATA

FAN NUMBER	AHU-1		RTU-1		RTU-2	
LOCATION	Mechanical Room		Rooftop		Rooftop	
AREA SERVED	Land Court		2nd Floor Lobby		1st Floor Deeds Hall	
MANUFACTURER	N/A		Trane		Carrier	
MODEL OR SIZE	N/A		TSD180G3ROAOXD		5OTC-D16A3A5A6F	
	DESIGN	ACTUAL	DESIGN	ACTUAL	DESIGN	ACTUAL
TOTAL CFM	3700	1190	5000	3337	5760	5149
RETURN AIR	2800	399 (1)	4000	2937	4610	4053
OUTSIDE AIR	900	791	1000	400	1150	1096
DISCH. STATIC	---	+0.73"	---	+0.65"	---	+1.18"
SUCTION STATIC	---	-0.53"	---	-0.65"	---	-0.84"
TOTAL STATIC	N/D	1.26"	N/D	1.3"	N/D	2.02"
FAN RPM	N/D	1014	N/D	704	N/D	534
PULLEY O.D.	8" X 1 1/8"		8 1/2" x 1 3/16"		12" x 1 3/16"	
ESP	---		---		---	
VFD SPEED	18"		21"		21.5"	
O.A.D.MIN POS	100% Open		10% Open (2,3)		25%	

MOTOR DATA

MANUFACTURER	Leland Faraday		Century			
MODEL OR FR.	182T		182TZ			
HORSEPOWER	N/D	3	N/D	N/L	N/D	5
MOTOR RPM	1755	1790	1770	1770	1755	1755
VOLTAGE / PH.	208/3	208/3	208/3	208/3	208/3	208/3
AMPS LEG 1	9.2	4.3	8.0	7.6	12.6	10.1
AMPS LEG 2	9.2	4.4	8.0	7.8	12.6	9.7
AMPS LEG 3	9.2	4.2	8.0	7.6	12.6	9.7
SHEAVE O.D.	4 3/4" x 1 1/8"		3 1/2" x 7/8"		6 1/2" x 1 1/8"	
BELTS - QUANTITY / SIZE	1/ B52		1/ Bx64		1/ Bx67	
SHEAVE POSITION	100% Closed		75% Closed		80% Open	
Filters	Good		Good		Good	

REMARKS

(1) Mixed air actuator has been deattached and is sitting on the floor next to this unit.
(2) 20" x 14" opening next to mixed air damper allows Return Air to bypass damper.
(3) Top edge of Return duct has 2" gap at connection to unit.

NA Not Available | **ND** No Design | **DD** Direct Drive | **N/R** No Requirement

SUPPLY FAN REPORT

PROJECT: Barnstable Probate Court | **DATE:** May 17, 2022

AREA SERVED: Land Court | **TECH:** BS, NC

FAN DATA

FAN NUMBER	RTU-3		RTU-4		RTU-5	
LOCATION	Rooftop		Rooftop		Rooftop	
AREA SERVED	2nd Floor Courtroom 2		Courtroom 1		Probate	
MANUFACTURER	Carrier		Carrier		Carrier	
MODEL OR SIZE	50TCA08A2A5A		48HJEOO8		48TCED12A2K	
	DESIGN	ACTUAL	DESIGN	ACTUAL	DESIGN	ACTUAL
TOTAL CFM	2700	1902 (2)	3000	1962 (2)	4000	2495 (2)
RETURN AIR	2160	1536	2220	1962	2600	1713
OUTSIDE AIR	540	366	780	0 (1)	400	782 (1)
DISCH. STATIC	---	+0.6"	---	+0.24"	---	+0.54"
SUCTION STATIC	---	-0.65"	---	-0.57"	---	-0.91"
TOTAL STATIC	N/D	1.25"	N/D	0.81"	N/D	1.45"
FAN RPM	N/D	760	N/D	501	N/D	865
PULLEY O.D.	8 1/2" X 1 1/8"		7.0" x 1"		7.0" x 1"	
ESP	---		---		---	
VFD SPEED	N/A		N/A		N/A	
O.A.D.MIN POS	10%		(1)		(1)	

MOTOR DATA

MANUFACTURER	Marathon		GE		Marathon	
MODEL OR FR.	56 Hz		56Y		56 Hz	
HORSEPOWER	N/D	N/L	N/A	N/A	N/D	N/D
MOTOR RPM	1725	1725	1725	1725	1725	1725
VOLTAGE / PH.	230/3	230/3	208/3	208/3	208/3	208/3
AMPS LEG 1	8.4	4.5	7.5	4.4	10.0	6.3
AMPS LEG 2	8.4	4.6	7.5	4.5	10.0	6.4
AMPS LEG 3	8.4	4.5	7.5	4.4	10.0	6.3
SHEAVE O.D.	5" x 7/8"		3 3/4" x 7/8"		4 1/2" x 7/8"	
BELTS - QUANTITY / SIZE	1/AX52		1/AX48		1/AX49	
SHEAVE POSITION	50% open		Fully closed		50% open	
C/C	17.5"		17.0"		17.0"	
Filters	Good		Good		Good	

REMARKS

(1) OA Actuator not functional.

(2) Unit needs a sheave change.

NA Not Available | **ND** No Design | **DD** Direct Drive | **N/R** No Requirement

SUPPLY FAN REPORT

PROJECT: Barnstable Probate Court	**DATE:** May 17, 2022
AREA SERVED: Land Court	**TECH:** BS, NC

FAN DATA

FAN NUMBER	RTU-6					
LOCATION	Rooftop					
AREA SERVED	2nd Floor Probate					
MANUFACTURER	Carrier					
MODEL OR SIZE	48HJE006					
	DESIGN	**ACTUAL**	**DESIGN**	**ACTUAL**	**DESIGN**	**ACTUAL**
TOTAL CFM	2000	2047				
RETURN AIR	1750	2047				
OUTSIDE AIR	350	0 (1)				
DISCH. STATIC	---	+0.27"				
SUCTION STATIC	---	-1.04"				
TOTAL STATIC	N/D	1.31				
FAN RPM	N/D	1115				
PULLEY O.D.	4 1/4" x 1/2"					
ESP	---					
VFD SPEED	NO VFD					
O.A.D.MIN POS	(1)					

MOTOR DATA

MANUFACTURER	GE					
MODEL OR FR.	56Y					
HORSEPOWER	N/A	N/A				
MOTOR RPM	1725	1725				
VOLTAGE / PH.	230/3	230/3				
AMPS LEG 1	5.2	3.1				
AMPS LEG 2	5.2	2.9				
AMPS LEG 3	5.2	2.7				
SHEAVE O.D.	3 1/2" x 5/8"					
BELTS - QUANTITY / SIZE	1/A40					
SHEAVE POSITION	75% Closed					
C to C	15"					
Filters	Bad					

REMARKS

(1) OA actuator no good and needs replacing.

NA Not Available | **ND** No Design | **DD** Direct Drive | **N/R** No Requirement

AIR DEVICE REPORT

PROJECT: Barnstable Probate Court | **DATE:** May 19 and 20, 2022

SYSTEM / AREA: RTU's 2, 3, 4 | **TECH:** BS, NC

LOCATION	NO.	SIZE	A K	DESIGN		TEST		FINAL		NOTES
				FPM	CFM	FPM	CFM	FPM	CFM	
RTU-2										
121 Deeds	1	20" x 20"	FH	---	N/D	---	556			
121 Deeds	2	20" x 20"	FH	---	N/D	---	611			
121 Deeds	3	20" x 20"	FH	---	N/D	---	586			
121 Deeds	4	20" x 20"	FH	---	N/D	---	575			
121 Deeds	5	20" x 20"	FH	---	N/D	---	671			
121 Deeds	6	20" x 20"	FH	---	N/D	---	656			
121 Deeds	7	20" x 20"	FH	---	N/D	---	783			
121 Deeds	8	20" x 20"	FH	---	N/D	---	709			
							5147			
RTU-3										
Courtoom 2	1	34" x 18"	FH	---	N/D	---	705			
Courtroom 2	2	34" x 18"	FH	---	N/D	---	670			
Office	3	9" x 9"	FH	---	N/D	---	197			
Restroom	4	9" x 9"	FH	---	N/D	---	56			
Judge's Chambers	5	12" x 12"	FH	---	N/D	---	274			
							1902			
RTU-4										
Courtroom 1	1	2412	FH	---	N/D	---	0			
Courtroom 1	2	2412	FH	---	N/D	---	325			
Courtroom 1	3	2412	FH	---	N/D	---	0			
Courtroom 1	4	2412	FH	---	N/D	---	371			
Courtroom 1	5	2412	FH	---	N/D	---	356			
Courtroom 1	6	2412	FH	---	N/D	---	386			
Judge's Chambers	7	12" x 12"	FH	---	N/D	---	264			
Office	8	8" x 8"	FH	---	N/D	---	111			
Office	9	2408	FH	---	N/D	---	159			
							1962			

REMARKS

NA Not Available | **ND** No Design | **DD** Direct Drive | **N/R** No Requirement

AIR DEVICE REPORT

PROJECT: Barnstable Probate Court | **DATE:** May 19 and 20, 2022

SYSTEM / AREA: RTU'S 1, 5, 6 / 2nd Floor | **TECH:** BS, NC

LOCATION	NO.	SIZE	A K	DESIGN		TEST		FINAL		NOTES
				FPM	CFM	FPM	CFM	FPM	CFM	
RTU-5										
Breakroom 207	1	12" x 8"	0.48	N/D	N/D	1154	554			
Office 219	2	12" x 8"	0.48	N/D	N/D	0	0			(1)
Corridor	3	12" x 8"	0.48	N/D	N/D	87	42			
Office 220	4	12" x 6"	0.36	N/D	N/D	110	40			
Open Office 222	5	12" x 8"	0.48	N/D	N/D	524	252			
Open Office 222	6	12" x 8"	0.48	N/D	N/D	480	231			
Open Office 222	7	36" x 8"	1.44	N/D	N/D	541	779			
Open Office 222	8	12" x 8"	0.48	N/D	N/D	741	356			
Corner Office	9	12" x 6"	0.36	N/D	N/D	669	241			
							2495			
RTU-6										
Open Office 222	1	24" x 6"	0.72	N/D	N/D	328	236			
Open Office 222	2	12" x 6"	0.36	N/D	N/D	458	165			
Open Office 222	3	24" x 6"	0.72	N/D	N/D	591	426			
Open Office 222	4	6" x 1"	0.04	N/D	N/D	375	15			(2)
Open Office 222	5	24" x 6"	0.72	N/D	N/D	576	415			
Open Office 222	6	14" x 6"	0.42	N/D	N/D	566	238			
Open Office 222	7	24" x 6"	0.72	N/D	N/D	766	552			
							2047			
RTU-1										
2nd Floor Lobby	1	20" x 20"	FH	---	N/D	---	784			
2nd Floor Lobby	2	20" x 20"	FH	---	N/D	---	584			
2nd Floor Lobby	3	20" x 20"	FH	---	N/D	---	334			
Corridor	4	20" x 20"	FH	---	N/D	---	395			
Office 225	5	9" x 9"	FH	---	N/D	---	180			
Office 229	6	9" x 9"	FH	---	N/D	---	0			
Office 230	7	9" x 9"	FH	---	N/D	---	143			
Office 231	8	9" x 9"	FH	---	N/D	---	225			
Office 232	9	9" x 9"	FH	---	N/D	---	364			
Office 233	10	9" x 9"	FH	---	N/D	---	106			
Office 234	11	9" x 9"	FH	---	N/D	---	222			
							3337			

REMARKS

(1) Face of grill covered.

(2) Face of grill covered except for 6" x 1" gap.

NA Not Available | **ND** No Design | **DD** Direct Drive | **N/R** No Requirement

VELOCITY PRESSURE READINGS

PROJECT: Barnstable Probate Court **DATE:** May 20, 2022

AREA SERVED: **TECH:** BS, NC

TRAVERSE LOCATIONS	DUCT SIZE "	AREA SQ.FT.	DESIGN		CENT. STAT. PRESS."	TEST		NOTES
			FPM	CFM		FPM	CFM	
Basement Unoccupied Unit	40" x 13"	3.61	---	N/D	Velgrid	333	1202	
Basement OA Unit	8" Ø	0.35	N/D	N/D	+0.02"	690	242	
Basement Lobby FCU	30" x 10"	1.5	N/D	N/D	Velgrid	179	255	
AHU-1 Total	40" X 12"	3.33	1111	3700	+0.07"	357	1190	
AHU-1 OA	18" X 14"	1.75	514	900	-0.11"	452	791	(1)
AHU-1 Return				2800			399	(3)
RTU-5 OA	32" x 23"	5.11	78	400	Velgrid	153	782	(2)
RTU-4 OA	32" x 16"	3.55	220	780	Velgrid	0	0	(2)
RTU-3 OA	35" x 19 1/2"	4.74	53	250	Velgrid	77	366	
RTU-2 Total	45" x 25 1/2"	7.97	723	5760	Velgrid	646	5149	
RTU-2 OA	45" x 25 1/2"	7.97	144	1150	Velgrid	138	1096	
RTU-1 OA	60" x 16"	6.67	150	1000	Velgrid	60	400	

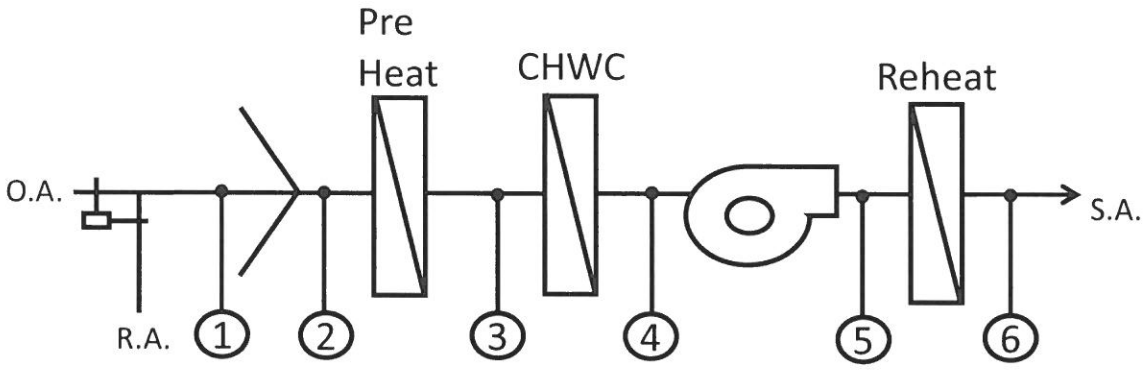
REMARKS

(1)- Directed to leave unit as is as far as O.A. is concerned
(2)- OA actuator not functional and needs replacing
(3)- Calculated

NA Not Available | **ND** No Design | **DD** Direct Drive | **N/R** No Requirement

SYSTEM STATIC PRESSURE PROFILE

PROJECT: Barnstable Probate	**DATE:** May 16, 2022
SYSTEM/AREA: AHU-1 / Land Court	**TECH:** BS, NC



UNIT	1	2	3	4	5	6	7	8	NOTES
AHU-1	-0.28"	-0.38"	-0.46"	-0.53"	+0.73"	+0.07"			

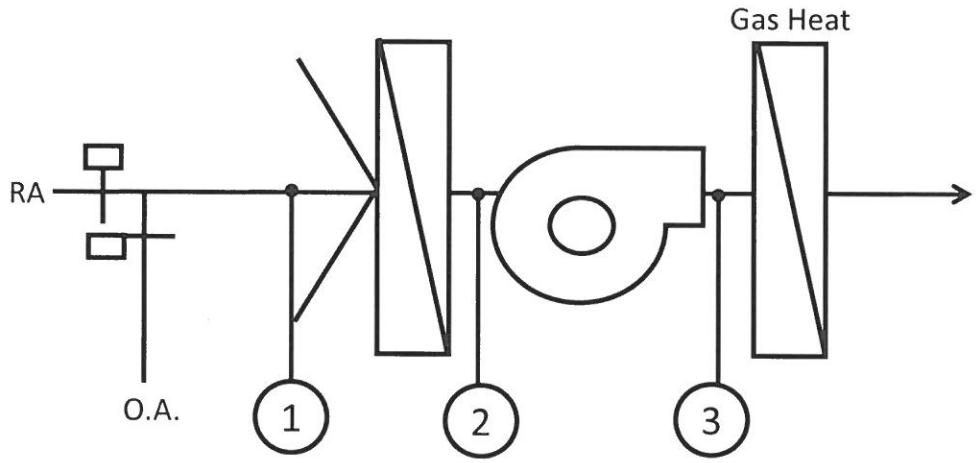
REMARKS

NA Not Available | **ND** No Design | **DD** Direct Drive | **N/R** No Requirement

SYSTEM STATIC PRESSURE PROFILE

PROJECT: Barnstable Probate | **DATE:** May 16-20, 2022

SYSTEM/AREA: RTU's 1-6 | **TECH:** BS, NC



UNIT	1	2	3	4	5	6	7	8	NOTES
RTU-1	-0.35"	-0.65"	+0.65"						
RTU-2	-0.55"	-0.89"	+1.18"						
RTU-3	-0.39"	-0.65"	+0.6"						
RTU-4	-0.37"	-0.57"	+0.24"						
RTU-5	-0.54"	-0.91"	+0.54"						
RTU-6	-0.52"	-1.04"	+0.27"						

REMARKS

NA Not Available | **ND** No Design | **DD** Direct Drive | **N/R** No Requirement

SUPPLY FAN REPORT

PROJECT: Barnstable Probate	**DATE:** May 16, 2022
AREA SERVED: Basement	**TECH:** BS, NC

FAN DATA

FAN NUMBER	Basement Unocc Unit		Basement Lobby FCU			
LOCATION	Unoccupied Space		Jan. Closet			
AREA SERVED	Unoccupied Space		Basement Lobby			
MANUFACTURER	Carrier		First CO			
MODEL OR SIZE	42PO5		6VFAO-126-31L			
	DESIGN	**ACTUAL**	**DESIGN**	**ACTUAL**	**DESIGN**	**ACTUAL**
TOTAL CFM	N/D	1213	N/D	275 (1)		
RETURN AIR	N/D	1202	N/D	255		
OUTSIDE AIR	N/A	N/A (2)	N/A	N/A (2)		
DISCH. STATIC	---	+0.24"	---	+0.1"		
SUCTION STATIC	---	-0.14"	---	-0.29"		
TOTAL STATIC	N/D	0.38"	N/D	0.39"		
FAN RPM	D/D	D/D	D/D	D/D		
PULLEY O.D.	D/D		D/D			
ESP	---		---			
VFD SPEED	NO VFD		NO VFD			
O.A.D.MIN POS	NO OA		NO OA			

MOTOR DATA

MANUFACTURER	AO Smith		Century			
MODEL OR FR.	45Y		N/A			
HORSEPOWER	1/4	1/4	1/8	1/8		
MOTOR RPM	1075	1075	1500	1500		
VOLTAGE / PH.	115/1	115/1	115/1	115/1		
AMPS LEG 1	11.0	10.0	1.2	1.1		
AMPS LEG 2	---	---	---	---		
AMPS LEG 3	---	---	---	---		
SHEAVE O.D.	D/D		D/D			
BELTS - QUANTITY / SIZE	D/D		D/D			
SHEAVE POSITION	D/D		D/D			
Filters	Good		Bad			

REMARKS

(1)- Filters need replacing
(2)- Recirc only, no OA

NA Not Available | **ND** No Design | **DD** Direct Drive | **N/R** No Requirement

AIR DEVICE REPORT

PROJECT: Barnstable Probate Court | **DATE:** May 16 + 19, 2022

SYSTEM / AREA: AHU-1 + Basement FCU's / Land Court & Unoccupied Basement | **TECH:** NC, BS

LOCATION	NO.	SIZE	A K	DESIGN		TEST		FINAL		NOTES
				FPM	CFM	FPM	CFM	FPM	CFM	
Basement Unoc FCU										
See Drawing	1	8" x 8"	FH	---	N/D	---	157			
See Drawing	2	8" x 8"	FH	---	N/D	---	157			
See Drawing	3	8" x 8"	FH	---	N/D	---	177			
See Drawing	4	16" x 6"	FH	---	N/D	---	379			
See Drawing	5	16" x 6"	0.48	---	N/D	715	242			
							1213			
Basement Lobby FCU										
Basement Lobby	1	8" R	FH	---	N/D	---	154			
Basement Lobby	2	8" R	FH	---	N/D	---	121			
							275			
AHU-1 Land Court										
See Drawing	1	2412	FH	---	N/D	---	31			
See Drawing	2	2412	FH	---	N/D	---	32			
See Drawing	3	2412	0.67	---	N/D	369	247			
See Drawing	4	2412	0.67	---	N/D	452	303			
See Drawing	5	2412	0.67	---	N/D	315	211			
See Drawing	6	2412	0.67	---	N/D	265	178			
See Drawing	7	2412	FH	---	N/D	---	94			
							1096			
Local AHU										
Lunchroom	1	2412	FH	---	N/D	---	304			

REMARKS

NA Not Available | **ND** No Design | **DD** Direct Drive | **N/R** No Requirement

EXHAUST FAN REPORT

PROJECT: Barnstable Probate Court | **DATE:** May 16, 2022

AREA SERVED: Roof/ Unoccupied Area | **TECH:** BS, NC

FAN DATA

FAN NUMBER		Fresh Air Fan	EF-1(4)(2)	EF-2	EF-3	
LOCATION		Unoccupied Area	Roof	Roof	Roof	
AREA SERVED		Unoccupied Area	Restrooms	Restrooms/ JC	Restrooms	
MANUFACTURER		Fantech	Berry Blower	AirXpeler	N/A	
MODEL OR SIZE		FR200	No Tag	PB12A	N/A	
TOTAL CFM	DESIGN	N/D	N/D	N/D	N/D	
	ACTUAL	242	(1)	310	391	
FAN RPM	DESIGN	---	N/D	D/D	---	
	ACTUAL	---	---	D/D	1210	
PULLEY	O.D.	D/D	4.5 x 3/4	D/D	3 1/2 x 3/4	
SERVICE		D/D	N/A	D/D	1.35	
C to C		D/D	7.5	D/D	4.75	

MOTOR DATA

MANUFACTURER		Fantech	N/A (3)	Marathon	Dayton	
MODEL NUMBER		FR200	N/A	48Z	48Y	
MOTOR HP	DESIGN	100 Watts	N/D	1/3	1/6	
	ACTUAL	100 Watts	N/A	1/3	1/6	
MOTOR RPM		N/A	N/A	1725	1725	
VOLTAGE/PHASE		115/1	115/1	115/1	115/1	
MOTOR AMPS	DESIGN	0.87	N/A	6.1	3.6	
	ACT. LEG 1	0.6	---	5.5	2.8	
	ACT. LEG 2	---	---	---	---	
	ACT. LEG 3	---	---	---	---	
SHEAVE		D/D	2.0 x 1/2	D/D	3 3/4 x 1/2	
BELTS-QTY/SIZE		D/D	1/3L250	D/D	1/36200	
SHEAVE POSITION		D/D	Fully Closed	D/D	Fully Open	

REMARKS

(1) Fan is not operational and hasn't run in many years
(2) Fan has exposed electrical wires on the roof leading into the fan
(3) Motor is missing nameplate tag
(4) Fan has lock-out/ tag out on disconnect

AIR DEVICE REPORT

PROJECT: Barnstable Probate Court | **DATE:** May 20,2022

SYSTEM / AREA: | **TECH:** BS, NC

LOCATION	NO.	SIZE	A K	DESIGN		TEST		FINAL		NOTES
				FPM	CFM	FPM	CFM	FPM	CFM	
EF-2										
Men's 209	1	8 x 8	FH	---	N/D	---	43			
Women's 210	2	8 x 8	FH	---	N/D	---	26			
Kitchen 211	3	2 x 8	.09	---	N/D	55	5			(1)
JC 2nd Floor	4	6 x 4	.12	---	N/D	458	35			
Toilet 122	5	8 x 8	FH	---	N/D	---	83			
Men's 14	6	14 x 6	FH	---	N/D	---	20			
Men's 14	7	14 x 6	FH	---	N/D	---	31			
Women's 10	8	14 x 6	FH	---	N/D	---	22			
Women's 10	9	14 x 6	FH	---	N/D	---	2			
JC 15	10	6 x 6	FH	---	N/D	---	25			
							310			
EF-3										
Men's 227	1	8 x 8	FH	---	N/D	---	175			
Women's 226	2	8 x 8	FH	---	N/D	---	154			
JC 239	3	6 x 6	FH	---	N/D	---	62			
							391			
Judge's Toilet EF										
237	1	8 x 8	FH	---	N/D	---	71			

REMARKS

(1)- Grille partially buried by cabinets.

NA Not Available | **ND** No Design | **DD** Direct Drive | **N/R** No Requirement

HYDRONIC FLOW ELEMENTS

PROJECT: Barnstable Probate Court | **DATE:** May 20, 2022

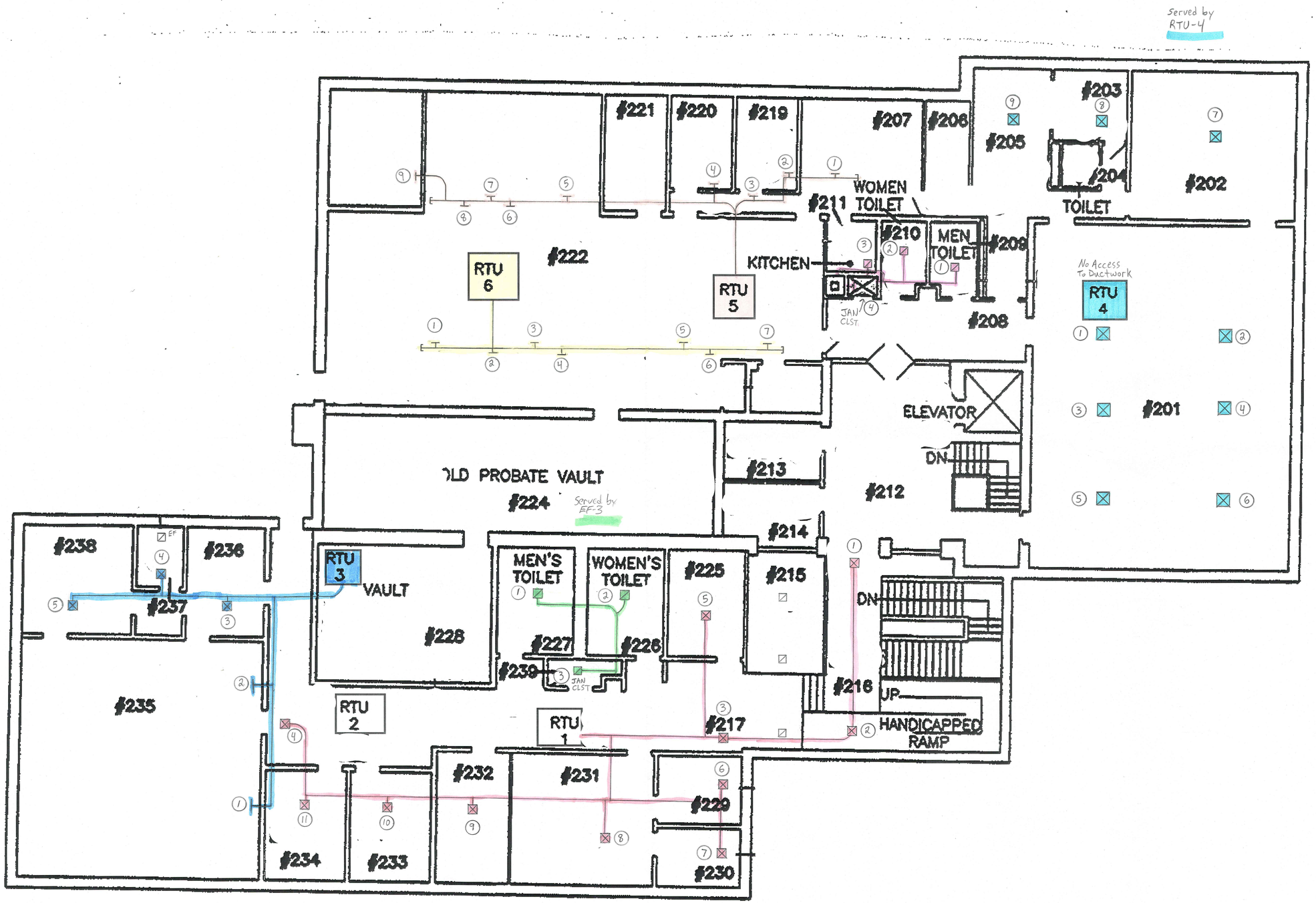
AREA SERVED: | **TECH:** BS

LOCATION	NO.	ELEMENT	MFG.	SIZE	DESIGN GPM	TEST I			FINAL			NOTES
						POS.	PR.DIF	GPM	POS.	PR.DIF	GPM	
Hot Water												
AHU-1 Preheat	1	Ultrasound	N/A	1"	N/D	Open	--	6.2				(1)
AHU-1 Reheat	1	Ultrasound	N/A	1 1/4"	N/D	Open	---	10.1				(1)

REMARKS

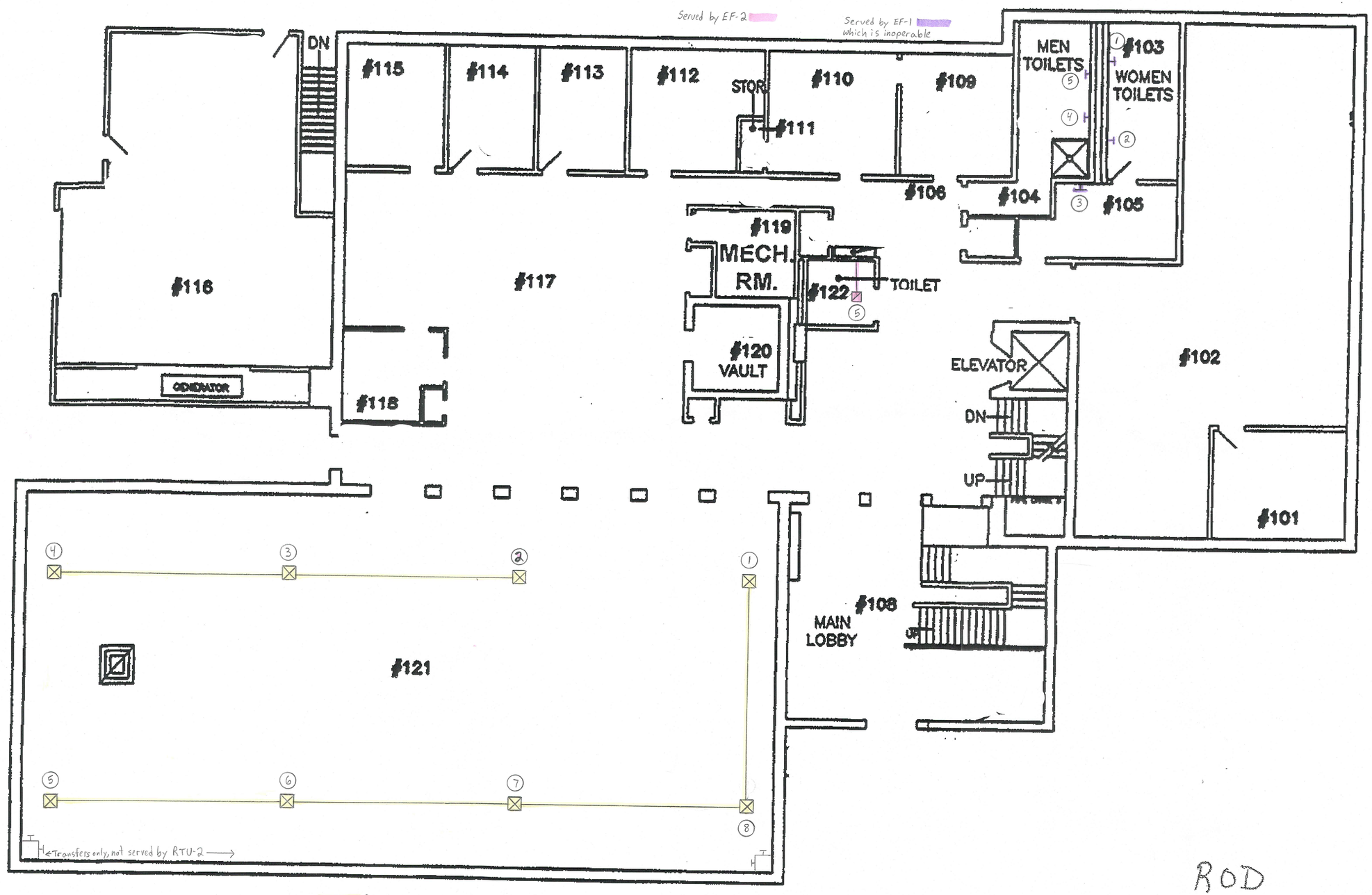
(1) Water loop is in winter mode still so no chilled water is flowing.

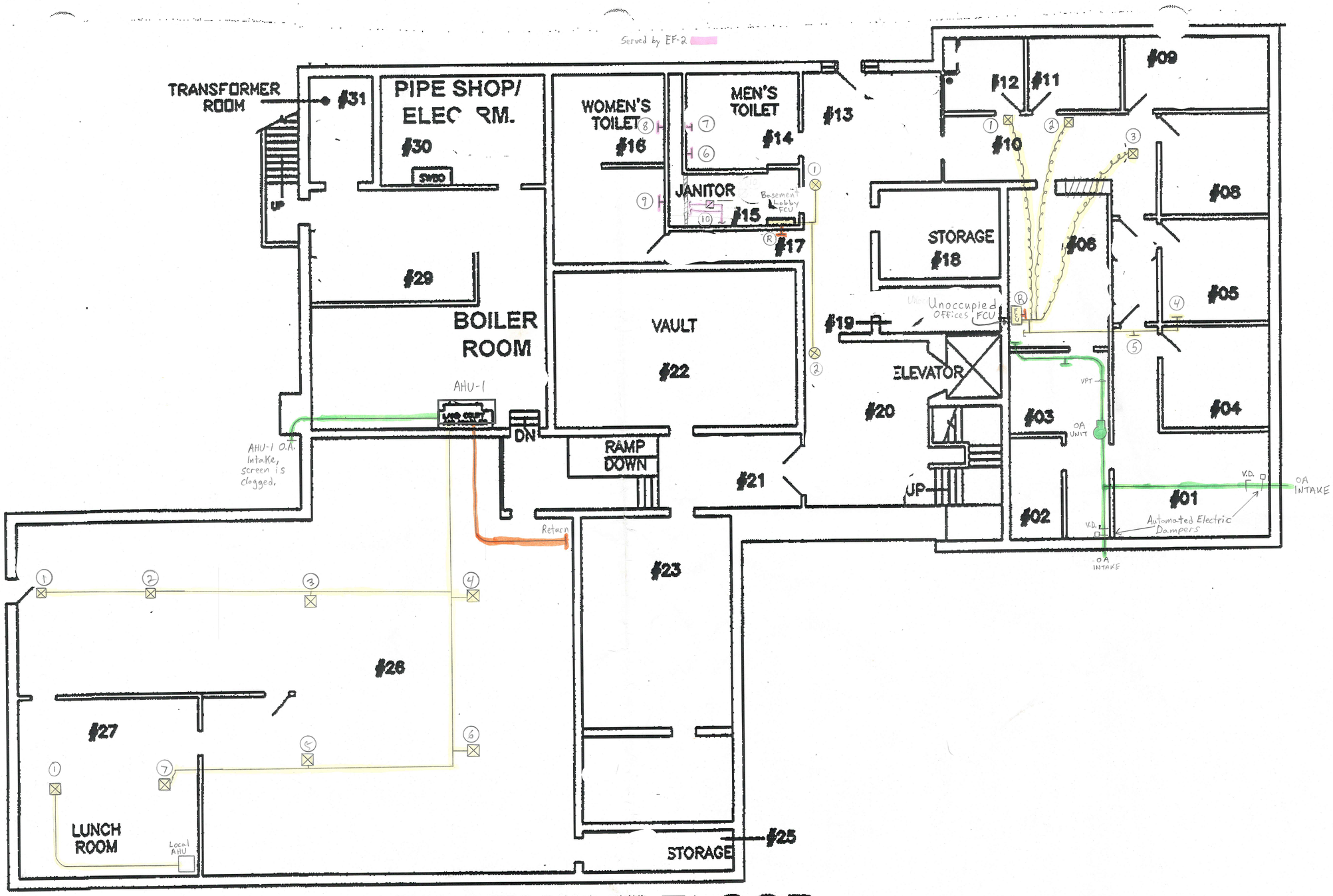
NA Not Available | **ND** No Design | **DD** Direct Drive | **N/R** No Requirement



2ND FLOOR

ROD


Served by EF-2
Served by EF-1 which is inoperable
DN
#115
#114
#113
#112
STOR
#111
#110
#109
MEN TOILETS
#103
WOMEN TOILETS
#106
#104
#105
#119
MECH. RM.
#122
TOILET
#116
#117
#120 VAULT
ELEVATOR
#102
DN
UP
#101
ODIENATOR
#118
#108
MAIN LOBBY
UP
#121
Transfers only, not served by RTU-2
RTU-2 No access to fully trace ductwork
1ST FLOOR
ROD



BASEMENT FLOOR

ROD