Stoughton District Court
Stoughton, MA

HVAC SYSTEM EVALUATIONS COVID-19

Office of Court Management

February 3, 2021

Tighe&Bond

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Section 1
Existing Conditions & Site Observations

Tighe & Bond visited the Stoughton District Courthouse on October 22, 2020. While on site we inspected the air handling equipment located in the mechanical rooms and toured the facility to determine if the spaces generally matched usages noted on the architectural plans.

Site Visit Attendees:

- *Office of Court Management:*
  - Mike Ostman, Courthouse Electrical Foreman
- *Tighe & Bond*
  - Jason R. Urso, PE, Mechanical Engineer

1.1 Existing Ventilation System

The Stoughton District Courthouse was constructed in 1962 and is approximately 16,000 square feet in size. A portion of the building's HVAC systems were renovated in 2000 and 2003. There are two Trane and two Reznor roof mounted, constant volume air handling units that serve the building. RTU-1 (Trane) serves the Courtroom and main lobby and RTU-2 (Trane) serves the detention areas and adjacent offices.

According to the 2003 design drawings, RTU-1 (Reznor) serves the office space on the ground and first floor of the west side of the building and RTU-2 (Reznor) serves the office space on the ground and first floor of the east side of the building, as well as the two east Courtrooms on the ground floor. A roof mounted exhaust fan is exhausting building air instead of returning the air back to RTU-2.

During out site visit, we did not see a supply diffuser in Courtroom #3 indicating this space is not mechanically ventilated, however there are operable windows. Courtroom 2 was not accessible during our visit. The 2003 design drawings indicate mechanical ventilation was not provided to the two ground floor offices in the southeast corner. We assume the windows are operable and meet the requirements for natural ventilation, however this should be confirmed.

Most office areas contain ductless mini split systems. The original 1961 design drawings indicate perimeter fan coil units were installed and provided ventilation air. All of the fan coil units appear to have been removed.

The two, constant volume Trane rooftop air handling units each contain a supply fan, refrigerant (DX) cooling coil, a natural gas heating coil, and 2" MERV 10 filters. RTU-1 is newer and in excellent condition. According to the name plate tag, RTU-2 was installed in 2002 and is in fair condition. The DX coil is dirty, and the gas heating coil was not accessible. The outdoor air damper section of RTU-2 was sealed shut and a gravity damper was installed in the ductwork located on the roof. It appears the function of the gravity damper is to allow outdoor air to enter the system, however we observed that the damper remained closed while RTU-2 was running. A dedicated return fan serves the two Trane air handling units. The return fan serving RTU-1 had a broken belt during out site visit.

The two Reznor units have a supply fan, DX cooling coils, gas fired heating coils, and 2" filters with an unknown MERV rating. They are both in poor condition and according to facilities staff, have not run in several years. The dampers and actuators are in fair condition and the coils are dirty. Since these units are not operational, the spaces they serve are not receiving any ventilation air to our knowledge.

Air is supplied to the detention rooms by RTU-2 and exhausted by an inline exhaust fan on the ground floor. According to the drawings, each holding area is negatively pressurized.

According to the 2003 design drawings, exhaust fans EF-2 (inline) and EF-4 (roof mounted) serve the building's toilet rooms.

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)	Pre/Final Filters	Condition
RTU-1 (Trane)	5,000	1,500	2" MERV 10	Excellent
RTU-2 (Trane)	1,245	500	2" MERV 10	Fair
RTU-1 (Reznor)	900	900	2" MERV Unknown	Poor
RTU-2 (Reznor)	3,000	3,000	2" MERV Unknown	Poor

Photo 1 – RTU-2 (Trane)

Photo 2 – RTU-2 (Reznor)

1.2 Existing Control System

We did not find evidence of either a pneumatic control system or a Building Management System (BMS) during our site investigation. We presume there are stand-alone, electric controls for each air handler. We are not aware of any demand control ventilation sequences in

Section 2
Recommendations

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

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

2.1 Filtration Efficiency Recommendations

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

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

> Replace the filters in both Trane rooftop units with MERV 13 filters. The TAB Contractor and/or Engineer shall verify that the air handlers can accommodate a MERV-13 filter per Appendix A in the overview of recommendations report.

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

RF-3a: *Connect the pressure sensor to a local alarm in the boiler room.*

2.2 Testing & Balancing Recommendations

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

We recommend the following testing and balancing measures be implemented for both all RTUs, however the Reznor units must be either repaired or replaced:

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)	Original Design Min. O.A. (CFM)	Current Code Min. O.A. Requirements (CFM)	Recommended Minimum O.A. (CFM)
RTU-1 (Trane)	5,000	1,500	755	1,500
RTU-2 (Trane)	1,245	500	195	500
RTU-1 (Reznor)	900	900	350	900
RTU-2 (Reznor)	3,000	3,000	1,350	3,000

Note: Although the ASHRAE Position Document on Infectious Aerosols recommends using the latest published standards and guidelines as a baseline for minimum ventilation, the mechanical code in effect at the time the HVAC systems were designed and constructed is what governs the required outdoor air flowrate for the HVAC equipment, if there have been no additions, renovations, alterations or changes in occupancy to the building. The 2015 International Mechanical Code does not prevent the continued use of existing systems.

The recommended outdoor air flow rate for both Reznor units is based on the fact that these are 100% outdoor air, constant volume units, assumes they will be repaired, and the units serve the spaces as shown in the 2003 design drawings. However, if these units are replaced, we recommend a building load analysis be performed and supply air be provided to spaces that are not currently mechanically ventilated. Refer to the "Other Recommendations" section for a more detailed explanation.

For both Trane RTUs, we recommend maintaining the outdoor airflows at the original designed values since they exceed the code minimums calculated by Tighe & Bond. Supplying more outdoor than required by code will provide better indoor air quality.

The average airflow rate per person is shown below in Table 3. These values are based on the original design supply airflow rate and the recommended outdoor air flow rates shown in Table 2. The airflow rate per person assumes a diversity factor of 70%, meaning the maximum number of occupants assumed to be in all zones at all times equates to 70% of the code required occupancy.

TABLE 3
Average Airflow Rate per Person

	All spaces	***Courtrooms***	***Non-Courtroom Spaces***
Total Occupancy (People)	201	134	67
Total Supply Air (CFM/Person)	52	45	62
Outdoor Air (CFM/Person)	29	19	51

The airflow rate per person for each Courtroom is shown below in Table 4. These values are based on full occupancy without taking diversity into account, the original design supply airflow rate, and the recommended outdoor airflow rate. The airflow rate per person assumes the full supply airflow is being delivered to the room. At times when the supply airflow is reduced due to the space temperature being satisfied, the airflow rate per person will also be reduced.

TABLE 4
Airflow Rate per Person (Full Occupancy)

		Total Air		*Outdoor Air*	
Courtroom	***Total People***	***Supply Airflow (CFM)***	***Airflow Rate (CFM/Person)***	***Outside Airflow (CFM)***	***Airflow Rate (CFM/Person)***
Courtroom 1	103	5,000	49	1,500	15
Courtroom 2[1]	51	500	10	500	10
Courtroom 3[1]	37	500	14	500	14

Note: Courtroom occupant density is based on 70 people/1,000 square feet, per the 2015 International Mechanical Code
Note 1: These airflow rates assume air is supplied per the 2003 design drawings. Further investigation is required to determine if air is actually supplied to these spaces. We did not see evidence of supply air in Courtroom 3 and Courtroom 2 was not accessible during out site visit.

The airflow rate per person for each Courtroom, based on a reduced occupancy schedule determined by the Office of Court Management, is shown below in Table 4a. The airflow rate per person assumes the full supply airflow is being delivered to the room. At times when the supply airflow is reduced due to the space temperature being satisfied, the airflow rate per person will also be reduced.

TABLE 4a
Airflow Rate per Person (Reduced Occupancy)

		Total Air		*Outdoor Air*	
Courtroom	***Total People***	***Supply Airflow (CFM)***	***Airflow Rate (CFM/Person)***	***Outside Airflow (CFM)***	***Airflow Rate (CFM/Person)***
Courtroom 1	13	5,000	385	1,500	115
Courtroom 2[1]	8	500	63	500	63
Courtroom 3[1]	8	500	63	500	63

Note: If occupancy is further reduced, the airflow rate per person will increase, assuming full airflow is being delivered to the space.
Note 1: These airflow rates assume air is supplied per the 2003 design drawings. Further investigation is required to determine if air is actually supplied to these spaces. We did not see evidence of supply air in Courtroom 3 and Courtroom 2 was not accessible during out site visit.

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

We recommend increasing the outdoor air flow rate for both Trane RTUs by 10% beyond the recommended outdoor air flow rates during non-peak outdoor air conditions. This may require additional controls to implement. We do not believe this would cause a threat of a potential coil to freeze given the amount of outside air as a percentage of total supply air, however cold spots on the coil may develop due to poor mixing. This may cause nuisance freeze stat trips via the existing freeze stat. If there is no existing freeze stat, we recommend installing one. The return air to each air handler will also have to be adjusted to accommodate the additional outdoor air during the operation of this sequence.

Assuming the Reznor RTUs are repaired, we do not recommend increasing the outdoor air flowrate since they are already supplying more outdoor air than is required by code.

2.3 Equipment Maintenance & Upgrades

We recommend the following equipment maintenance and upgrades:

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

Replace dampers and actuators that are not functioning properly.

RE-2: *Clean air handler coils and drain pans.*

2.4 Control System Recommendations

We recommend the following for the control system:

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

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

The existing control system does not appear to be sophisticated enough to implement this type of sequence. Additional controls and sensors will be required.

Prior to implementing this control strategy, the TAB Contractor should verify the quantity of outside air the outdoor air intake sections of the air handling units can accommodate without exceeding an intake air velocity of 450 feet/minute (FPM). Exceeding this air velocity through an intake air louver may result in rain or snow entering the louver.

RC-5: *Disable demand control ventilation sequences if they exist.*

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 accommodate 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 Repair or Replace the Reznor Units

We recommend either repairing or replacing the two non-functional Renzor air handling units. According to the 2003 design drawings, these units were designed to provide 100% outdoor air. 100% outdoor air is typically not required for the office space or the two Courtrooms that these units serve, and these units may be expending more energy than required to deliver supply air. However, if each space supplied by these RTUs are cooled by a mini split system, all that may be required for supply air is code required ventilation air. We recommend evaluating the heating, cooling, and ventilation air requirements for the spaces these units serve to determine how much supply air is required for each space, taking into consideration the ductless mini split systems serving the spaces. It may be viable to replace RTU-2 (Reznor) with a unit that can return air, instead of exhausting it to the outdoors. The existing roof mounted exhaust fan can be removed and the exhaust ductwork in the ceiling can be routed to the return section of the new air handler. A new roof opening may be required to run the return ductwork up through the roof.

We recommend the same analysis for RTU-1 (Reznor), however this unit may be able to remain as a 100% outdoor air unit. This unit only provides 900 CFM of air of which can be used as make-up air for adjacent toilet exhausts and serve as air to help pressurize the building.

The calculation to determine the required outdoor air depends on the configuration of the air system. If either of these two units are converted to recirculating type systems, the code required outdoor air noted in Table 2 may change.

2.7.2 Replace RTU-1 (Trane) OA Damper

It appears RTU-1 (Trane) may not be providing any outdoor air to the building, considering the gravity damper was closed during out site visit. We recommend removing the existing gravity air damper installed on the return duct serving RTU-1 (Trane).

There are two options to supply outdoor air to RTU-1 (Trane). One is to repair the outdoor air damper section on the RTU and balance the damper to the recommended outdoor air flow rate. We presume this damper was abandoned and the duct mounted gravity damper was installed because there may have been difficulty balancing this damper to the correct

outdoor air flow rate and controlling the supply air temperature. Another option is to extend the branch duct serving the gravity air damper out approximately 18", installing a volume damper, motorizing damper, a wire mesh screen on the outlet, and balancing the outdoor air to the recommended flow rate. The sequence and operation of the motorized damper should also be defined for the HVAC controls contractor.

2.7.3 Add Supply Air to Rooms Not Mechanically Ventilated

We recommend adding supply air to spaces that are not mechanically ventilated. A more detailed field investigation is required to determine which spaces are not supplied with air, as well as a heating and cooling load analysis of these spaces.

2.7.4 Install a Building Management System

We recommend installing a Building Management System to control and monitor HVAC equipment. This recommendation is an energy saving and maintenance measure and does not affect the indoor air quality of the building.

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.

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