# ORLEANS DISTRICT COURT
# HVAC SYSTEM EVALUATION SUMMARY

Visited February 11, 2021. While on site, inspected the ventilation equipment located around the building and toured the facility to determine if the spaces generally matched usages noted on the architectural plans. The Orleans District Court is a single-story building constructed in 1971 and is approximately 21,000 square feet in size.

## 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 Deliberation Room | 3 | 400 | 133 | 68 | 23 |
| Courtroom 1 | 26 | 6,000 | 231 | 919 | 335 |
| Courtroom 2 | 9 | 2,000 | 222 | 275 | 31 |
| Juvenile Courtroom | 8 | 800 | 100 | 275 | 34 |

## 2.0 Recommendations

| Section | Recommendation/Finding | Action |
|---|---|---|
| 2.1 | **Filtration Efficiency** | |
| | Since the unit ventilators are currently supplying inadequate ventilation, and have MERV-7 filters that cannot be upgraded to MERV-13, we recommend using air cleaning devices that are discussed in Section 2.5. | N/A |
| 2.2 | **Testing and Balancing** | |
| RTB-1 | Test and rebalance air handling unit supply air and minimum outside air flow rates | Complete |
| RTB-5 | Test and balance all air inlets and outlets | Complete |
| RTB-6 | Test and balance all unit ventilator chilled and hot water coils | Complete |
| 2.3 | **Equipment Maintenance and Upgrades** | |
| RE-1 | Test existing air handling system dampers and actuators for proper operation | Complete |
| RE-2 | Clean air handler coils and drain pans | Complete |
| RE-5 | Install freeze stats on each unit ventilator | Deferred |
| RE-7 | Test the existing unit ventilator dual-temperature coil control valves and actuators for proper operation | Complete |
| 2.4 | **Control System** | |
| RC-1 | Implement a pre and post-occupancy flush sequence | Deferred |
| 2.5 | **Additional Filtration and Air Cleaning** | |
| RFC-1 | Install portable HEPA filters to continue to operate at any capacity in all occupied areas | Complete |
| RFC-2 | Install Bipolar Ionization if the unit ventilators are not replaced and cannot be made to provide adequate outside air capacity | Deferred |

| | | |
|---|---|---|
| 2.6 | Humidity Control | |
| | No actionable items listed – continuous monitoring for seasonal changes | On-going |
| | | |
| 2.7 | Other Recommendations | |
| 2.7.1 | Repair or replace exhaust fans | Complete |
| 2.7.2 | Replace unit ventilators | Deferred |
| 2.7.3 | Remove or replace covers on outdoor air intakes | Complete |
| 2.7.4 | Provide ventilation air for holding area | Deferred |
| 2.7.5 | Install a building management system | Deferred |
| 2.7.6 | Caulk and seal air leakage in building envelope | Deferred |

**Orleans District Court**
**Orleans, MA**

# HVAC SYSTEM EVALUATIONS COVID-19

Office of Court Management

April 28, 2021

Tighe&Bond

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# Section 1
# Existing Conditions & Site Observations

Tighe & Bond visited the Orleans District Court on February 11, 2021. While on site we inspected the ventilation equipment located around the building, and toured the facility to determine if the spaces generally matched usages noted on the architectural plans.

Site Visit Attendees:

- *Office of Court Management:*
  - District Court Facilities Staff
- *Tighe & Bond*
  - Todd Holland, PE, Senior Mechanical Engineer
  - Matt Mancini, Staff Mechanical Engineer

## 1.1 Existing Ventilation System

The Orleans District Court is a single-story building constructed in 1971 and is approximately 21,000 square feet in size. McQuay unit ventilators provide heating, cooling, and were designed to provide ventilation air to the building. There are 21 units on the first floor, and 12 units in the basement. Each unit contains a supply fan, single-row water coil, and a 1" thick MERV-7 filter. Perimeter units have an outdoor air (OA) damper that connects to an exterior louver. Nine units are on interior walls and have no OA intake. The original design intent seemed to provided ventilation air only in perimeter rooms and was drawn through interior spaces by the exhaust systems. Ventilating interior spaces via this method is not acceptable per current code requirements.

Photo 1 – Representative Unit Ventilator

All units appear to be from the original construction in 1971 and are in poor condition. The OA dampers and actuators do not appear to be functional.

Photo 2 – Non-Functional Outdoor Air Damper

A conditions assessment report, dated March 1980, noted that the systems were in "good condition with local temperature control" and noted "no operational problems". However, it also mentioned that it "may be possible to reduce minimum outside air quantities". This was a common, but often ill-advised energy conservation measure during that period, and appears to have been implemented. Many of the OA intake louvers are boarded up with plywood, leaving only a small gap at the bottom. We do not know if these intakes were boarded up to address other issues, such as coil freezing, wind-driven rain, or excessive indoor humidity in summer.

Photos 3 and 4 – Outdoor Air Intakes Boarded Over

The 1980 report also noted that expansion joints in the concrete were not sealed and subject to air infiltration.

The lockup area is served by roof-mounted exhaust fans connected to grilles over the toilets in each of the holding cells. While the exhaust airflow rates noted in the design drawings appear to meet code, there does not appear to be a dedicated source of makeup air for the area.

The unit ventilators are on a two-pipe loop, switched between heating in winter and cooling in summer. A modular gas-fired hydronic boiler with six sections and atmospheric combustion, rated for 1.76 million Btu/hr output, provides hot water to the unit ventilators and unit heaters.

A 70-ton air cooled chiller, located on grade in the parking lot, provides chilled water in summer. This unit was installed in 1996 and is reported to have marginal capacity to cool the building in peak conditions. The chiller is beyond its expected service life of 20 years and uses R-22 refrigerant, which has been phased out of production.

One small (3/4 ton) mini-split heat pump serves a break room on the basement level.

Facilities personnel noted that the building has problems with high humidity in summer, and mold growth on the basement level. Most areas have a portable scrubber unit and an industrial dehumidifier in the space. Because of the noise they make, these units are switched on by cleaning personnel in the evening and turned off by facilities personnel when they arrive in the morning.

Two central exhaust fans that were not operational at the time of our visit. One is dedicated to Courtroom 1, and the other serves Courtroom 2, the Juvenile Courtroom, and 12 other spaces on the basement level.

Table 1 summarizes the unit ventilators' 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 |
|---|---|---|---|---|
| UV-A | 300 | 75 | MERV-7 | Poor |
| UV-B | 400 | 100 | MERV-7 | Poor |
| UV-C | 600 | 300 | MERV-7 | Poor |
| UV-D | 800 | 400 | MERV-7 | Poor |
| UV-E | 1,000 | 250-300 | MERV-7 | Poor |
| UV-F | 1,200 | 600 | MERV-7 | Poor |

## 1.2 Existing Control System

A Powers pneumatic system controls the existing HVAC equipment. The compressor, air dryer, and distribution system appear to be in good condition, and we observed no major air leaks. However, this is an old, obsolete system and appears to be original. We did not see any evidence or components of a Building Management System (BMS) during our site visit. We are not aware of any demand control ventilation sequences in use at the Orleans District Court.

Many of the exhaust fans, including the two largest systems that serve courtrooms and staff areas, are not operational. It is not known to Tighe & Bond whether this is due to control or equipment maintenance issues.

# Section 2
# Recommendations

Below is a list of recommendations that we propose for the Orleans District Court. 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.

The Orleans District Court appears to have little or no mechanical ventilation. The only operational exhaust fans serve the holding cells and large toilet rooms. Other areas, including the courtrooms, conference rooms, offices, and small toilet rooms, have inadequate or nonexistent mechanical ventilation.

## 2.1 Filtration Efficiency Recommendations

Since the unit ventilators are currently supplying inadequate ventilation and have MERV-7 filters that cannot be upgraded to MERV-13, we recommend using air cleaning devices that are discussed in Section 2.5.

## 2.2 Testing & Balancing Recommendations

The unit ventilators are approximately 50 years old and it is unknown to Tighe & Bond if they were ever tested and balanced. Also, the code requirements to determine the outdoor air flow rates that were used to design the original system are likely very different than the 2015 International Mechanical Code (IMC) and current ASHRAE Standard 62.1 requirements.

We recommend the following testing and balancing measures be implemented:

**RTB-1:** *Test and balance unit ventilator supply air and minimum outdoor air flow rates.*

> We recommend testing and balancing the outdoor air flow rates for all unit ventilators units to the recommended minimum O.A. rates listed in Table 2, or to the O.A. rates on the original design drawings. We also recommend investigating why the outdoor air intakes were covered over to begin with. If it was to address coil freeze or wind-driven rain problems, the solution may be different than if it was simply an energy conservation measure.

**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) |
|---|---|---|---|---|
| UV-A | 300 | 75 | 40 | **75** |
| UV-B | 400 | 100 | 70 | **100** |
| UV-C | 600 | 300 | 75 | **150** |
| UV-D | 800 | 400 | 275 | **275** |
| UV-E | 1,000 | 250-300 | 140 | **250** |
| UV-F | 1,200 | 600 | 184 | **300** |

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.

The six sizes of unit ventilators in Table 2 show the O.A. flow rates shown on the original design drawings. Typically, the O.A. flow rates are 25% of the total supply, and 50% for units serving courtrooms. We are recommending 25% O.A. across the board, except for the 800-cfm unit that serves the Juvenile Courtroom, which must be slightly higher to meet code, but not as high as the original 50%.

During the pandemic, we recommend maintaining the outdoor airflows at the original designed values where they exceed the code minimums calculated by Tighe & Bond. Supplying more outdoor than required by code will provide better indoor air quality.

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

**TABLE 3**
Average Airflow Rate per Person

| | ***All spaces*** | ***Courtrooms*** | ***Non-Courtroom Spaces*** |
|---|---|---|---|
| Total Occupancy (People) | 253 | 176 | 77 |
| Total Supply Air (CFM/Person) | 99 | 50 | 214 |
| Outdoor Air (CFM/Person) | 12 | 8 | 20 |

The airflow rate per person for each Courtroom and the Jury Pool Room is shown below in Table 4. These values are based on full occupancy without taking diversity into account, the original full design supply airflow rate, and the recommended outdoor airflow rate. The airflow rate per person assumes the full supply airflow is being delivered to the room.

**TABLE 4**
Airflow Rate per Person (Full Occupancy)

| | | *Total Air* | | *Outdoor Air* | |
|---|---|---|---|---|---|
| ***Courtroom*** | ***Total People*** | ***Supply Airflow (CFM)*** | ***Airflow Rate (CFM/Person)*** | ***Outdoor Airflow (CFM)*** | ***Airflow Rate (CFM/Person)*** |
| Jury Deliberation Rm. | 11 | 400 | 36 | 68 | 6 |
| Courtroom 1 | 157 | 6,000 | 38 | 919 | 6 |
| Courtroom 2 | 47 | 2,000 | 43 | 275 | 6 |
| Juvenile Courtroom | 47 | 800 | 17 | 275 | 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 and the Jury Pool Room, based on a reduced occupancy schedule determined by the Office of Court Management, is shown below in Table 4a. The airflow rate per person assumes the full supply airflow is being delivered to the room. 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)*** | ***Outdoor Airflow (CFM)*** | ***Airflow Rate (CFM/Person)*** |
| Jury Deliberation Rm. | 3 | 400 | 133 | 68 | 23 |
| Courtroom 1 | 26 | 6,000 | 231 | 919 | 35 |
| Courtroom 2 | 9 | 2,000 | 222 | 275 | 31 |
| Juvenile Courtroom | 8 | 800 | 100 | 275 | 34 |

Note: If occupancy is further reduced, the airflow rate per person will increase, assuming full airflow is being delivered to the space.

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

We recommend testing all exhaust systems and grilles serving holding cells, toilet rooms, courtrooms, and other areas.

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

Testing and balancing the dual-temperature 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 condition 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 unit ventilator dampers and actuators for proper operation*.

Repair or replace dampers and actuators that are not functioning properly.

**RE-2:** *Clean unit ventilator coils and drain pans.*

**RE-5:** *Install freeze stats on each unit ventilator.*

**RE-7:** *Test the existing unit ventilator dual-temperature coil 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-occupancy flush sequence.*

This sequence should start all unit ventilators and exhaust fans before the building is occupied, with the start time calculated to provide three air changes per hour (ACH) of ventilation air, or for two hours before people arrive.

## 2.5 Additional Filtration

Because the unit ventilators cannot have their filters upgraded to MERV-13, we recommend the following:

**RFC-1:** *Install portable HEPA filters.*

If the Orleans District Court is to continue to operate at any capacity, we recommend installing portable HEPA filters in all occupied areas. They should also be deployed in courtrooms, depending on the occupancy and how much noise is generated. The noise levels will vary depending on the manufacturer, and how many are required for each space. According to EPA guidelines, units should be sized to provide 5 air changes per hour (ACH) airflow.

This would have the added benefit of taking the place of the large portable air scrubbers, which are too noisy to be run during occupied hours. Below is a list of specific areas where we recommend placing portable HEPA filtration units, including offices if those spaces are regularly occupied by more than one person. If any of these spaces have only a single occupant, a HEPA filter is not needed.

- Courtroom 1
- Courtroom 2
- Jury Deliberation Rm
- Juvenile Courtroom
- Juvenile Probation
- Probation Office
- Clerk Magistrate
- Magistrate's Offices
- Judge's Lobbies (3)
- Court Clinic
- Main Lobby
- Staff Lounge
- Court Officers
- DA Witness Office
- Maintenance

**RFC-2:** *Install Bipolar Ionization.*

If the unit ventilators are not replaced and cannot be made to provide adequate OA capacity, we recommend installing bipolar ionization (BI) units. Bipolar ionization units charge airborne particles causing them to agglomerate and increase in size, and then fall to the floor. One benefit is that ions work to purify the supply air and continue to work in the space. It is not necessary to bring all the air back to the unit, as with an air filter.

The CDC's position on bipolar ionization is "Relative to other air cleaning and disinfecting technologies, bipolar ionization has a less documented track record in regard to cleaning/disinfecting large and rapidly moving volumes of moving air within heating, ventilation, and air conditioning systems. This is not to imply that the technology doesn't work as advertised, only that in the absence of an established body of evidence reflecting proven efficacy under as-used conditions, the technology is still considered by many to be an 'emerging technology'."

## 2.6 Humidity Control

We recommend that the Orleans District Court continue to deploy portable dehumidifiers and attempt to keep relative humidity in the space below 60% RH in summer. This is consistent with recommendations to limit the transmissibility of airborne pathogens such as coronavirus.

## 2.7 Other Recommendations

### 2.7.1 Repair or Replace Exhaust Fans

The exhaust fans that serve the courtrooms and ancillary offices were not operating at the time of our visit. We were unable to determine if this was due to control, electrical, or mechanical issues. These fans are an important part of the ventilation scheme, should be brought back online, and scheduled according to the recommendation in Section 2.4.

### 2.7.2 Replace Unit Ventilators

The unit ventilators are well beyond their expected service life of 20 years and are in poor condition. New unit ventilators have more efficient electronically-commutated motors, have much quieter fans, and can use MERV-13 filters. We also recommend providing mechanical ventilation to all interior zones.

### 2.7.3 Remove or Replace Covers on Outdoor Air Intakes

In order to achieve the proper amount of outdoor ventilation air for the unit ventilators, it may be necessary to remove some the restrictive covers added to the exterior louvers over the years. We recommend replacing these covers and adding hoods if there has been a problem with wind-driven rain entering the unit ventilators.

### 2.7.4 Provide Ventilation Air for Holding Area

The holding cells are served by exhaust fans, but there does not appear to be a source of conditioned makeup air, other than pulling from adjacent office spaces. Tighe & Bond recommends installing a dedicated makeup air unit to provide conditioned ventilation air for the cells, corridor, and support offices.

### 2.7.5 Install a Building Management System

If the HVAC systems servicing this building are replaced, we recommend replacing the pneumatic control system with a Building Management System to control and monitor HVAC equipment. Pneumatic air systems are antiquated and do not offer the same benefits as a BMS. This recommendation is an energy saving and maintenance measure, and only affects the indoor air quality of the building insofar as the ability to better schedule starting and stopping the ventilation systems, and to monitor alarms if they stop functioning correctly.

### 2.7.6 Caulk and Seal Air Leakage in Building Envelope

The conditions assessment from March 1980 noted that expansion joints in the concrete were not sealed and subject to air infiltration. Tightening up the building envelope, by insulating and air sealing, should also be considered. A blower door test can quantify how leaky the building is relative to similar structures, and help identify the major leaks. Plugging these leaks will increase energy efficiency, improve thermal comfort and IAQ, and allow the ventilation systems to work as designed.

## 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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