Arlington Public Schools

Building Ventilation Assessment – Taylor

March 2021

Final Draft

VENTILATION ASSESSMENT – Taylor Elementary Schools

Arlington Public Schools is in the process of doing additional assessment of ventilation systems in the less ventilated schools to improve conditions as recommended to open schools. The assessment is to review the available ventilation systems and include long-term planning to increase the ventilation in the classrooms to meet expected occupancy of the facilities (long term).

The buildings are conditioned by different types of HVAC systems, even in the same facility. Thus, a "typical" classroom, that was ventilated differently, was reviewed based on system type in the facility. In general, the main system types include dedicated ventilation units serving the classroom HVAC unit or centrally located HVAC units. In rooms where the ventilation rate were below the recommendations, these systems were reviewed to determine methods to increase the ventilation in the classrooms. The continuation of the ventilation study was review schools in which ventilation rates are to be increased to the extent possible. This report addresses the Taylor Elementary School.

The current American Society for Heating, Refrigerating and Air Conditioning (ASHRAE) code 62.1-2010 requires ventilation to be calculated based both on the classroom size (square foot of the room) and classroom occupancy. The classroom ventilation was designed as necessary to meet the current code level ventilation unit. As part of the guidelines for opening buildings, ventilation rates should be increased to the extent possible as a method to dilute airborne contaminants to the extent possible. ASHRAE recommends diluting the room air utilizing ventilation to the extent possible while not adversely affecting space air conditioning.

Harvard T.H. Chan's Guidelines for opening schools recommend that facilities verify the outside air ventilation system is operational and provide adequate ventilation. In addition to outside air ventilation, the guidelines also recommend that the building HVAC systems provide adequate air movement in the classrooms by using a combination of outdoor air and recirculating air. The target air movement rate in a classroom is to cycle the air in a room, 5 times per hour [called air change rates per hour (ACH)]. Having a minimum of 5 ACH would mean the air is cycled 5 times in an hour – or every 12 minutes. The recommendation for cycling air in the classroom is to allow the HVAC systems to filter the air.

Both Harvard and ASHRAE recommend increasing filtration efficiencies to the highest allowable by the limits of the HVAC system. This varies by HVAC system, with MERV 13 equivalence being the minimum recommended filtration level due to its ability to remove 85 percent of the particles larger than 1 micron. While the virus is smaller than 1 micron, the general consensus is that the virus transmits in droplet form with the RNA infectious dose most likely in a size range greater than 1 micron. If the HVAC system isn't capable of utilizing MERV 13 filtration, the recommendation is to supplement the room with a fan/filter unit capable of using very high-efficient filters (HEPA) to allow better filtration and to increase the effective, clean air in the room.

Dedicated Ventilation and classroom HVAC systems: Taylor predominantly uses central type dedicated ventilation/air handling units mainly located on the roof. These units ventilate all the classrooms throughout the facility. Each classroom includes an above ceiling mounted heat pump unit(s) which provides temperature controlled to maintain space temperature while the dedicated unit provides the necessary outside air ventilation rates. The ventilation in these rooms equates to approximately 3 air changes per hour (average). The complete HVAC system (Heat pump/ventilation air) were designed to meet code and provide over 7 air changes per hour of filtered/ventilated air (the air is cycled every 8 to 9 minutes). The ventilation systems utilized MERV 11 for the outside air (ventilation), while the heat pump units are also equipped with grille mounted, MERV 8 filters.

Discussion:
In general, the systems using the dedicated ventilation with heat pump units would meet the code required ventilation and filtration. However, the ventilation system doesn't provide air directly to the classroom, the ventilation is delivered through the heat pump unit's supply fan. The code applies an effectiveness factor which indicates the ventilation provided in this method is only 80 percent efficient.

The HVAC system being designed for MERV 8 filters, would limit the ability to change the filtration levels for the equipment. Thus, MERV 13 filters cannot be utilized effectively for the HVAC system. To increase the calculated, filtered air change rate, supplemental classroom air filter units would be required.

Issues
- The method of ventilation air effectiveness is impacted by the original design of supplying outside air to the heat pump unit.
- The existing outside air units would need to be increased in airflow and capacity by 25% to overcome the effectiveness penalty.

Recommendations:
- Revise the ventilation design such that the ventilation air is provided directly to the classroom and is not ducted through the heat pump unit.
  - This would revise code effectiveness to 1.0
  - This would increase room overall air change rate to over 8.5 air changes per hour.
- The ductwork would need to be modified and routed to a diffuser in the center of each classroom.
- The outside airflow rates would need to be measured and set by balanced.
- The classroom HVAC systems will require rebalancing and diffuser adjustments as necessary to accommodate the recommended airflow upgrades.
- Replace all MERV 8 filters with MERV 11.

APPENDIX A

Disclaimers

General air change data

Disclaimers

Disclaimers

- The information in this document is provided as general guidance based on the current information available utilizing the strategies developed by ASHRAE and Harvard. HVAC systems play only a small role in infectious disease transmission, the airflow information provided in these documents are not mitigation strategies. Additional non-HVAC mitigation strategies to be used includes:

  - **Building Occupancy Levels Allowed**
  - **Face mask requirements**
  - **Social distancing between desks, students, teachers, etc.**
  - **Directional flow for movement through the building**
  - **Personal hygiene**
  - **Cleaning requirements**
  - **Touchless services.**

- It is important to note that HVAC strategies are means to improve the air quality and reduce risk but will not prevent all possibility of virus transmission, user should acknowledge that there is a no "zero risk" scenario. HVAC improvements are intended to be used as part of an overall risk reduction strategy for reopening schools. Each building and situation are unique and the guidance provided doesn't not equally apply to all buildings or classrooms.
- The information in this report is based on the very latest recommendations but the COVID-19 crisis remains an ever-evolving situation and this assessment and our recommendations are not intended to override or supersede any current or future guidance from health and government experts. This guidance should be used in conjunction with relevant guidance and research from governmental agencies. This information is not a substitute for guidance as recommended by health care professionals.
- CMTA does not warrant the accuracy or completeness of this guidance, by adopting these recommendations for use, each adopter agrees to accept the full responsibility in connection with their use. CMTA assumes no responsibility for any injury, loss, or damage arising out of or in connection with this guidance.

	Location		Area	HVAC System Type	Design Year	Number of Class rooms	Classrm Size (SF)	OA CFM per Classrm	Ceiling Height	Room Volume	Room OA ACH	Number of Blue	Blue AIR 211+ Airflow	Equivalent ACH	Harvard Room ACH
31	Taylor		Area A	Classrooms - ERVs and HPs	2011	8	1000	400	9.0	**9000**	**2.67**	**1**	**350**	**2.33**	**5.00**
	Elementary		Area B	PODS - ERVs and HP s	2011	4	575	375	9.0	**5175**	**4.35**	**1**	**350**	**4.06**	**8.41**
			Area B	PODS - ERVs and HPS	2011	2	400	300	9.0	**3600**	**5.00**	**1**	**350**	**5.83**	**10.83**
			Area B	PODS - ERVs and HPs	2011	6	500	375	9.0	**4500**	**5.00**	**1**	**350**	**4.67**	**9.67**
			Area B	1st Grd - ERVs and HPs	2011	1	860	195	9.0	**7740**	**1.51**	**1**	**350**	**2.71**	**4.22**
			Area B	1st Grd - ERVs and HPs	2011	1	820	180	9.0	**7380**	**1.46**	**1**	**350**	**2.85**	**4.31**
			Area B	2nd Grd - ERVs and HPs	2011	1	875	195	9.0	**7875**	**1.49**	**1**	**350**	**2.67**	**4.15**
			Area B	2nd Grd - ERVs and HPs	2011	1	825	180	9.0	**7425**	**1.45**	**1**	**350**	**2.83**	**4.28**
			Area B	Spec Ed - ERVs and HPs	2011	4	600	375	9.0	**5400**	**4.17**	**1**	**350**	**3.89**	**8.06**
			Area D	Pre-K/MIPA - ERVs and HPs	2011	2	800	415	9.0	**7200**	**3.46**	**1**	**350**	**2.92**	**6.38**
			Area D	Grd 4/5 - ERVs and HPs	2011	6	800	415	9.0	**7200**	**3.46**	**1**	**350**	**2.92**	**6.38**
			Area D	Grd 3/5s - ERVs and HPs	2011	8	800	375	9.0	**7200**	**3.13**	**1**	**350**	**2.92**	**6.04**
						44	32680	366			**3.29**			**3.14**	**6.43**