Arlington Public Schools

Building Ventilation Assessment – Ashlawn

March 2021

Final Draft

VENTILATION ASSESSMENT – Ashlawn Elementary School

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.

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 Ashlawn 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: Ashlawn utilizes a central type dedicated ventilation/air handling unit located on the roof. These units ventilate all the classrooms throughout the first and second floors. Each classroom includes a closet mounted heat pump unit(s) which provides temperature control to maintain space temperature while the dedicated unit provides the necessary outside air ventilation rates. The ventilation in these rooms equates to approximately 2.5 air changes per hour (average). The complete HVAC system (Heat pump/ventilation air) were designed to provide over 9 air changes per hour of filtered/ventilated air (the air is cycled every 6 to 7 minutes, reducing stagnation). The ventilation systems utilizes both MERV 8 and MERV 13 for the outside air (ventilation), while the heat pump units are also equipped with duct/HP mounted, MERV 8 filters.

Classroom HVAC/Unit Ventilator systems: Ashlawn also has approximately 21 classrooms (approximately 55 percent) which uses local room, unit ventilator (fan/coil type units). These systems utilize room located, floor mounted HVAC unit(s) that are located on the exterior wall. The ventilation for these type systems is provided by connecting the unit through the exterior wall to a louver. Outside air intake and ventilation is controlled by a damper which is opened or closed to draw in ventilation air from the outside. The ventilation rate through these units varies by classroom and unit capacity. The ventilation generally provides the necessary outside air ventilation rates, especially for Hybrid occupancy. The ventilation in these rooms equates to approximately 2.4 air changes per hour. The HVAC system provides an average of 8-9 air changes per hour of filtered/ventilated air (the air is cycled every 6 to 7 minutes, reducing stagnation).

The unit ventilators utilize a unit mounted, ½" to 1" filter bank with maximum filter efficiency of approximately MERV 8. These filters are only capable of filtering approximately 20 percent of the particles,1 Micron or above.

Discussion:
Some of the classrooms using the dedicated ventilation with heat pump units do not meet the code required ventilation during full classroom occupancy. While the ventilation system provides air directly to the classroom, the ventilation rate can only support an occupancy of 19 to 20 persons.

While the designed, generally provides the required ventilation rates through the unit, several rooms are utilizing reduced ventilation rate that can only support 22 students. Furthermore, the methodology of providing ventilation directly through the unit ventilator can have a detrimental effect on building comfort conditions. During humid climate conditions, this ventilation air can affect indoor air humidity levels and cause higher than desired/comfort levels.

The HP HVAC system being designed for MERV 8 filters, would limit the ability to change the filtration levels for the equipment. While the MERV 8 filters can be upgraded to MERV 11 fairly easily, MERV 11 filters provide lower efficiencies for filtration of smaller particles (when compared to MERV 13).

The unit ventilators utilize a unit mounted, ½" to 1" filter bank with maximum filter efficiency of approximately MERV 4-6. These filters are only capable of filtering approximately 20-30 percent of the particles,1 to 3 Micron.

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. The effective air change rate depends on filtration levels, with MERV 13 equivalence being recommended. Therefore, the recommendation to add an auxiliary HEPA filtration unit, increases the effective air change rate for the classroom to approximately 5 ACH (or cycled every 12-13 minutes).

Issues (HP with DOAS):

- The method of ventilation air design is impacted by the original design of supplying outside air at lower design airflow rate.
- The existing outside air unit would need to be increased in airflow and capacity by 10% to overcome to provide the correct ventilation rates.

Issues (Unit ventilators):

- By increasing the ventilation rate, classroom comfort levels become more affected as the exterior humidity levels (and temperatures) increase. When humidity levels (increase in exterior dewpoints), the interior humidity levels can increase to outside normal ASHRAE comfort zones.
- Increased ambient temperatures can also increase indoor conditions to outside normal ASHRAE comfort zones.
- Colder, winter ambient temperatures can decrease indoor conditions to below normal ASHRAE comfort zones (causing the space to be too cold).
- Colder temperatures can cause cold drafts, especially at feet level, thus affecting room comfort levels.
- Some rooms have lower capacity unit ventilators, the temperature control and humidity issues will be more prominent in these classrooms then typically experienced. Extra care will be needed used when delivering ventilation air through the unit ventilators.

Recommendations:

- Rebalance the dedicated ventilation unit with additional airflow to provide the required airflow.
- Some of the ductwork would need to be modified and enlarged or redistributed to accommodate the additional 30 percent ventilation rate in several of the classrooms.
- 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 HP - MERV 8 filters with MERV 11.

Recommendations (Long term – Unit Ventilators):

- Due to humidity issues that occur when using unit ventilators, the recommended long-term solution is to install dedicated outside air systems which deliver the ventilation, directly to the classroom. By using dedicated ventilation units, the cooling/heating of the room is separated from heating/cooling the ventilation air. This allows the ventilation air to be dehumidified separately from the function of space cooling/heating.

- Due to building design already being a Heat pump type school, replace all unit ventilators with heat pump units and utilize roof mounted dedicated outside air units to serve the remaining classrooms.

APPENDIX A

Disclaimers

General air change data

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- 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
2	Ashlawn		Bsmt Flr - A	Class 183 - HP unit with OAU	2013	1	935	290	9.8	**9116**	**1.91**	**1**	**350**	**2.30**	**4.21**
	Elementary		Bsmt Flr - A	Mont 182 - HP unit with OAU	2013	1	930	285	9.8	**9068**	**1.89**	**1**	**350**	**2.32**	**4.20**
			Bsmt Flr - A	SPED/PreK 181 - HP unit with OAU	2013	1	895	270	9.8	**8726**	**1.86**	**1**	**350**	**2.41**	**4.26**
			Bsmt Flr - A	SPED/PreK 180 - HP unit with OAU	2013	1	930	280	9.8	**9068**	**1.85**	**1**	**350**	**2.32**	**4.17**
			Lwr Lvl - A	Flex 274 - HP unit with OAU	2013	1	815	350	9.8	**7946**	**2.64**	**1**	**350**	**2.64**	**5.29**
			Lwr Lvl - A	Kind 283 - HP unit with OAU	2013	1	970	370	9.8	**9458**	**2.35**	**1**	**350**	**2.22**	**4.57**
			Lwr Lvl - A	Kind 282 - HP unit with OAU	2013	1	910	365	9.8	**8873**	**2.47**	**1**	**350**	**2.37**	**4.84**
			Lwr Lvl - A	Kind 281 - HP unit with OAU	2013	1	915	365	9.8	**8921**	**2.45**	**1**	**350**	**2.35**	**4.81**
			Lwr Lvl - A	Kind 280- HP unit with OAU	2013	1	960	370	9.8	**9360**	**2.37**	**1**	**350**	**2.24**	**4.62**
			Lwr Lvl - B	GR4 - 245-248 (UV-6) (x2)	1994	4	1000	320	8.5	**8500**	**2.26**	**1**	**350**	**2.47**	**4.73**
			Lwr Lvl - B	ELL - 252 - HP Unit	2013	1	800	365	8.5	**6800**	**3.22**	**1**	**350**	**3.09**	**6.31**
			Lwr Lvl - B	SC-GR4 - 251 HP Unit	2013	1	365	175	8.5	**3103**	**3.38**	**1**	**350**	**6.77**	**10.15**
			Lwr Lvl - B	SC-GR5 - 250 HP Unit	2013	1	400	189	8.5	**3400**	**3.33**	**1**	**350**	**6.18**	**9.50**
			Lwr Lvl - C (2nd)	GR5 - 236/237 - Unit Ventilators	2013	2	1050	390	8.5	**8925**	**2.62**	**1**	**350**	**2.35**	**4.97**
			Lwr Lvl - C (2nd)	GR5 - 238/239 - Unit Ventilators	1994	2	1050	390	8.5	**8925**	**2.62**	**1**	**350**	**2.35**	**4.97**
			Lwr Lvl - C (2nd)	Music 223 - HP units with OAU	2013	1	1125	535	8.5	**9563**	**3.36**	**1**	**350**	**2.20**	**5.55**
			Lwr Lvl - C (2nd)	Music 224 - HP units with OAU	2013	1	1125	515	8.5	**9563**	**3.23**	**1**	**350**	**2.20**	**5.43**
			Lwr Lvl - C (2nd)	Music 225 - HP units with OAU	2013	1	1125	390	8.5	**9563**	**2.45**	**1**	**350**	**2.20**	**4.64**
			Upper lvl - A (3rd)	FLEX 374 - HP units with OAU	2013	1	820	350	9.8	**7995**	**2.63**	**1**	**350**	**2.63**	**5.25**
			Upper lvl - B (3rd)	Classroom - 351 - HP Units	2013	1	835	385	8.5	**7098**	**3.25**	**1**	**350**	**2.96**	**6.21**
			Upper lvl - B (3rd)	SC-GR1 - 352 - HP Units	2013	1	365	160	8.5	**3103**	**3.09**	**1**	**350**	**6.77**	**9.86**
			Upper lvl - B (3rd)	GR1 - 347-349 - Unit Vent	1994	3	985	320	8.5	**8373**	**2.29**	**1**	**350**	**2.51**	**4.80**
			Upper lvl - B (3rd)	GR1 - 350 - Unit Vent	1994	1	895	320	8.5	**7608**	**2.52**	**1**	**350**	**2.76**	**5.28**
			Upper lvl - B (3rd)	GR2 - 345-346 - Unit Vent	1994	2	985	320	8.5	**8373**	**2.29**	**1**	**350**	**2.51**	**4.80**
			Upper lvl - C (3rd)	GR3 - 338/339 - Unit Ventilators	2013	2	1060	390	8.5	**9010**	**2.60**	**1**	**350**	**2.33**	**4.93**
			Upper lvl - C (3rd)	Gr3 - 340/Gr2 341-342 - Unit Vent.	2013	3	1000	390	8.5	**8500**	**2.75**	**1**	**350**	**2.47**	**5.22**
			Upper lvl - D (3rd)	Art rooms - Unit Vent.	1994	2	1000	320	8.5	**8500**	**2.26**	**1**	**350**	**2.47**	**4.73**
						39	36360	343			**2.51**			**2.57**	**5.08**