Arlington Public Schools

Building Ventilation Assessment – Abingdon

March 2021

Final Draft

VENTILATION ASSESSMENT – Abingdon 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 Abingdon 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: Abingdon newest addition uses central type dedicated ventilation/air handling units mainly located on the roof. These units ventilate several classrooms throughout the facility. Each classroom includes a fan coil style unit which provides airflow which is temperature controlled to maintain space temperature while the dedicated unit provides the necessary outside air ventilation rate; the ventilation in these rooms generally exceeds 3 air changes per hour. The complete HVAC system (fan coil/ventilation air) were designed to meet code and provide approximately 11 to 12 air changes per hour of filtered/ventilated air (the air is cycled every 5 to 6 minutes, reducing stagnation in the classrooms). The fan coil units are equipment with MERV 4-6 filters.

Central HVAC systems: Many of the original classrooms had an HVAC upgraded in 2002, and then again in 2016 (equipment replaced) which replaced unit ventilators with central type HVAC roof top units. These units condition several classrooms throughout the facility. The ventilation for these units operates using dampers and controls directly connected to the outdoors via to draw outdoor air through the unit. The unit then heat or cools the ventilation air providing the necessary cooling/heating air to the individual classrooms and spaces. Each classroom includes a terminal unit which provides a constant airflow which is temperature controlled to maintain space temperature while meeting the necessary outside air ventilation rates. The ventilation in these rooms ranges from 2 to 3 air changes per hour, with 3 rooms averaging at 1.5 ACH. The complete HVAC system provides approximately 6 to 8 air changes per hour of filtered/ventilated air (the air is cycled every 8 to 10 minutes, reducing stagnation in the classrooms). Note that 3 of the classrooms have total airflow averaging 5 ACH. The roof top units are equipment with MERV 8 filters.

However, 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 4 to 6 ACH, averaging over 6 ACH (or cycled every 10 minutes). Three of the classrooms are utilizing two filtration units to increase the effective air change rate.

Discussion:
The systems using the dedicated ventilation with fan coil units meet the code required ventilation and filtration. However, MERV 13 filters cannot be utilized in the fan coil units. To increase the calculated, filtered air change rate, supplemental classroom air filter units would be required.

The central system roof top units, can generally provide increased ventilation through the existing HVAC system. The existing ventilation rate is approximately 30%. This ventilation rate is adequate for the hybrid occupancy. To meet code level ventilation rates, approximately 40% to 45% outside air will be required. This additional ventilation load will have some effect on available operating temperatures. In order to meet full ventilation loads, equipment with additional energy recovery features and more heating/cooling capacity will be required.

Issues

- The existing outside air dampers and controls would need to be adjusted to increase the ventilation rates to approximately 40% of the supply air.
- The outside airflow rates would need to be measured and set by balanced.
- The classrooms will require rebalancing and diffuser adjustments as necessary to provide the adequate supply and ventilation air change rates.
- This operation should be limited to hybrid mode and when ambient temperatures wont effect cooling and heating capacity of the system.

Temporary, short term:

- In order to increase ventilation airflow rate, outside air temperature operating conditions needs to be adjusted to allow the air handling unit's existing cooling/heating coils to produce adequate supply air temperatures to meet the classrooms heating and cooling needs.

Long term corrections.

- The roof top units serving the classrooms would need to have an HVAC system upgrade or replacement to meet the additional ventilation requirements and provide the required cooling/heating capacity.
- The outside airflow rates would need to be measured and set by balanced.
- Several classrooms will require rebalancing and diffuser adjustments as necessary to provide the adequate supply and ventilation air change rates.

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
1	Abingdon		Lower	Classrooms 001-005 (VRF-DOAS)	2016	4	815	390	8.5	**6928**	**3.38**	**1**	**350**	**3.03**	**6.41**
	Elementary		Lower	Classroom 019 (VRF-DOAS)	2016	1	900	435	8.5	**7650**	**3.41**	**1**	**350**	**2.75**	**6.16**
			Lower	Classroom 027 (VRF-DOAS)	2016	1	900	440	8.5	**7650**	**3.45**	**1**	**350**	**2.75**	**6.20**
			Lower	Small Grp (VRF-DOAS)	2016	2	450	215	8.5	**3825**	**3.37**	**1**	**350**	**5.49**	**8.86**
			Main - A	ERTU-3 (2002 - RTU-1)	2016	1	780	420	8.5	**6630**	**3.80**	**1**	**350**	**3.17**	**6.97**
			Main - A	ERTU-3 (2002 - RTU-1)	2016	1	800	396	8.5	**6800**	**3.49**	**1**	**350**	**3.09**	**6.58**
			Main - A	ERTU-3 (2002 - RTU-1)	2016	3	955	459	8.5	**8118**	**3.39**	**1**	**350**	**2.59**	**5.98**
			Main - B	ERTU-3 (2002 - RTU-1)	2016	3	955	459	8.5	**8118**	**3.39**	**1**	**350**	**2.59**	**5.98**
			Main - A	Music 136 - ERTU-2	2016	1	1075	300	8.5	**9138**	**1.97**	**1**	**350**	**2.30**	**4.27**
			Main - A	Small Grp Inst - ERTU-2	2016	2	400	110	8.5	**3400**	**1.94**	**1**	**350**	**6.18**	**8.12**
			Main - A	Music 140 - ERTU-1	2016	1	985	230	8.5	**8373**	**1.65**	**1**	**350**	**2.51**	**4.16**
			Main - A	Music 142 - ERTU-1	2016	1	785	230	8.5	**6673**	**2.07**	**1**	**350**	**3.15**	**5.22**
			Main - A	ART - ERTU-4	2016	1	1055	194	8.5	**8968**	**1.30**	**2**	**350**	**4.68**	**5.98**
			Main - B	Classrooms - FCU/DOAS	2016	1	995	470	8.5	**8458**	**3.33**	**1**	**350**	**2.48**	**5.82**
			Main - B	Classrooms - FCU/DOAS	2016	1	735	365	8.5	**6248**	**3.51**	**1**	**350**	**3.36**	**6.87**
			Main - B	Sm Grp - FCU/DOAS	2016	1	455	215	8.5	**3868**	**3.34**	**1**	**350**	**5.43**	**8.77**
			Main - B	ART - ERTU-6	2016	1	995	210	8.5	**8458**	**1.49**	**2**	**350**	**4.97**	**6.46**
			Main - B / Main C	Classroom 174 - 177 (RTU-3)	2016	4	1045	456	8.5	**8883**	**3.08**	**1**	**350**	**2.36**	**5.44**
			Main - C	Classroom 178 (ERTU-8)	2016	1	995	193	8.5	**8458**	**1.37**	**2**	**350**	**4.97**	**6.34**
			Upper	Classrooms 201 - 205/Flex 220-221	2016	6	785	375	9.5	**7458**	**3.02**	**1**	**350**	**2.82**	**5.83**
			Third	Classrooms 301 - 305	2016	4	815	390	9.5	**7743**	**3.02**	**1**	**350**	**2.71**	**5.73**
						41	34295	358			**2.94**			**3.09**	**6.03**