Arlington Public Schools

Building Ventilation Assessment – Traditional

March 2021

Final Draft

VENTILATION ASSESSMENT – Traditional 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 Gunston Middle 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.

Central HVAC systems: Traditional has several classroom units which utilize central type air conditioning units located in mechanical rooms. These units provide heating, cooling, and ventilation for these eight classrooms. The ventilation for these units operates using louvers, ductwork, dampers and controls directly connected to the outdoors 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. Generally, the ventilation in these rooms exceeds 2.5 air changes per hour. The HVAC system provides an average of 6 air changes per hour of filtered/ventilated air (the air is cycled every 10 to 12 minutes). These central units are equipped with MERV 8 filters.

Classroom HVAC/Unit Ventilator systems: Traditional also has approximately 15 classrooms (approximately 65 percent) which uses local room, 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 provides the necessary outside air ventilation rates. The ventilation in these rooms equates to approximately 2.5 air changes per hour. The HVAC system provides an average of 6 air changes per hour of filtered/ventilated air (the air is cycled every 10 to 12 minutes).

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:
The central system air handling units, can generally provide increased ventilation through the existing HVAC system. The existing ventilation rate is approximately 35%. To meet code level ventilation rates, approximately 50% outside air will be required. This additional ventilation load will have some effect on available operating temperatures.

While the designed ventilation rates through the unit ventilators, generally meets code requirements. This methodology of providing ventilation 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.

Issues

- Air handling units
  - The existing outside air dampers and controls would need to be adjusted to increase the ventilation rates to approximately50% of the supply air.
  - The outside airflow rates would need to be measured and set by balance.
  - The classrooms will require rebalancing and diffuser adjustments as necessary to provide the adequate supply and ventilation air change rates.
  - The increased ventilation rate will greatly restrict available ambient conditions due to increase in outside air loads on the roof top units. The outside air design temperature to operate in the increased ventilation loads would need to be less than 85°F or greater than 30°F.

- Unit ventilators.
  - The increased humidity levels being provided by the ventilation being delivered by unit ventilators is not desired.
  - Higher humidity levels affect overall space comfort.
  - Prolonged increase of space humidity levels can cause moisture type issues in the building.

Recommendations:

- The existing, air handling will need to be replaced. These units will need to be designed to accommodate the higher ventilation rates.

- The units would need to be increase in capacity to accommodate the higher outside air loads.

- Several classrooms will require rebalancing and diffuser adjustments as necessary to provide the adequate supply and ventilation air change rates. Approximately 1/3 of the of 32 classrooms will need classroom diffuser and airflow adjustments to achieve desired air change rates and ventilation airflows.

- Provide dedicated ventilation units to serve the classrooms that utilize unit ventilators. The dedicated units would be ducted to provide ventilation directly to the classroom spaces.

- Replace the 2002 vintage unit ventilators serving the classrooms, blocking off the outside air louver, and sealing the wall.

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
33	**Traditional**	1st Flr - North	KG 111 - AHU-2 (40% OA)	2002	1	1000	400	9.0	**9000**	**2.67**	**1**	**350**	**2.33**	**5.00**
	Elementary	1st Flr - North	KG 112 - AHU-2 (40% OA)	2002	1	1000	400	9.0	**9000**	**2.67**	**1**	**350**	**2.33**	**5.00**
		1st Flr - North	KG 113 - AHU-2 (40% OA)	2002	1	1000	400	9.0	**9000**	**2.67**	**1**	**350**	**2.33**	**5.00**
		1st Flr - North	First 108 - AHU-2 (40% OA)	2002	1	795	450	9.0	**7155**	**3.77**	**1**	**350**	**2.94**	**6.71**
		1st Flr - North	First 107 - AHU-2 (40% OA)	2002	1	780	400	9.0	**7020**	**3.42**	**1**	**350**	**2.99**	**6.41**
		1st Flr - North	First 106 - AHU-2 (40% OA)	2002	1	775	400	9.0	**6975**	**3.44**	**1**	**350**	**3.01**	**6.45**
		1st Flr	Music 126 - AHU-3 (34% OA)	2002	1	1145	272	9.0	**10305**	**1.58**	**2**	**350**	**4.08**	**5.66**
		1st Flr	Art Room 134 - FCU	2002	1	1480	450	9.0	**13320**	**2.03**	**2**	**350**	**3.15**	**5.18**
		2nd Floor	Classrm 208 - AHU-3 (34% OA)	2002	1	1200	272	9.0	**10800**	**1.51**	**2**	**350**	**3.89**	**5.40**
		1st Flr - Pre-K	Unit Ventilators	2002	2	965	360	9.0	**8685**	**2.49**	**1**	**350**	**2.42**	**4.91**
		1st Flr - 2nd	Unit Ventilators	2002	1	1025	360	9.0	**9225**	**2.34**	**1**	**350**	**2.28**	**4.62**
		1st Flr - 2nd	Unit Ventilators	2002	1	965	360	9.0	**8685**	**2.49**	**1**	**350**	**2.42**	**4.91**
		1st Flr - 2nd	Unit Ventilators	2002	1	925	360	9.0	**8325**	**2.59**	**1**	**350**	**2.52**	**5.12**
		1st Flr - 3r Grd	Unit Ventilators	2002	3	965	360	9.0	**8685**	**2.49**	**1**	**350**	**2.42**	**4.91**
		2nd Flr - 4th Gr	Unit Ventilators	2002	1	825	360	12.0	**9900**	**2.18**	**1**	**350**	**2.12**	**4.30**
		2nd Flr - 4th Gr	Unit Ventilators	2002	2	950	360	9.0	**8550**	**2.53**	**1**	**350**	**2.46**	**4.98**
		2nd Flr - 5th	Unit Ventilators	2002	2	965	360	9.0	**8685**	**2.49**	**1**	**350**	**2.42**	**4.91**
		2nd Flr- ESOL-208	Unit Ventilators	2002	1	705	360	12.0	**8460**	**2.55**	**1**	**350**	**2.48**	**5.04**
					23	18450	369			**2.63**			**2.46**	**5.09**