



Arlington Public Schools Ventilation Assessment – Williamsburg
March 2021

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Final

VENTILATION ASSESSMENT – Williamsburg

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 short term and long-term planning to increase the ventilation in the classrooms to accommodate the hybrid in-person learning (short term) and include ventilation rates to meet expected occupancy of the facilities (long term).

The middle school is conditioned using three different types of HVAC systems. Each classroom was reviewed based on system type in the facility. The three systems include wall mounted unit ventilator units, 5 classrooms are conditioned using a variable refrigerant cassette unit (VRF), and six of the classrooms use an overhead roof top unit. In rooms where the ventilation rate were below the recommendations, these systems were reviewed to determine methods to increase the ventilation in the classrooms. This report addresses the Williamsburg 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 4 to 6 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.

Unit Ventilator HVAC system is utilized for a majority of the classrooms at Williamsburg. 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.

Discussion:

The unit ventilators damper and the associated exterior louver was adequate to generally deliver the ventilation airflows required; however, the unit ventilators cooling and heating capacity was not designed to accommodate higher outside airflows. In order to increase ventilation airflow rate, outside air temperatures needs to be appropriate to allow the unit ventilator's cooling/heating coils to produce adequate supply air temperatures to meet the classrooms heating and cooling needs.

Williamsburg unit ventilator's and fan coil type HVAC systems can provide the Hybrid occupancy, code level ventilation. These HVAC systems are estimated to be providing an average room airflow of 5-8 ACH, averaging almost 7 ACH. This air change rates equates to the air being cycled in under 9 minutes, preventing stagnation in the rooms. The hybrid ventilation rates can affect the HVAC's system ability to heat and cool the classrooms when ambient conditions exceed 90°F or is colder than 15-18°F. Furthermore, when outside dewpoints increase (generally above 65-70°F), the relative humidity in the space can increase.

Several of Williamsburg's core classroom are conditioned utilizing a dedicated HVAC system, which in addition to being capable of code level ventilation, this system also provides an average room airflow of 12 ACH. This air change rates equates to the air being cycled every 5 minutes. This HVAC system can provide the necessary heating and cooling needed during ambient conditions below 90°F and above 15°F.

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 5 ACH (or cycled every 12 minutes).

Issues:

- 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 than typically experienced. Extra care will be needed used when delivering ventilation air through the unit ventilators.
- Many of the classrooms utilize dehumidification units to supplement the HVAC system and reduce indoor humidity levels.

Recommendations:

- In order to utilize the unit ventilator outside air damper and louver, the controls need to be verified to allow complete control of the unit.
- Outside air will need to be balanced to the required outside air rates.
- Maintain exhaust fan operations to help with ventilation rates in the unit ventilators.

Recommendations (Long term):

- 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 and construction limitations, the recommended method for dedicated outside air systems would need to be concentrated around using small, roof mounted heat pump systems which serve dedicated classroom wings.

APPENDIX A

Disclaimers

Air change calculations using HEPA filter units.

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.

Williamsburg - Airflow Calculations																	
Room Number	Room Use	Area Sq Ft	Ceiling Height (Feet)	Number of Students (Hybrid)	Unit Tag	Supply Airflow	Supply Total ACH	Year	OA Design Airflow	Room OA ACH	Blue Air 211+ Airflow	Quant	HEPA ACH	"Clean" ACH			
101	Core Classroom	843	9.5	13.00	UV-G	900	6.41	1990	250	1.78	350	1	2.62	4.40			
102	Special Education	808	9.5	13.00	UV-G	900	6.68	1990	250	1.86	350	1	2.74	4.59			
103	Core Classroom	825	9.5	14.00	UV-G	900	6.55	1990	250	1.82	350	1	2.68	4.50			
104	Core Classroom	825	9.5	14.00	UV-G	900	6.55	1990	250	1.82	350	1	2.68	4.50			
105	Core Classroom	729	9.5	12.00	UV-C	900	7.41	1990	250	2.06	350	1	3.03	5.09			
1A5	Speech	367	9.5	5.00	UV-C	600	9.81	1990	250	4.09	350	1	6.02	10.11			
106	Core Classroom	728	9.5	12.00	UV-C	900	7.42	1990	250	2.06	350	1	3.04	5.10			
1A6	Special Education	774	9.5	14.00	UV-C	600	4.65	1990	250	1.94	350	1	2.86	4.79			
107	Science	746	9.5	12.00	UV-B	900	7.24	1990	250	2.01	350	1	2.96	4.97			
108	Life Skills	738	9.5	8.00	UV-C	900	7.32	1990	250	2.03	350	1	3.00	5.03			
109	Core Classroom	911	9.5	13.00	UV-M	900	5.93	1990	250	1.65	350	1	2.43	4.07			
111	Core Classroom	736	9.5	12.00	UV-3	900	7.34	1990	250	2.04	350	1	3.00	5.04			
112	Core Classroom	739	9.5	12.00	UV-3	900	7.31	1990	250	2.03	350	1	2.99	5.02			
113	Core Classroom	738	9.5	12.00	UV-3	900	7.32	1990	250	2.03	350	1	3.00	5.03			
114	Special Education	630	9.5	10.00	UV-3	900	8.57	1990	250	2.38	350	1	3.51	5.89			
115	Core Classroom	829	9.5	13.00	UV-4	900	6.51	1990	250	1.81	350	1	2.67	4.48			
116	Core Classroom	846	9.5	13.00	UV-4	900	6.38	1990	250	1.77	350	1	2.61	4.39			
117	Core Classroom	827	9.5	13.00	UV-4	900	6.53	1990	250	1.81	350	1	2.67	4.49			
118	Core Classroom	832	9.5	13.00	UV-4	900	6.49	1990	250	1.80	350	1	2.66	4.46			
119	Core Classroom	866	9.5	13.00	UV-4	900	6.24	1990	250	1.73	350	1	2.55	4.28			
119A	Core Classroom	Not found	9.5	13.00													
120	Core Classroom	828	9.5	13.00	UV-4	900	6.52	1990	250	1.81	350	1	2.67	4.48			
121	Core Classroom	842	9.5	13.00	UV-4	900	6.41	1990	250	1.78	350	1	2.63	4.41			
124	EL Classroom	674	9.5	11.00	UV-124	800	7.12	1994	250	2.23	350	1	3.28	5.51			
125	Core Classroom	769	9.5	13.00	UV-125	800	6.24	1994	250	1.95	350	1	2.87	4.83			
127	Art	1800	9.5	20.00	UV-7 (x3)	1800	6.00	2003	1000	3.33	350	1	1.23	4.56			
128	FACS	1970	9.5	20.00	UV-7 (x3)	1800	5.48	2003	1000	3.05	350	1	1.12	4.17			
129	Tech Ed	1992	9.5	18.00	UV-7 (x3)	1800	5.42	2003	1100	3.31	350	1	1.11	4.42			
130	Tech Ed	545	9.5	5.00	FCU-4	800	8.81	2003	200	2.20	350	1	4.06	6.26			
132	Core Classroom	651	9.5	11.00	RWC-5	651	6.00	2003	163	1.50	350	1	3.40	4.90			
133	Core Classroom	677	9.5	11.00	RWC-4	677	6.00	2003	169	1.50	350	1	3.27	4.77			
134	Core Classroom	713	9.5	12.00	RWC-3	713	6.00	2003	178	1.50	350	1	3.10	4.60			
136	Core Classroom	713	9.5	12.00	RWC-1	713	6.00	2003	178	1.50	350	1	3.10	4.60			
137	Core Classroom	750	9.5	12.00	RWC-2	750	6.00	2003	188	1.50	350	1	2.95	4.45			
201	Core Classroom	736	9.0	12.00	UV-H	900	7.34	1990	250	2.04	350	1	3.17	5.21			
202	Core Classroom	729	9.0	12.00	UV-H	900	7.41	1990	250	2.06	350	1	3.20	5.26			
203	Core Classroom	727	9.0	12.00	UV-H	900	7.43	1990	250	2.06	350	1	3.21	5.27			
204	Core Classroom	820	9.0	13.00	UV-J	900	6.59	1990	250	1.83	350	1	2.85	4.67			
205	Core Classroom	729	9.0	12.00	UV-H	900	7.41	1990	250	2.06	350	1	3.20	5.26			
206	Core Classroom	641	9.0	10.00	UV-E	600	5.62	1990	250	2.34	350	1	3.64	5.98			
207	Core Classroom	684	9.0	11.00	UV-G	900	7.89	1990	250	2.19	350	1	3.41	5.60			
208	Core Classroom	730	9.0	12.00	UV-H	900	7.40	1990	250	2.05	350	1	3.20	5.25			
209	Core Classroom	727	9.0	12.00	UV-H	900	7.43	1990	250	2.06	350	1	3.21	5.27			
210	Core Classroom	729	9.0	12.00	UV-H	900	7.41	1990	250	2.06	350	1	3.20	5.26			
211	Core Classroom	723	9.0	12.00	UV-H	900	7.47	1990	250	2.07	350	1	3.23	5.30			
214	Core Classroom	814	9.0	13.00	UV-G	900	6.63	1990	250	1.84	350	1	2.87	4.71			
215	Core Classroom	817	9.0	13.00	UV-G	900	6.61	1990	250	1.84	350	1	2.86	4.69			
216	Core Classroom	817	9.0	13.00	UV-G	900	6.61	1990	250	1.84	350	1	2.86	4.69			
217	Core Classroom	823	9.0	13.00	UV-J	900	6.56	1990	250	1.82	350	1	2.84	4.66			
218	Core Classroom	873	9.0	14.00	UV-G	900	6.19	1990	250	1.72	350	1	2.67	4.39			
219	Special Education	821	9.0	13.00	UV-G	900	6.58	1990	250	1.83	350	1	2.84	4.67			
220	Core Classroom	825	9.0	14.00	UV-G	900	6.55	1990	250	1.82	350	1	2.83	4.65			
225	Band	1625	9.0	13.00	UV-3 (x2)	1800	6.65	1990	250	0.92	350	3	4.31	5.23			
227	Orchestra/Chorus	1435	9.0	13.00	UV-3 (x2)	1800	7.53	1990	250	1.05	350	2	3.25	4.30			
228	Theatre/ASL	695	9.0	9.00	UV-2 (x2)	1600	13.81	1990	250	2.16	350	1	3.36	5.52			
231	Science	757	9.0	14.00	UV-4	900	7.13	1990	250	1.98	350	1	3.08	5.06			
232	Science	757	9.0	14.00	UV-4	900	7.13	1990	250	1.98	350	1	3.08	5.06			
233	Science	757	9.0	14.00	UV-4	900	7.13	1990	250	1.98	350	1	3.08	5.06			
in library	Journalism	516	9.0	14.00	FCU-2 (x2)	800	9.30	2003	300	3.49	350	1	4.52	8.01			
C101	Core Classroom	742	9.0	12.00	VAV-1/RTU-1	1500	12.13	2003	250	2.02	350	1	3.14	5.17			
C102	Core Classroom	754	9.0	12.00	VAV-2/RTU-1	1500	11.94	2003	250	1.99	350	1	3.09	5.08			
C103	Core Classroom	658	9.0	11.00	VAV-5/RTU-1	1500	13.68	2003	250	2.28	350	1	3.55	5.83			
C104	Core Classroom	740	9.0	12.00	VAV-6/RTU-1	1500	12.16	2003	250	2.03	350	1	3.15	5.18			
C105	Core Classroom	772	9.0	13.00	VAV-4/RTU-1	1500	11.66	2003	250	1.94	350	1	3.02	4.97			
C106	Core Classroom	771	9.0	13.00	VAV-3/RTU-1	1500	11.67	2003	250	1.95	350	1	3.03	4.97			
Averages - UV/FCU		837		12.49			6.97			2.01			3.01	5.02			
Averages - RTU-1		740		12.21			12.21			2.03			3.16	5.20			