Date: March 2021

Re: Classroom ventilation update

Background:

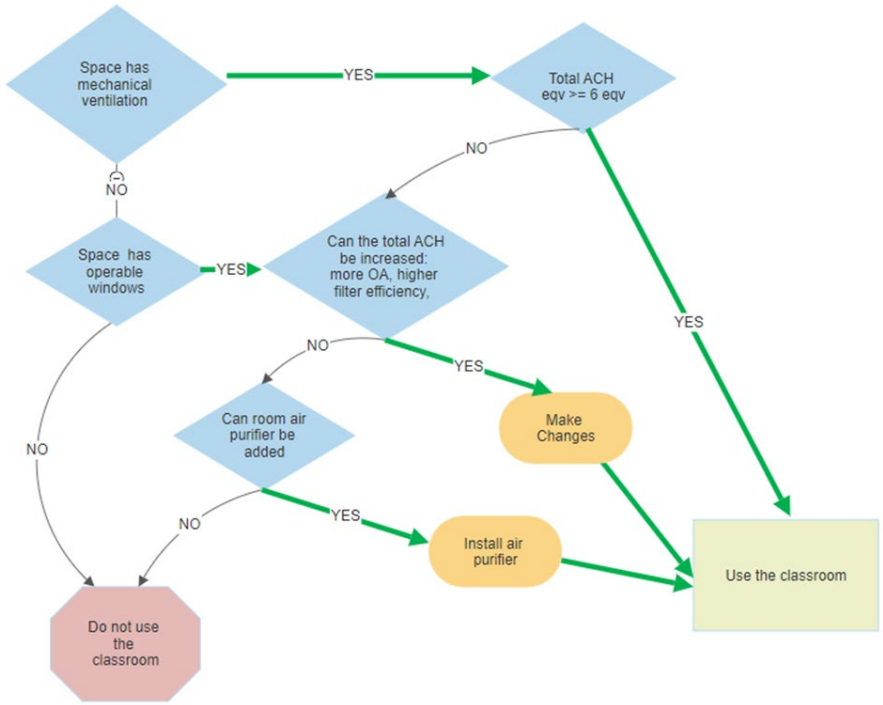
As part of our ongoing review of the University pandemic response protocols, the tri-campus ventilation strategy was recently evaluated. As part of this review, the University retained external professional engineers with expertise in ventilation. Changes are being implemented to classroom ventilation as a result of the assessment.

Additional classroom-specific control measures:

Due to the transient nature of the population using and passing through classrooms that results in greater numbers and density of people in classrooms compared to other spaces, the following control measures are being implemented in classroom environments, refer also to *Figure 1*:

1. ***Performing an HVAC assessment***, including conducting air surveys, to determine air flow rates in classrooms.
2. ***Setting a target ventilation rate*** of 6 equivalent air changes per hour (ACHeq) that has been recommended for classroom environments when they are in use, in alignment with other higher education peers and health sector guidelines.
3. ***Executing ventilation measures in classrooms that do not meet the equivalent ACH target***. Classrooms that do not meet this ventilation target will undergo the following:
    a. First, explore and make changes to existing equipment and/or operations to meet the equivalent ACHeq target if feasible, safe, and appropriate.
    b. If further measures are required to meet the ACHeq target in the space, install one or multiple local air purifier(s).

Figure 1: The following flow chart illustrates the process used in the analysis above:



Scope of classroom assessment:

As part of this process, all classrooms on all three campuses are being evaluated. On the St. George campus, current space inventory includes 618 Classrooms, including Learning Space Management (LSM), divisional, and leased spaces.

Status: As at March 23, 2021, 559 rooms on the St. George campus have been evaluated. Of these:

- 346 meet the target of 6 equivalent air changes per hour
- 213 rooms do not meet the target and are being assessed for either improved HVAC operations or addition of the air purifier.

The evaluation of all spaces is anticipated to be completed end of April with specific follow up in early May.

Similar analysis is being conducted at UTM and UTSC. These assessments and installations (if necessary) are targeted to be completed well in advance of the Fall 2021 term.

Calculations

The University followed the AHSRAE guidance document in assessing the classroom ventilation rates:

ASHRAE: In-Room Air Cleaner Guidance for Reducing COVID 19 In Air in your Space/Room – January 21, 2021

See ***Appendix A*** for sample calculations for classrooms in Sidney Smith Hall.

Air purifier installation – Sidney Smith:

The University has procured air purifiers with HEPA filter systems capable of removing at least 99.97% of airborne particles as small as 0.3 microns to provide supplemental air purification to be installed in those classrooms with less than 6 equivalent air changes per hour.

Additional advantages of installing this particular air purifier unit include:

- ✓ Low decibel levels to minimize disturbance to classroom users and pedagogy
- ✓ Visual indicator of filter health to trigger timely replacement
- ✓ Non - intrusive installations

A sample of these units was installed in one Sidney Smith classroom, and was reviewed by Learning Space Management.

Appendix A: Example Sidney Smith Building, 100 St. George Street

HVAC assessment was completed for 41 rooms at Sidney Smith.

Step 1: **Collect as found HVAC data**

A certified air balancing technician measured supply air at the air vents and measured minimum volumetric % of outside air at the air handling units.

Sample of data collection for selected rooms is presented in the table below.

Room #	Room Name	Seat Capacity	Shared Area (sqm)	AHU (ID # or N/A)	Height (m)	min % of Outside Air @ AHU (based on AHU OA cfm/SA	VAV or CV system	Overhead or Underfloor supply (OH / UF)	Total SA cfm min	Total SA cfm max	Comments for Filtering	min ACH (min OA)	Min ACH (MERV 13 85% Eff)	ACH eqv
2101	Non-Spclzd Seminar Room	25.00	38.42	AH-08 /AH-12	3.333	30.00%	CV	OH	845	845		3.30	6.92	10
2104	Seminar Room	15.00	19.02	AH-08	3.326	30.70%	CV	OH	295	295		2.46	4.99	7
2112	Non-Spclzd Seminar Room	15.00	19.17	AH-08	3.327	30.70%	CV	OH	335	335		2.76	5.61	8
2114	Non-Spclzd Seminar Room	26.00	39.36	AH-08	3.328	30.70%	CV	OH	540	540		2.15	4.36	7
2116	Non-Spclzd Seminar Room	15.00	18.78	AH-08	3.320	30.70%	CV	OH	335	335		2.76	5.61	8
2119	Non-Spclzd Seminar Room	15.00	18.78	AH-12	3.323	46.00%	CV	OH	470	470		5.98	6.31	12
2120	Non-Spclzd Seminar Room	25.00	39.36	AH-12	3.317	46.00%	CV	OH	1260	1260	AM to review	7.36	7.77	15
3041	Seminar/Meeting Room	7.50	9.41	AH-13	2.703	32.20%	VAV	OH	405	500	AM to review	9.02	17.07	26
3130	Seminar Room	0.00	91.82	INFILL AH#17 UNIT	2.500	22.40%	VAV	OH	2530	2530		4.26	13.26	18
4004	Seminar Room	8.00	17.65	AH-13	2.703	32.20%	VAV	OH	315	410		3.54	6.71	10
4043	Seminar Room/Lounge	10.00	29.97	AH-14	2.696	32.00%	VAV	OH	135	550	minimum SA air	0.96	1.83	3
5016G	Seminar Room	30.00	46.14	AH-14	2.712	32.00%	VAV	OH	460	885	AM to review	1.92	3.67	6
5064	Seminar/Conference Room	8.00	8.82	AH-16	2.713	19.60%	VAV	OH	205	340	AM to review	2.94	10.85	14

Step 2: Calculation of ACHeq

Calculation of ACHeq, is the calculation of the air change rate if the total supply air is 100% outdoor air – hence the name equivalent air change rate.

- ACHeq = ACHoa + ACHf
  - ACHoa – air change rate per hour from the outside air
  - ACHf – air change rate per hour from the filtered recirculated air.

The MERV 13 filter has average efficiency of 0.8998 (approx 90%), hence the ACHf is calculated as:

ACHf=ACHr * (1-0.8998) = (ACH-ACHoa)*(1-0.8998)

Step 3: **Selection of air purifiers**

4 rooms had ACHeq < 6:

Building #	Room #	Room Name	Max of min % of Outside Air @ AHU (based on AHU OA cfm/SA cfm)	Max of Total SA cf	min OA ACH	Min REC ACH (MERV 13 89.93% Eff)	Total ACH eqv
033	1078	Classroom - Flat Floor	30.70%	505	1.23	2.49	4
033	2105	Classroom - Flat Floor	30.70%	515	0.92	1.87	3
033	2111	Classroom - Flat Floor	30.70%	460	0.92	1.87	3
033	4043	Seminar Room/Lounge	32.00%	135	0.96	1.83	3

Following the assessment of the operation and the decision to install air purifiers, the consultant selected the unit and marked up the preferred location.

Name of Space / AHU / Building	Units	Sidney Smith Hall Room # 1078	Sidney Smith Hall Room # 2105	Sidney Smith Hall Room # 2111	Sidney Smith Hall Room # 4043
Area	Sq Ft	695.8	855.9	845.2	322.59
Average Ceiling Height	Ft	9.87	10.88	10.92	8.85
Volume	Cu Ft	6867.546	9312.192	9229.584	2854.9215
Total Supply Air	CFM	505	515	460	135
Total Outdoor Air	CFM	155	158	141	43
Supply Air ACH	ACH	4.41	3.32	2.99	2.84
Outdoor Air ACH	ACH	1.35	1.02	0.92	0.91
Central AHU Filter MERV Rating	MERV	13	13	13	13
UVC Single Pass Inactivation	%	0.00%	0.00%	0.00%	0.00%
In Room Fan HEPA Filter (minimum)	CADR	220	420	495	140
In Room Fan HEPA Filter (actual)	CADR	280	420	560	140
Number of In Room Fan HEPA Filters	Qty	1	2	2	1
Effective Air Changes Based on Technology					
ACH_OA	ACH	1.35	1.02	0.92	0.91
ACH_f	ACH	2.75	2.07	1.86	1.74
Sub-Total Effective ACH prior to ACH_ir	ACH	4	3	3	3
ACH_e,c	ACH	0.00	0.00	0.00	0.00
ACH_ir	ACH	2.45	2.71	3.64	2.94
Sub-Total Effective ACH	ACH	7	6	6	6
Zone Air Distribution Effectiveness	Ez	1.0	1.0	1.0	1.0
Total Effective ACH_e		7	6	6	6
Time Required to achieve Target Air Changes	Target Air Changes	3	3	3	3
Minutes	Min	27.48	31.07	28.03	32.23
Hours	Hours	0.46	0.52	0.47	0.54
Req'd CFM @ TOTAL 6 ACH =		687	931	923	285
HEPA UNITS REQUIRED:					
AERAMAX PRO III		--	1	--	1
AERAMAX PRO IV		1	1	2	--

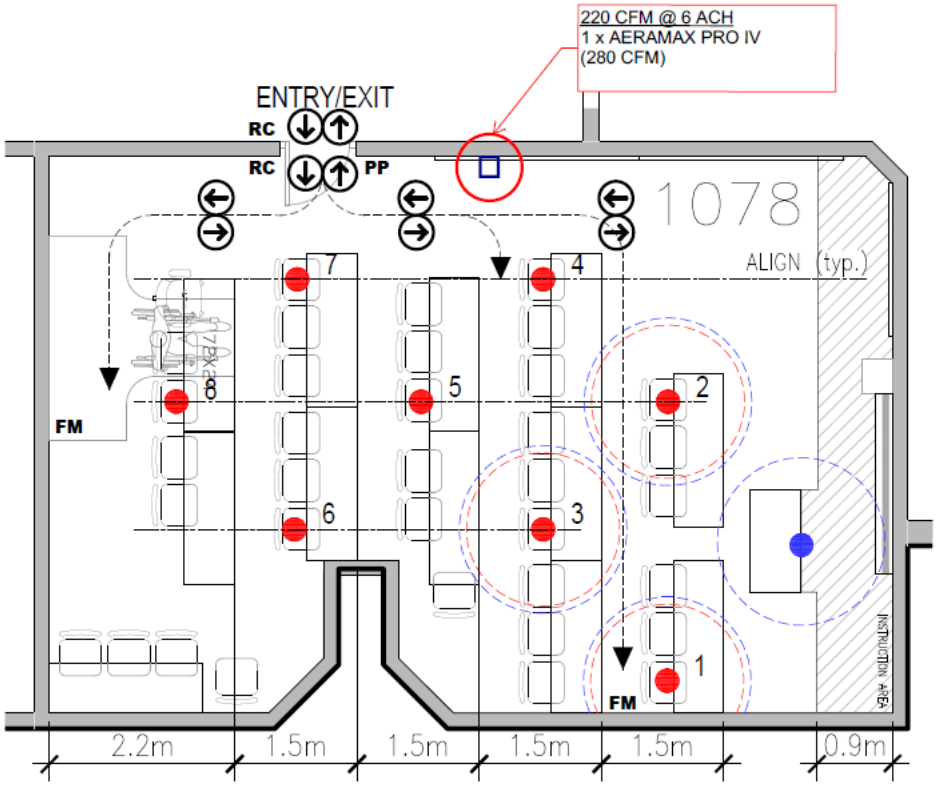
SIGNAGE REQUIREMENTS :

1. Entry and Exit signs to be posted on both the inside and outside of the marked door. Door(s) are marked with the text "ENTRY/EXIT"
2. Path of Travel to be marked with arrowhead decals on the ground as indicated by this symbol ↑.
3. Room capacity (**RC**) signage to be placed adjacent to the entry door on the wall, inside and outside of the room.
4. Informational signage to be placed adjacent to the entry door on the wall;
   A. Room Capacity (**RC**)
   B. Prevention + Precautions (**PP**)
   C. Furniture - Restricted Movement (**FM**)
5. The *Safe Presentation Area* at the front of the room to be marked as indicated by this symbol ▨.

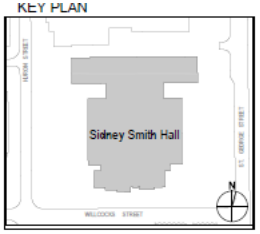
NOTES :

1. This classroom has loose tables and/or chairs; furniture configuration to be as indicated to accommodate positional layout.

DIMENSIONS AND LAYOUTS ARE APPROXIMATE AND REQUIRE SITE VERIFICATION



KEY PLAN



LEGEND

- 2M Dia. Physical Distancing Area
- 1.8M (6') Dia. Physical Distancing Area
- Position for Use (Student)
- Position for Use (Instructor and/or Teaching Assistant)
- Accessible Position
- Teaching Station
- Teaching Station Junior
- Teaching Dock (Projector)
- Teaching Dock (Monitor)

LEARNING SPACE MANAGEMENT
UNIVERSITY OF TORONTO
ST. GEORGE CAMPUS
MCMURRICH BUILDING
Toronto, ON M5S 1S8
tel: 416 978 2187
lsm.team@utoronto.ca

SIDNEY SMITH SAFE CAPACITY SEATING PLAN

SIDNEY SMITH HALL
100 St George St, Toronto, ON M5S 3G3

TITLE:	SS 1078
SAFE CAPACITY:	8
DATE:	July 28, 2020
SCALE:	1:50

SIGNAGE REQUIREMENTS :

1. Entry and Exit signs to be posted on both the inside and outside of the marked door. Door(s) are marked with the text "ENTRY/EXIT"
2. Path of Travel to be marked with arrowhead decals on the ground as indicated by this symbol (↑).
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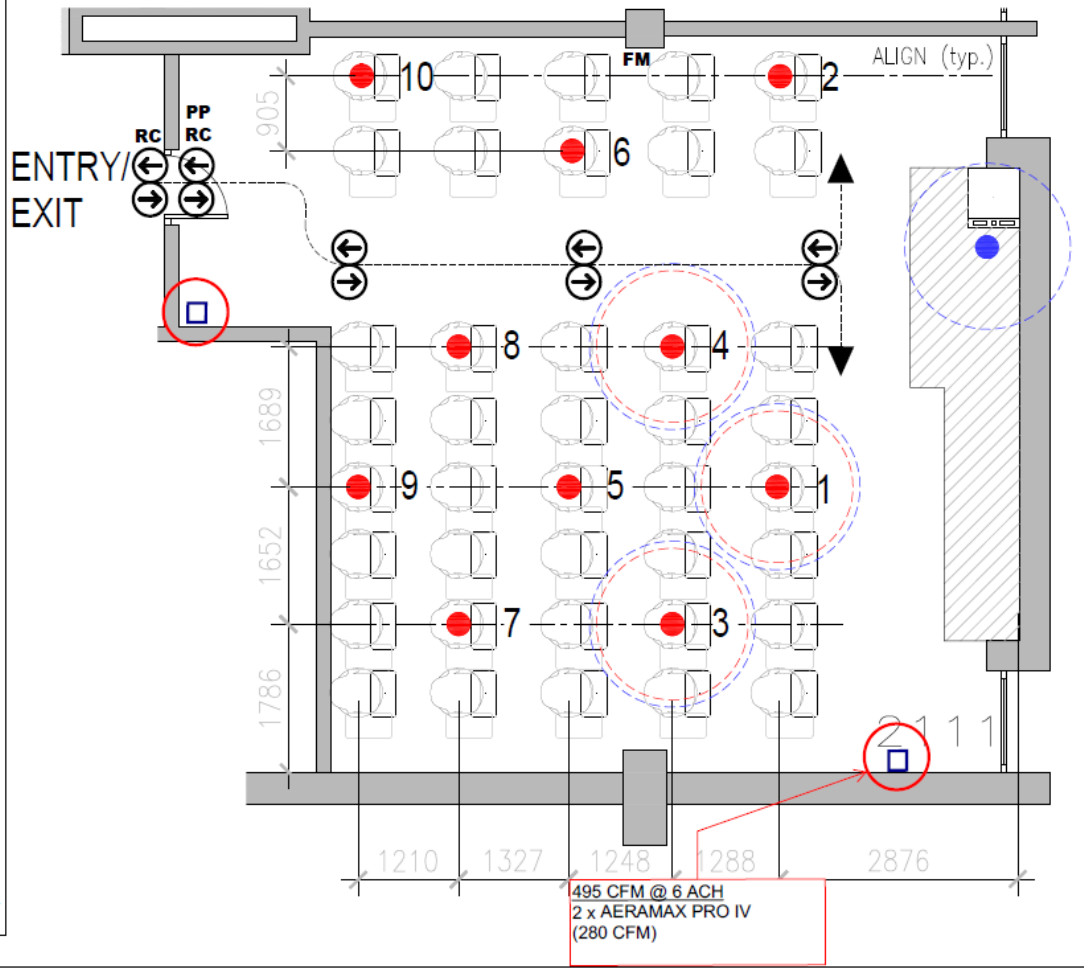

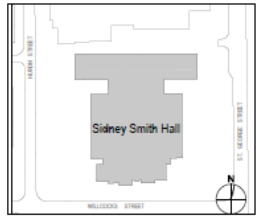

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SIDNEY SMITH SAFE CAPACITY SEATING PLAN

SIDNEY SMITH HALL
100 St George St, Toronto, ON M5S 3G3

TITLE:	SS 2111
SAFE CAPACITY:	10
DATE:	July 29th, 2020
SCALE:	1:50

SIGNAGE REQUIREMENTS :

1. Entry and Exit signs to be posted on both the inside and outside of the marked door. Door(s) are marked with the text "ENTRY/EXIT"
2. Path of Travel to be marked with arrowhead decals on the ground as indicated by this symbol (↑).
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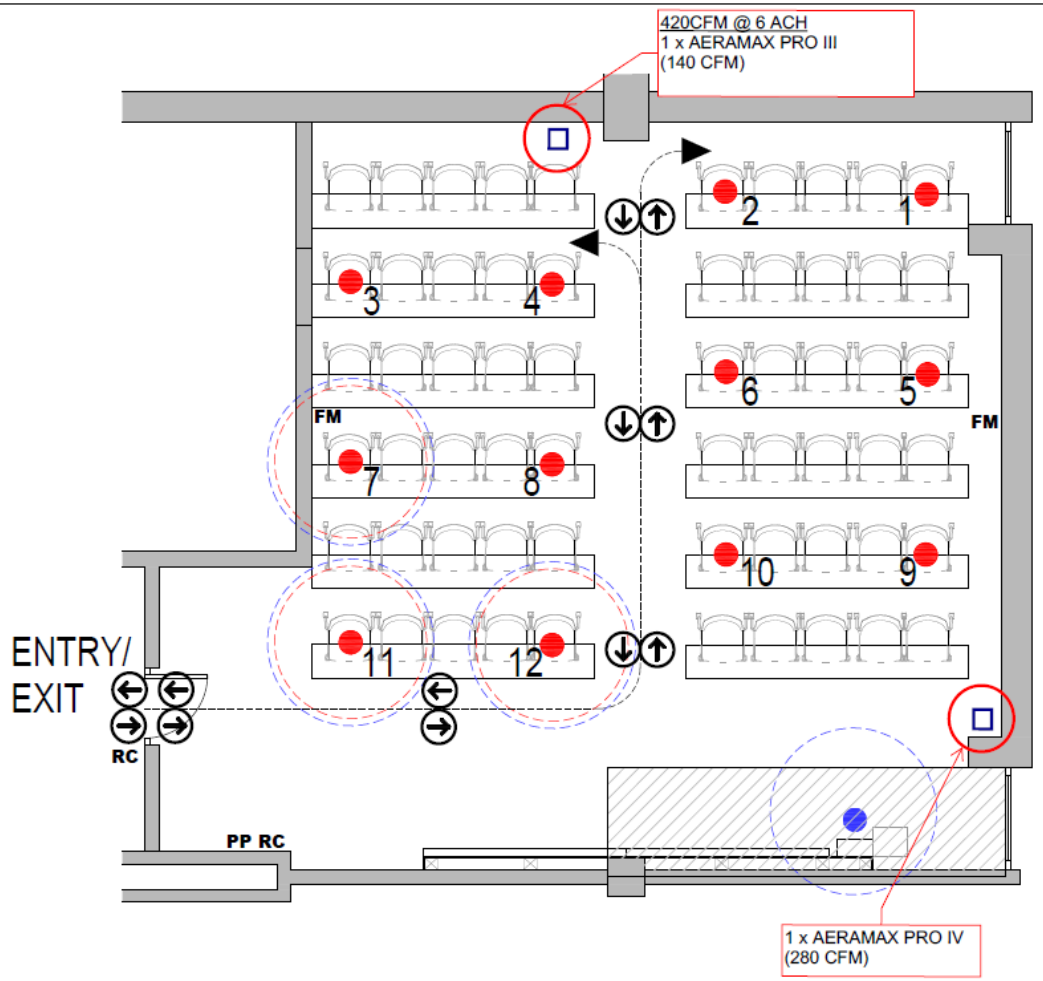
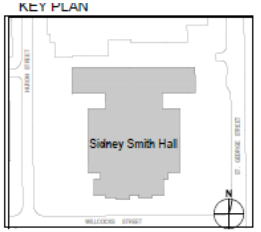


KEY PLAN



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SIDNEY SMITH SAFE CAPACITY SEATING PLAN

SIDNEY SMITH HALL
100 St George St, Toronto, ON M5S 3G3

TITLE:	SS 2105
SAFE CAPACITY:	12
DATE:	July 28th, 2020
SCALE:	1:50