



2023 ASHRAE WINTER CONFERENCE

ATLANTA, Feb 4-8 | AHR Expo, Feb 6-8

Seminar 9: Infection Control in Commercial Spaces

**Modeling Portable Air Cleaners with Existing Ventilation System to
Combat Airborne Disease Transmission in a Retail Store**

Long Phan, Ph.D.

long.phan@coilmastercorp.com

Learning Objectives

1. Learn how to use CFD to investigate the mitigation strategies for indoor contaminant spread.
2. Understand how to model airborne virus transmissions by drift-flux model.
3. Explain the importance of particle surface deposition when modeling airborne virus transmissions.
4. Understand the relative effectiveness of various controls among space and HVAC system types.

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Outline/Agenda

- Background
- Retail Space Layout
- Retail Space Models
- Age of Air
- Contaminant Mass Concentration
- Conclusion

Background

- Air cleaners and HVAC filters can help reduce airborne contaminants including viruses in a building or small space.
- Portable air cleaners (PACs) are recommended to supplement increased HVAC system ventilation and filtration, especially in areas where adequate ventilation is difficult to achieve
- Air cleaning may be useful when used along with source control and ventilation, but it is not a substitute for either method
- Each space is different (i.e., layout, systems, etc.), thus, requires different number of PACs and placements.
- Effective placement of PACs is very important to mitigate airborne disease transmission

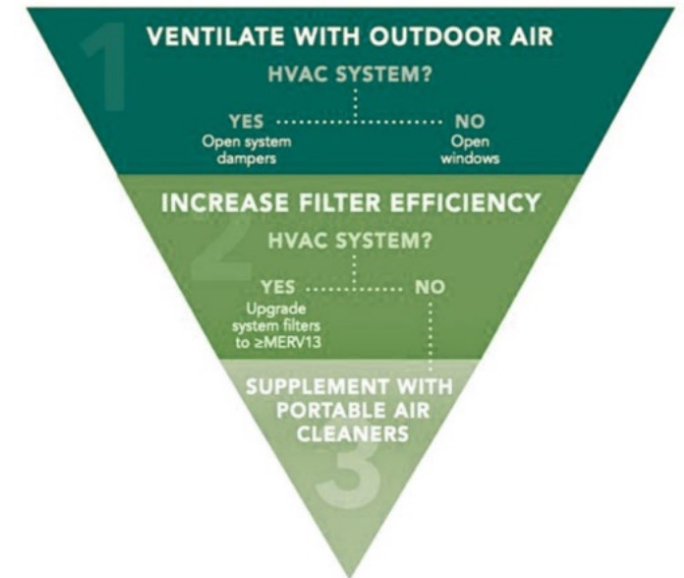
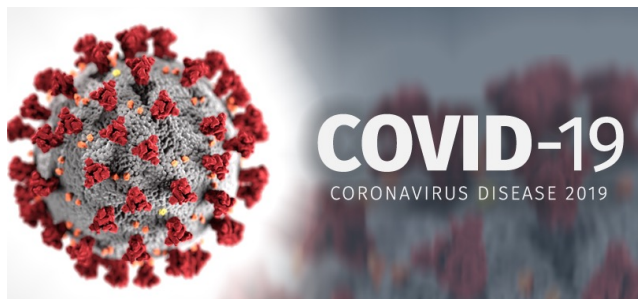
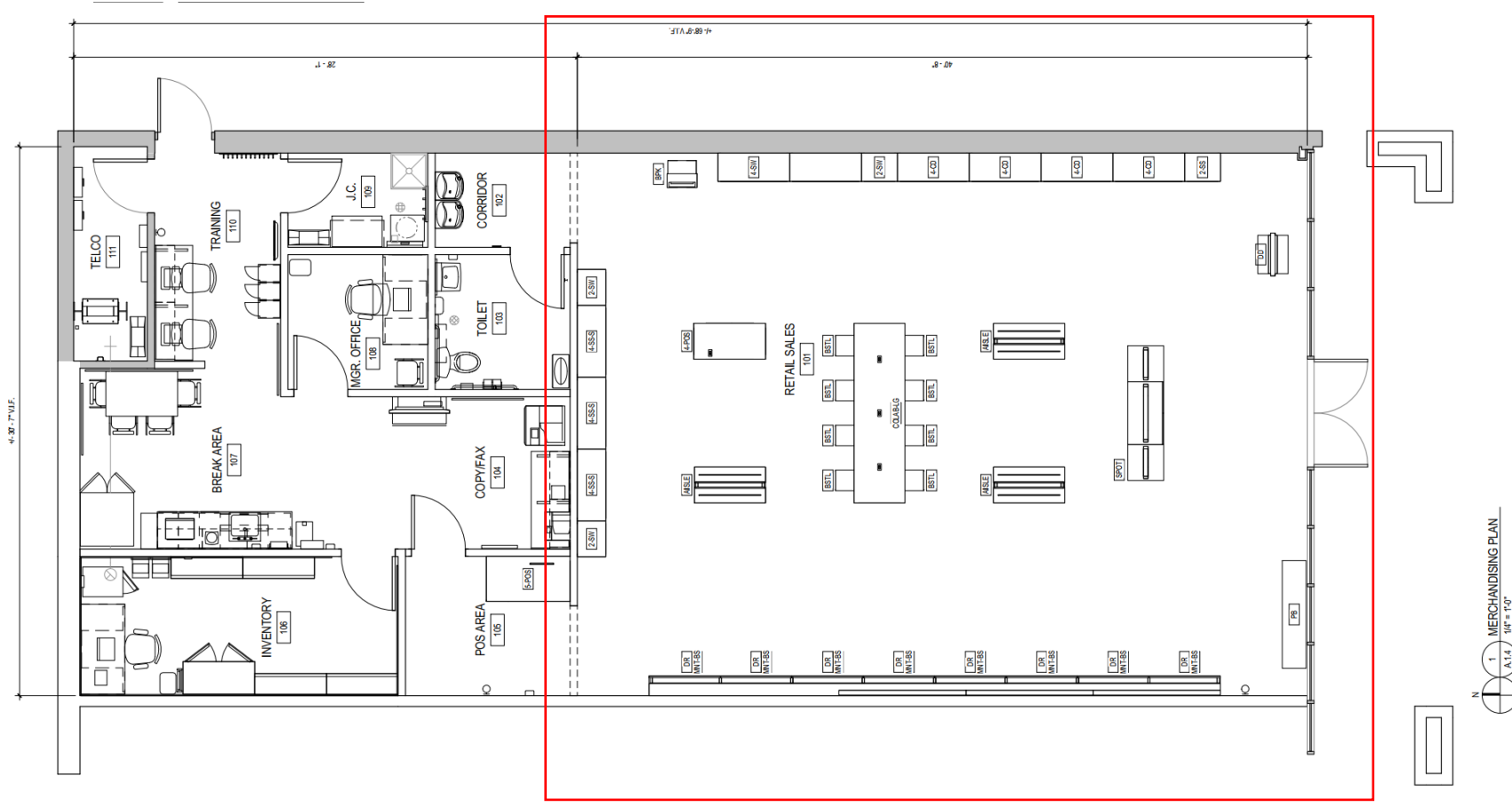


Figure 2. Illustration of the order in which to consider improvements to ventilation in buildings.²

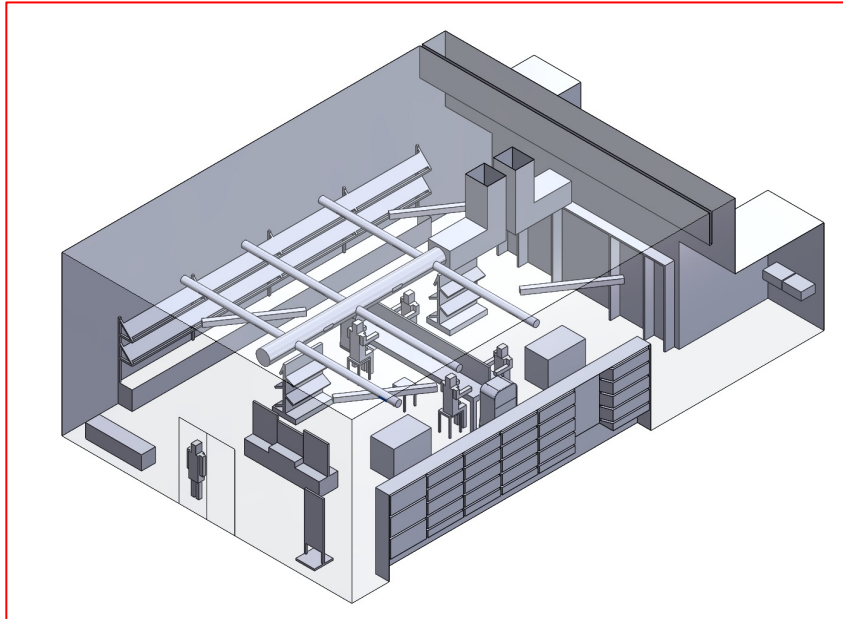
Source: Source, Jones et al, 2020. Schools for Health, Risk Reduction Strategies for Reopening Schools. Harvard Healthy Buildings Program.

Retail Store Layout

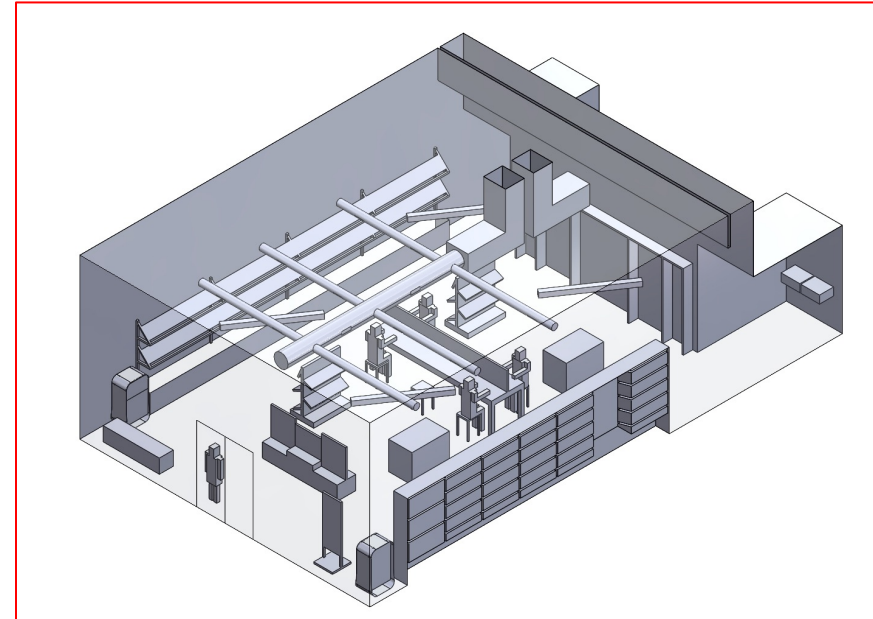


Retail Space Models

PACs at table

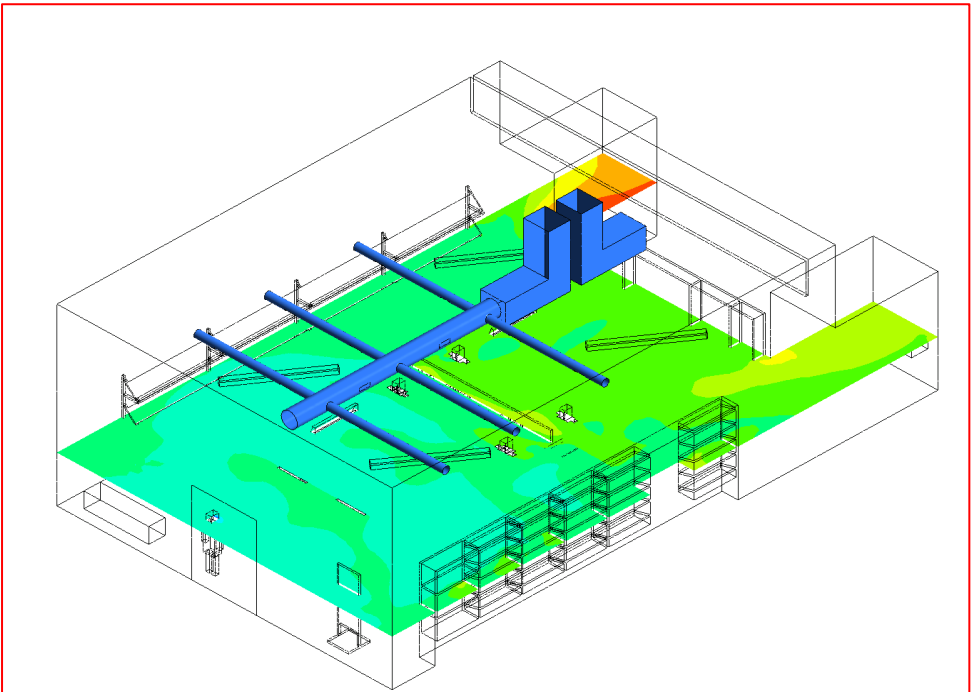
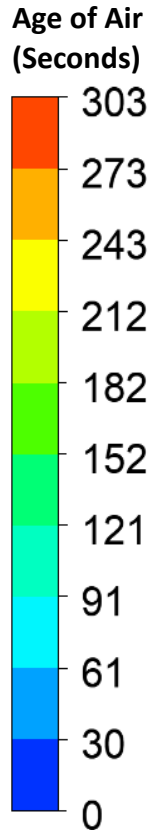


PACs in front of store

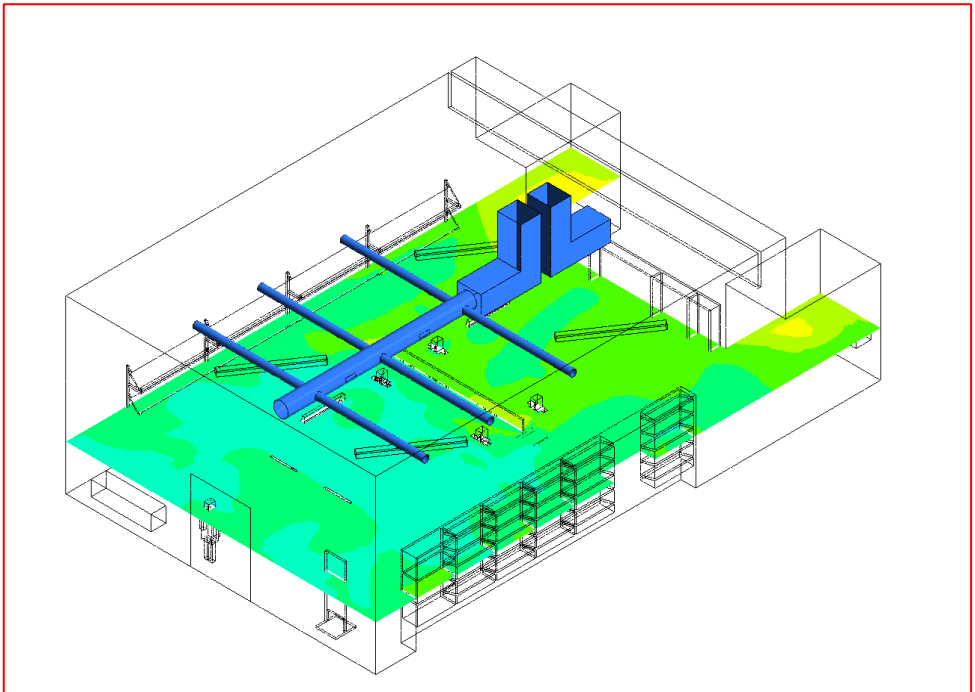


Store Volume	22,006	cu. ft.
Total Supply (HVAC)	7,000	CFM
OA Supply	1,050	CFM
CFM per PACs	220	CFM
No. of PACs	2	
CADR Supply (Purifier)	440	CFM
eACH	4.06	

Age Of Air (Sectioned Plane At 4.5 Ft)



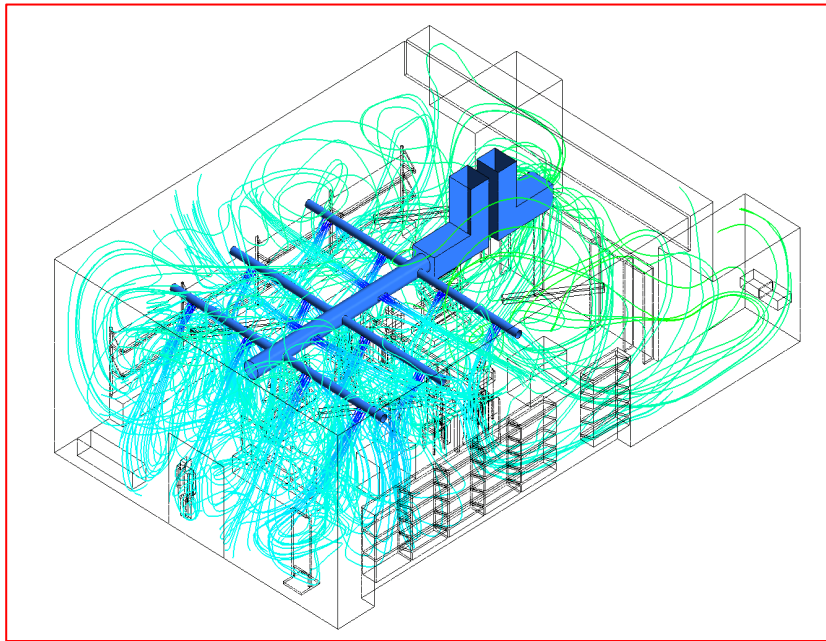
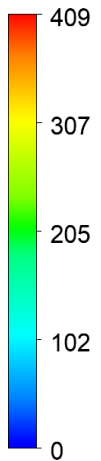
Without PACs



With PACs

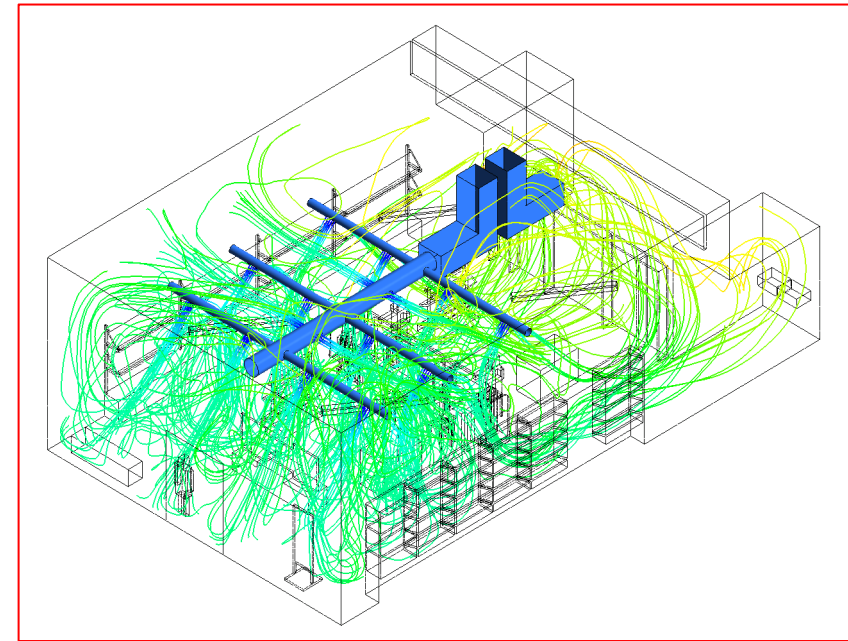
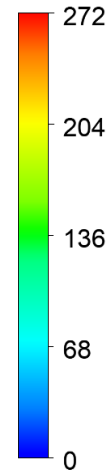
Age Of Air (Released From Main Diffusers)

Age of Air
(Seconds)



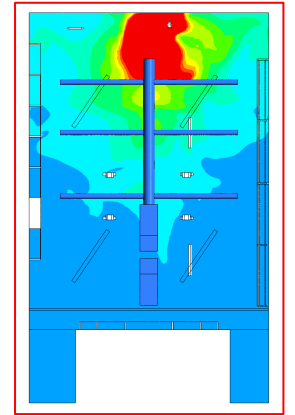
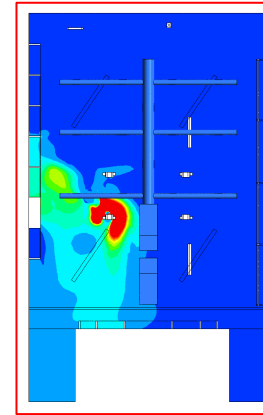
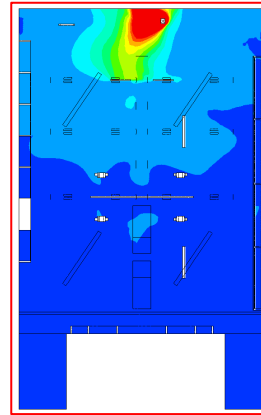
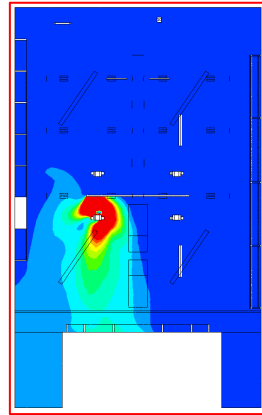
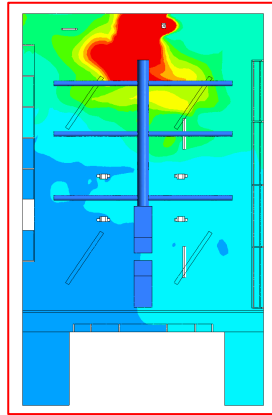
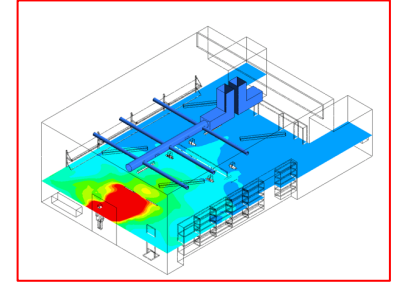
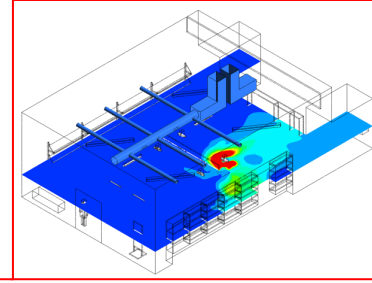
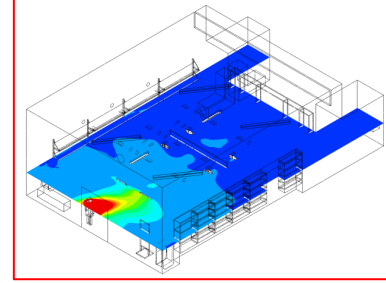
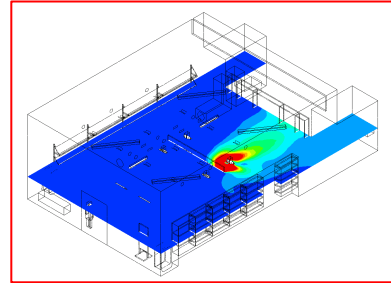
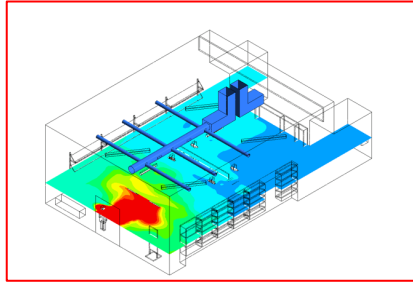
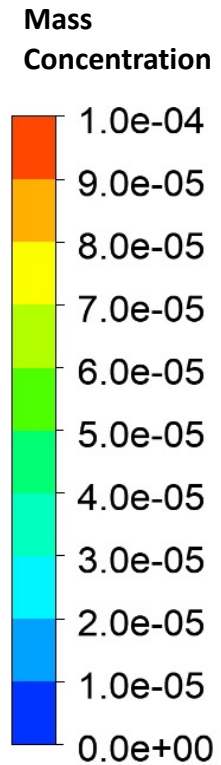
Without PACs

Age of Air
(Seconds)



With PACs

Contaminant Mass Concentration (Top View at 4.5 ft)



w/o PACs

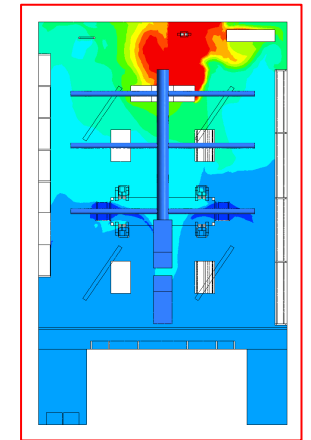
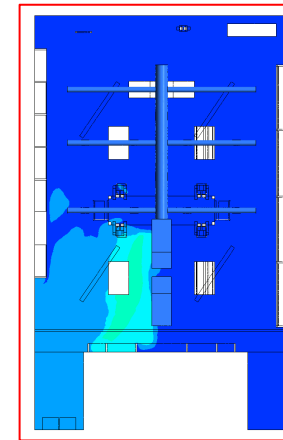
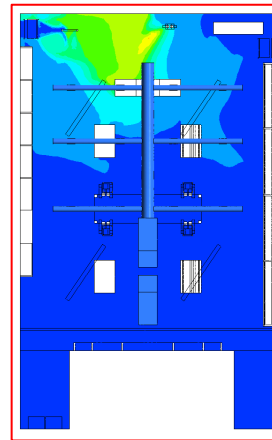
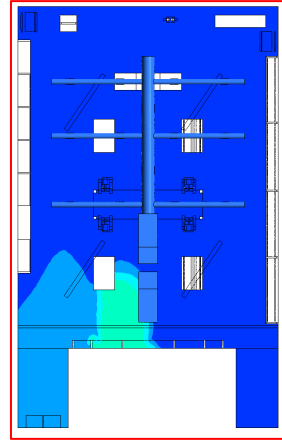
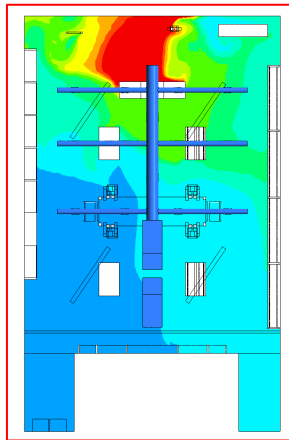
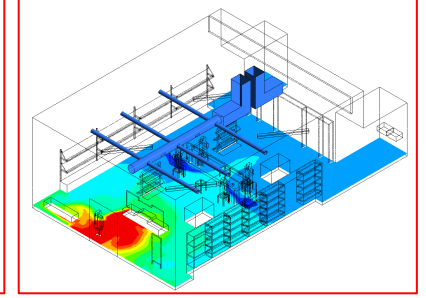
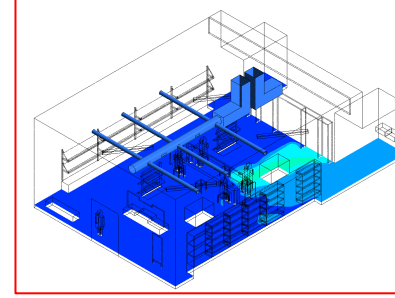
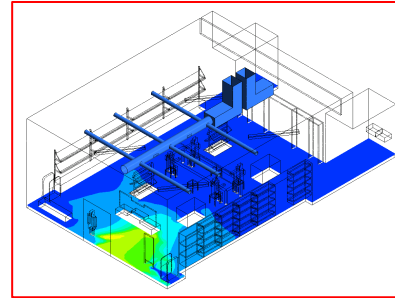
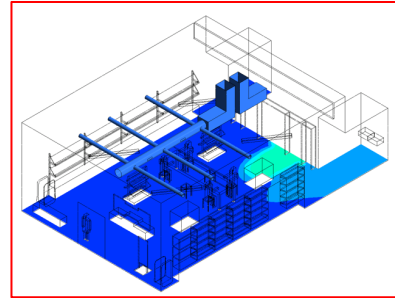
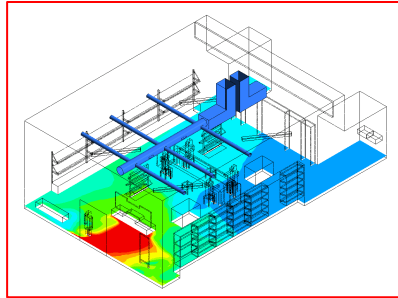
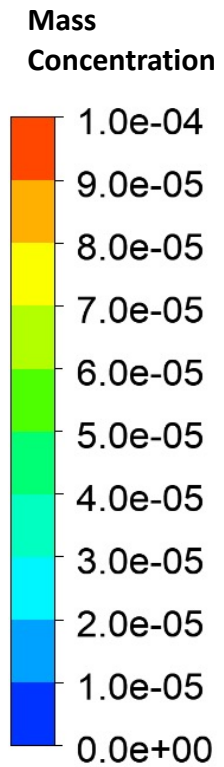
w/ PACs (front)

w/ PACs (front)

w/ PACs (table)

w/ PACs (table)

Contaminant Mass Concentration (Top View at 0.5 ft)



w/o PACs

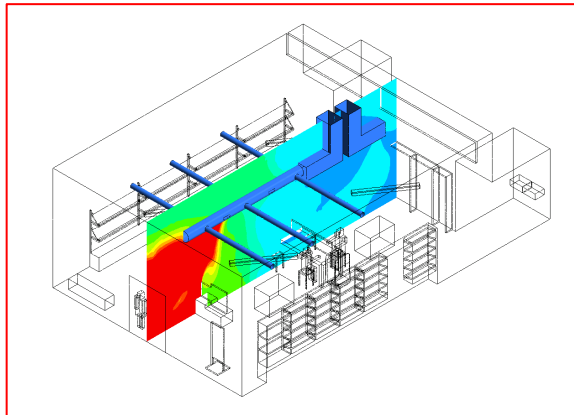
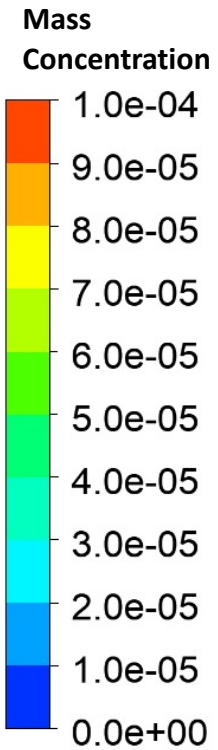
w/ PACs (front)

w/ PACs (front)

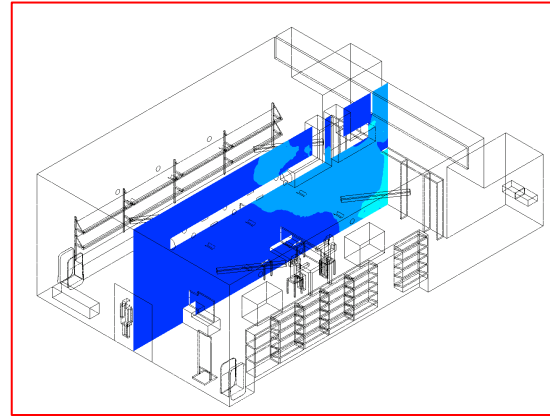
w/ PACs (table)

w/ PACs (table)

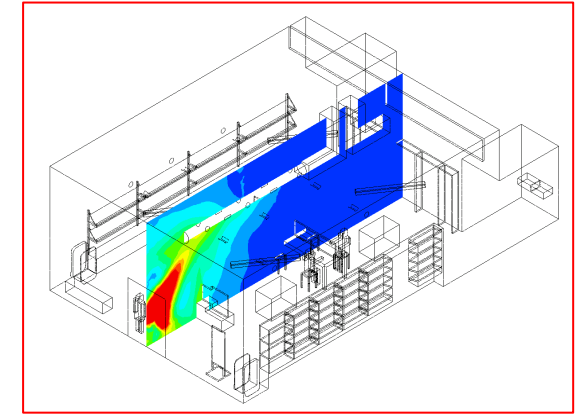
Contaminant Mass Concentration at Mid Plane



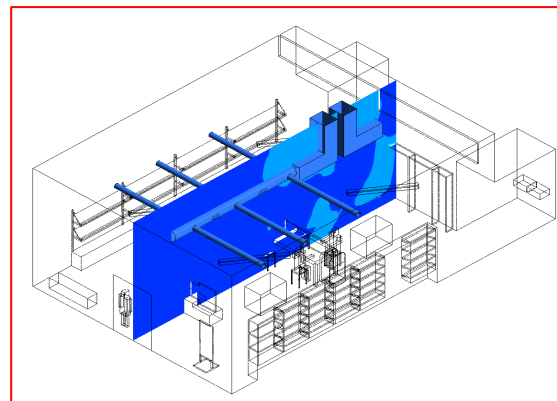
w/o PACs



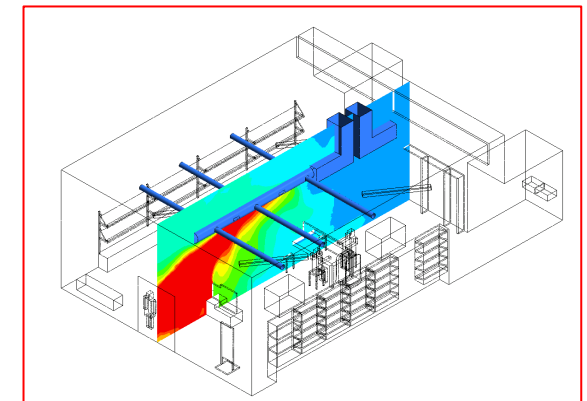
w/ PACs (front)



w/ PACs (front)

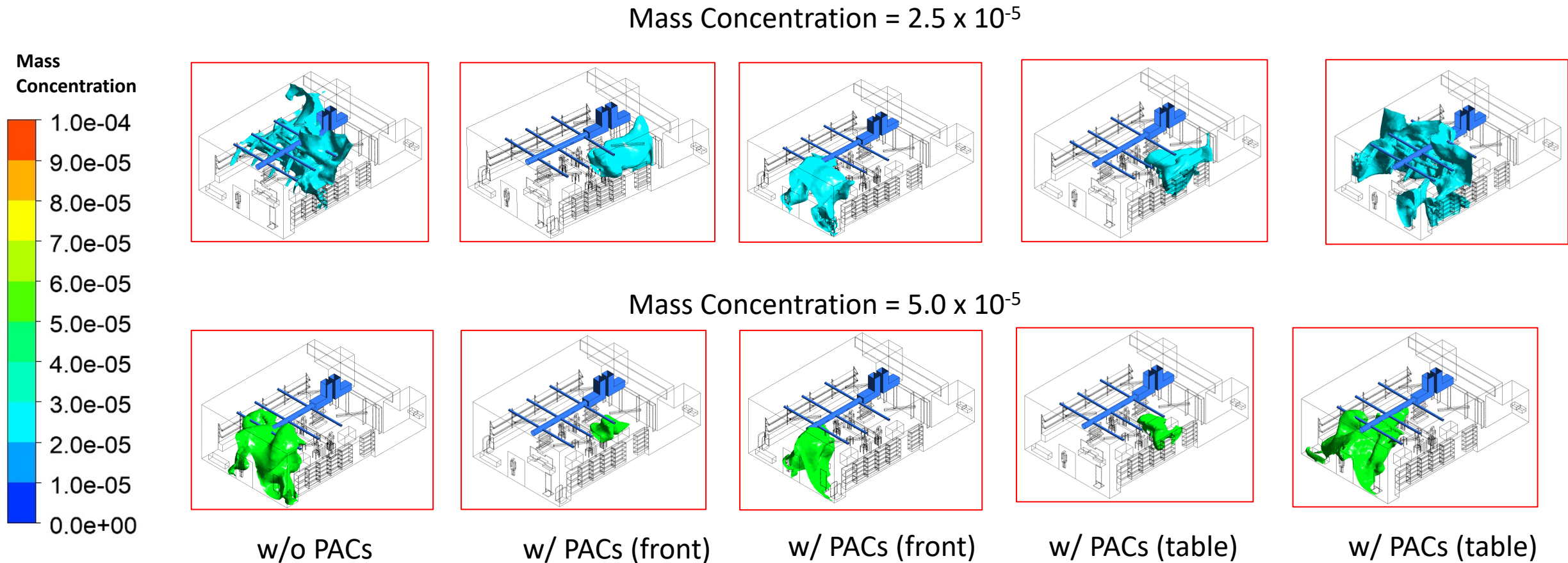


w/ PACs (table)



w/ PACs (table)

Contaminant Mass Concentration at Different Levels



Conclusion

- With and without portable air cleaners (PACs) are compared to show airborne contaminant control effectiveness
- PACs are recommended to supplement increased HVAC system ventilation and filtration, especially in areas where adequate ventilation is difficult to achieve.
- PACs also enhance the ACH of the building when used with existing ventilation shown by the reduction in age of air.
- Front placement of PACs shows effective mitigation of contaminants released from persons at both front door and working table.