

# COMMERCIAL BUILDING DESIGN FOR COVID-19 & BEYOND

June 18<sup>th</sup>, 2020

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**ENVIRONMENT**

**SPACES**

**SYSTEMS**

**ENVIRONMENT**

**SPACES**

**SYSTEMS**

OUTDOOR VS. INDOOR

2



7322



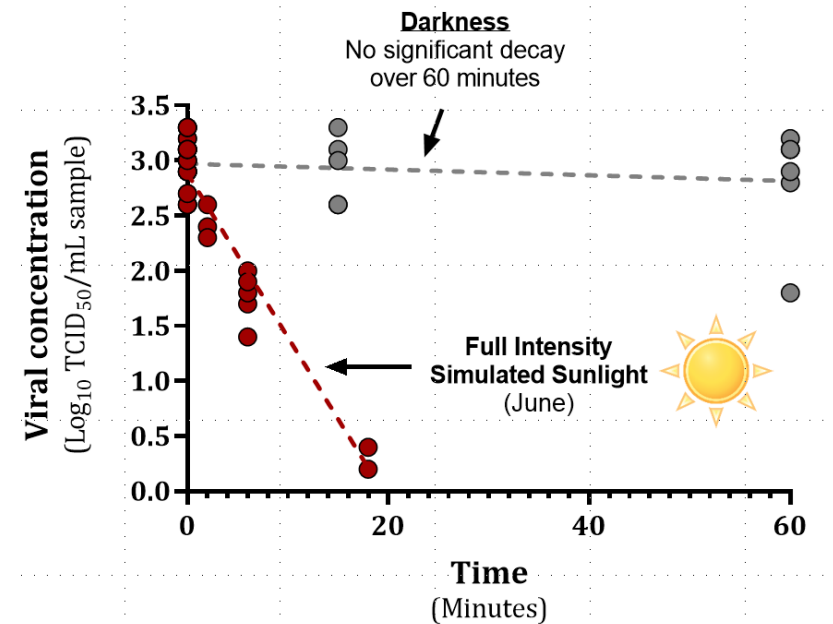
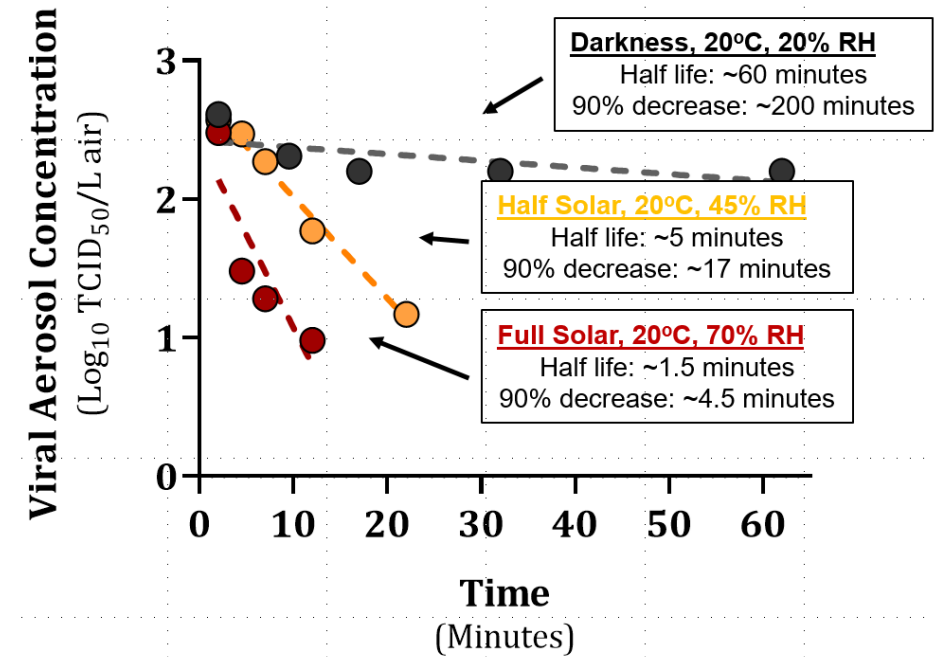
# SOLAR IMPACT SARS-COV2 :

## TOP: AIR

90% reduction from 200 minutes to 4.5 minutes

## BOTTOM: STAINLESS STEEL

90% reduction in 7 minutes



# AIR QUALITY

*“...increase of only 1 g/m<sup>3</sup> in PM2.5 is associated with a 15% increase in the COVID-19 death rate..”*

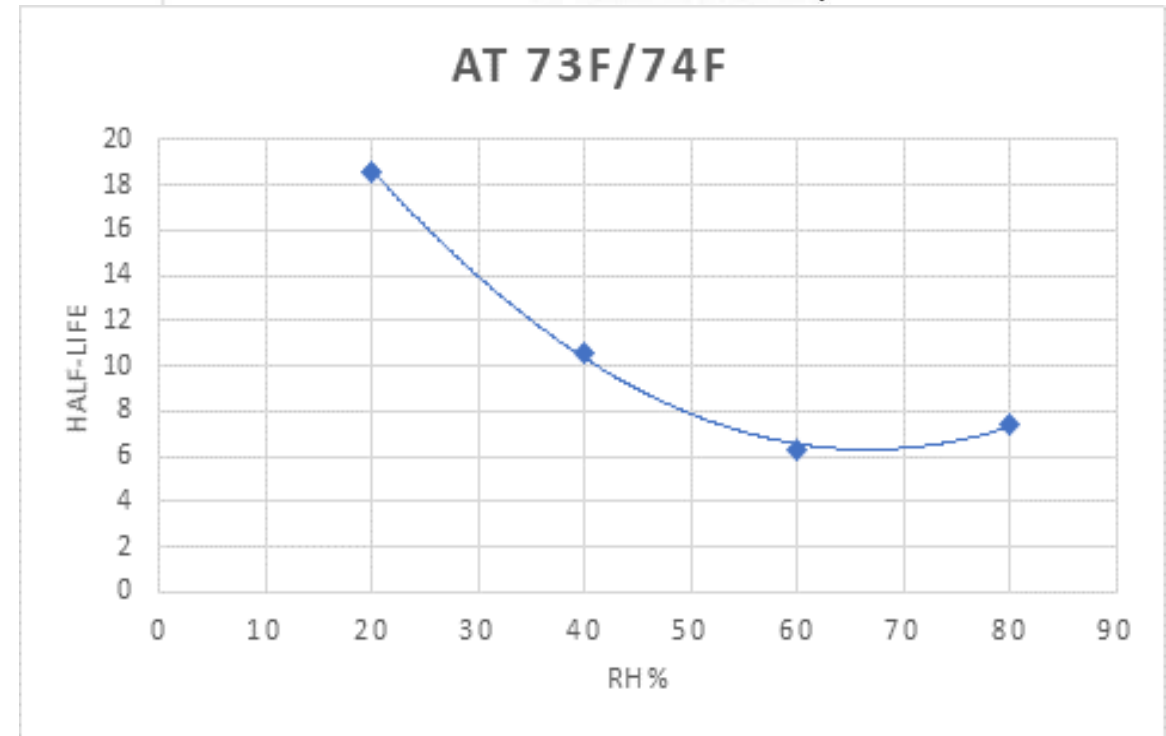
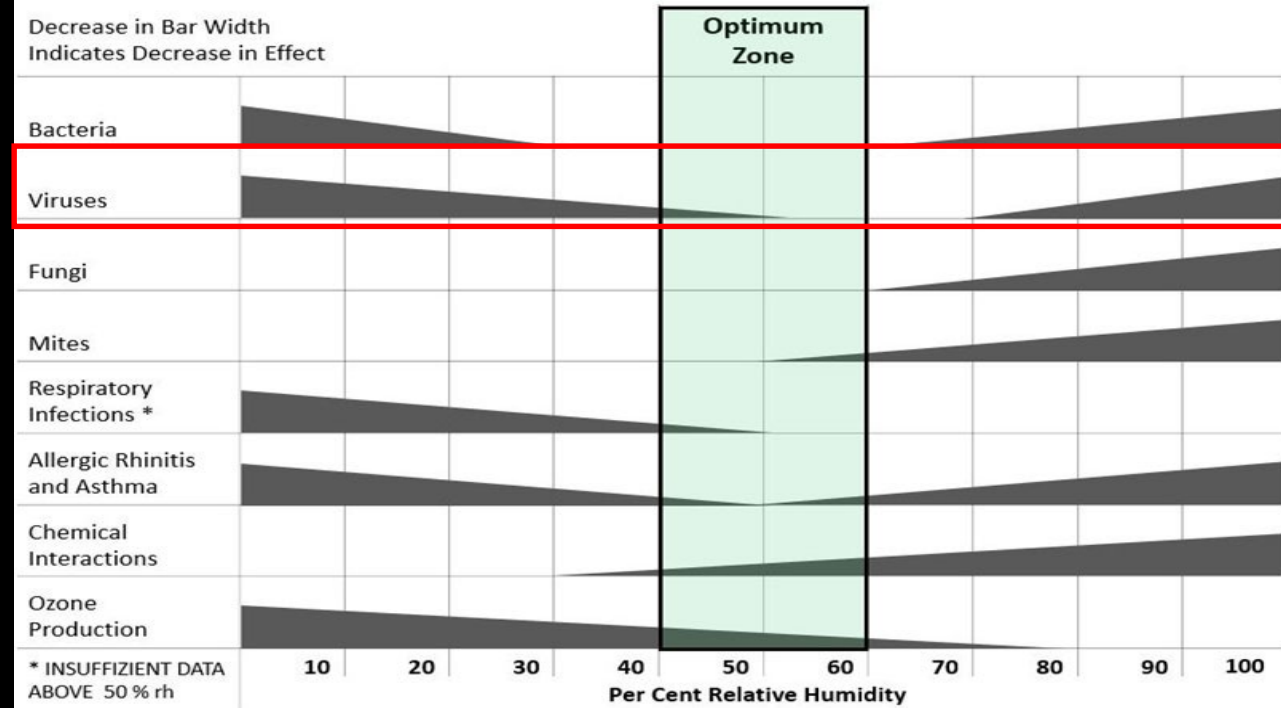
Harvard T.H. Chan School of Public Health



# ENVIRONMENT

Relative Humidity:

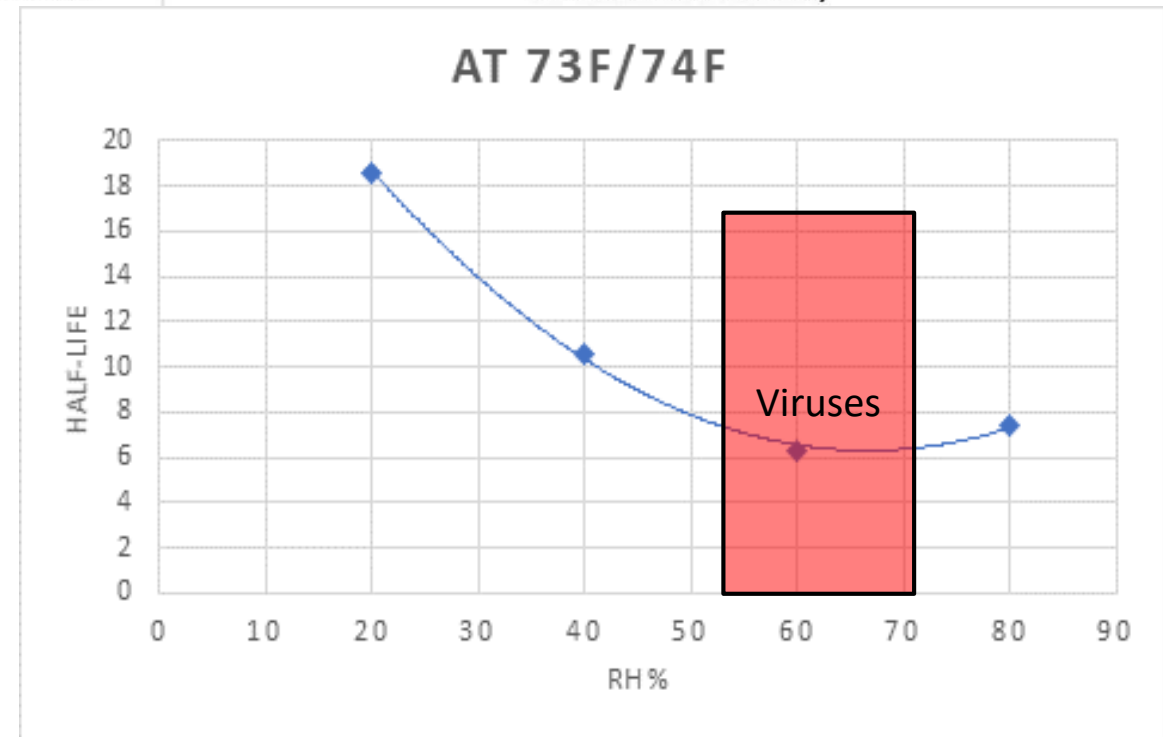
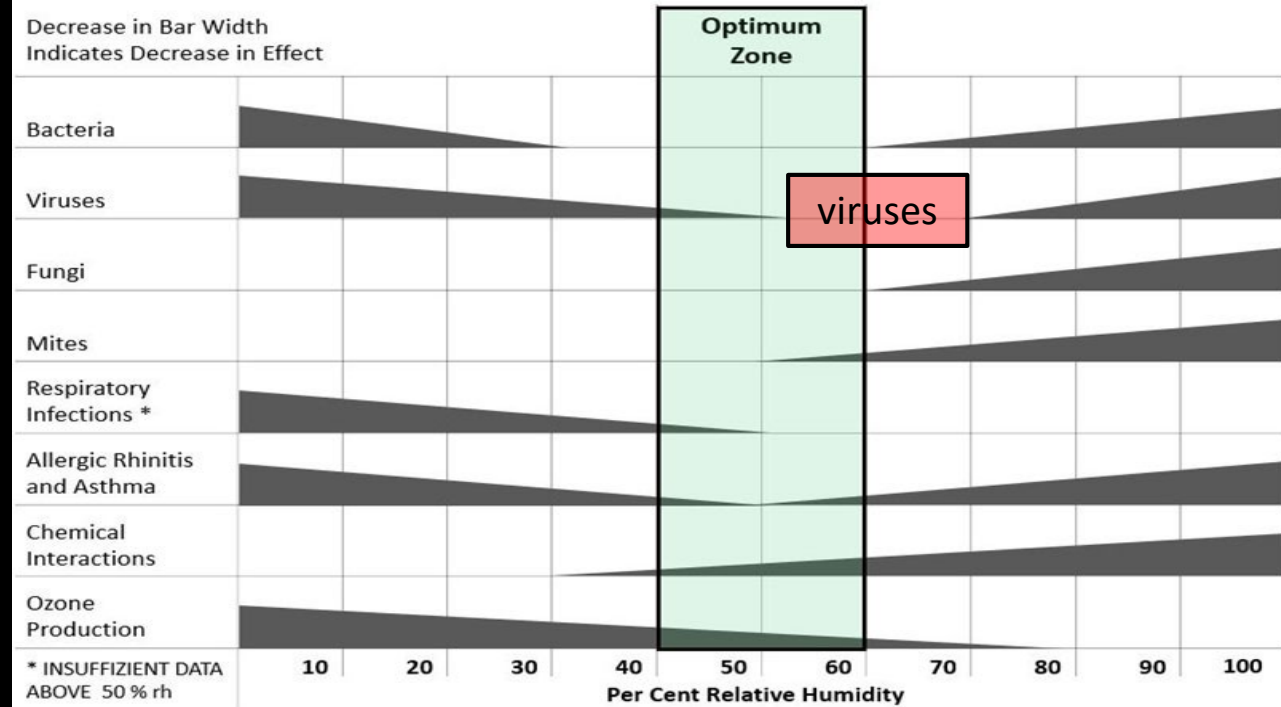
- 40-60%



# ENVIRONMENT

Relative Humidity:

- 40-60%





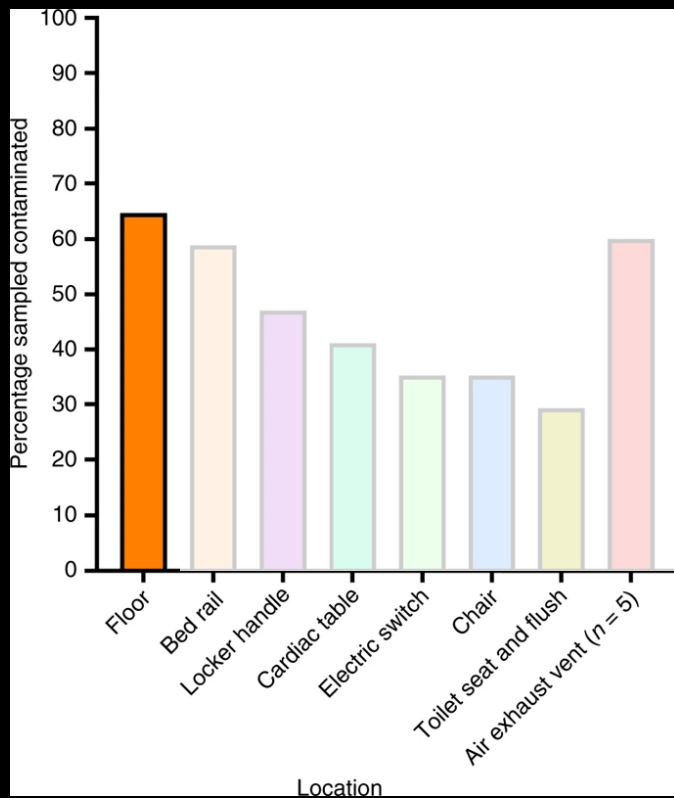
# ENVIRONMENT

40 °F  
Stable for weeks

158 °F  
Inactivate in 5 Minutes



# RESUSPEND - FLOOR





# CARPET VS. HARD FLOOR

## Surface dust loading values (mg m<sup>-2</sup>)

	D <sub>p</sub> <500 μm	D <sub>p</sub> <45 μm	D <sub>p</sub> <10 μm	D <sub>p</sub> <2.5 μm
<b>Carpet</b>				
Geometric mean	7800	310	41	16
95th Percentile	38000	1500	200	76
<b>Hard floor</b>				
Geometric mean	420	17	2.2	0.8
95th Percentile	2400	96	12	4.8

Almost 20 Times More Material



ENVIRONMENT

**SPACES**

SYSTEMS

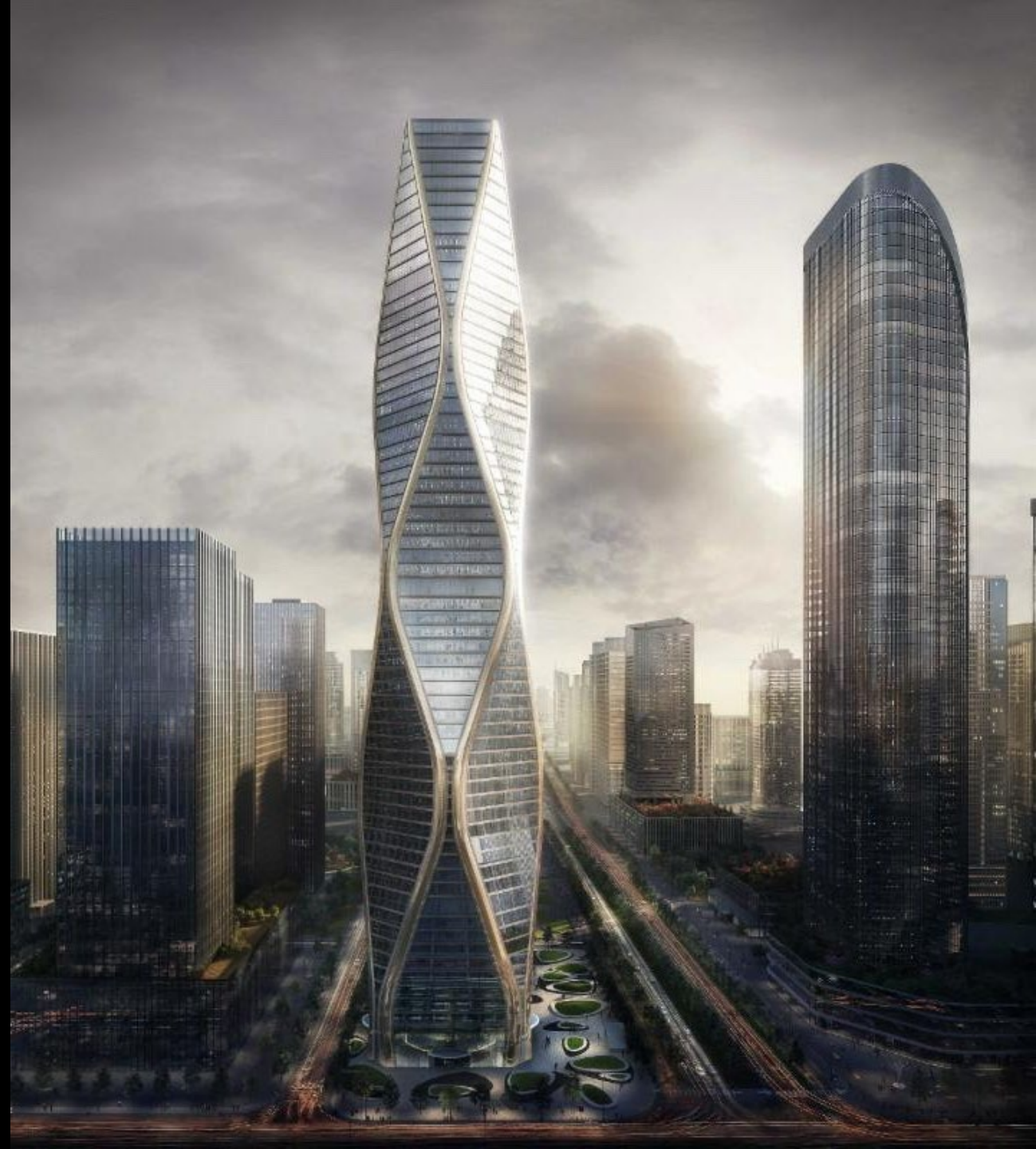


# BASE BUILDING CONSIDERATIONS

Epidemic plan from base building

*"Employees should wear a cloth face covering to cover their nose and mouth in all areas of the business."*

COVID-19 Employer Information for Office Buildings



# LOBBY

1. Pressurized
2. Sanitized
3. Time - touchless





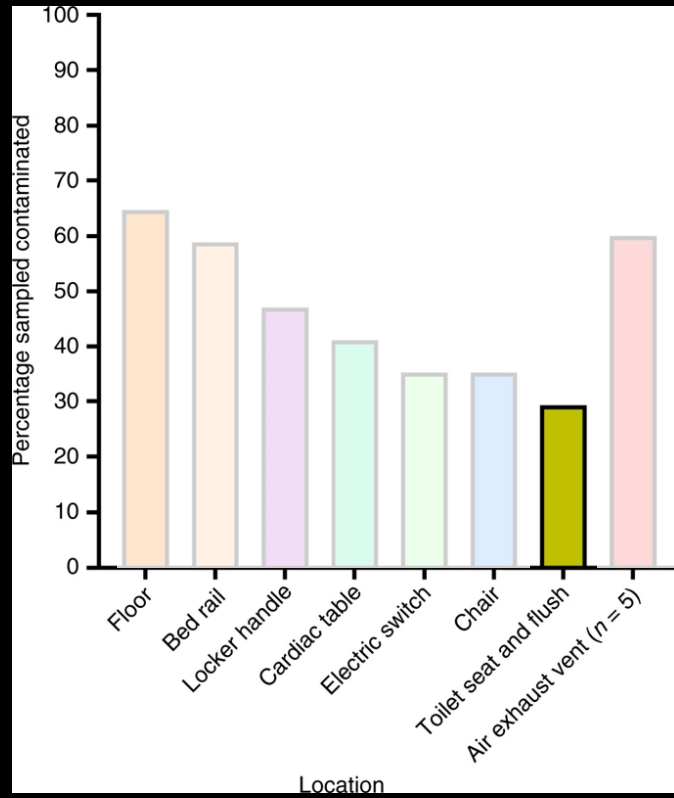


请站在黄格内测温  
Please stand in the yellow grid for temperature measurement.

请站在黄格内测温  
Please stand in the yellow grid for temperature measurement.

通往商场  
EXIT TO MALL  
出口  
EXIT

# RESUSPEND - TOILET





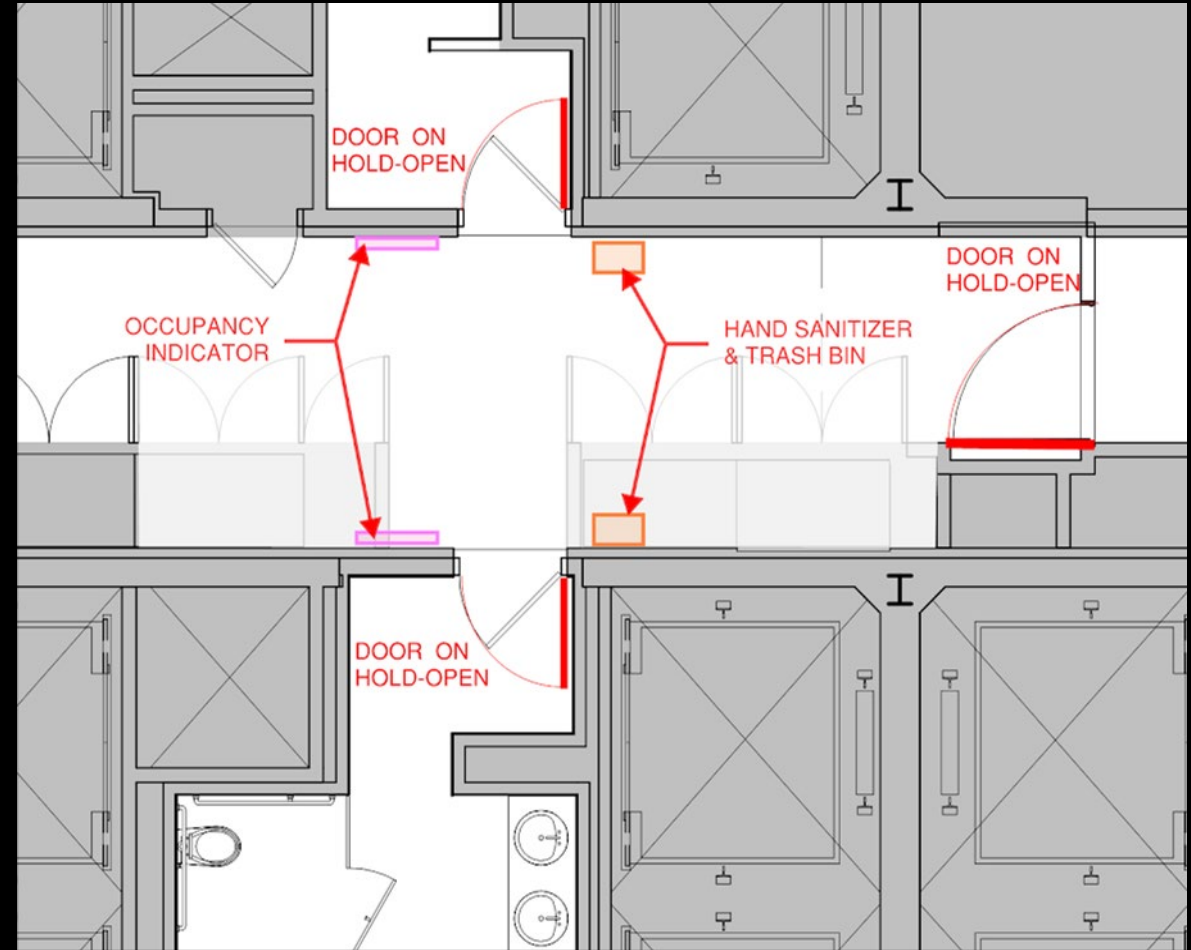
# TOILET

1. Continuous exhaust
2. Door hold open
3. Consider occupants indicator

Occupancy Indicator

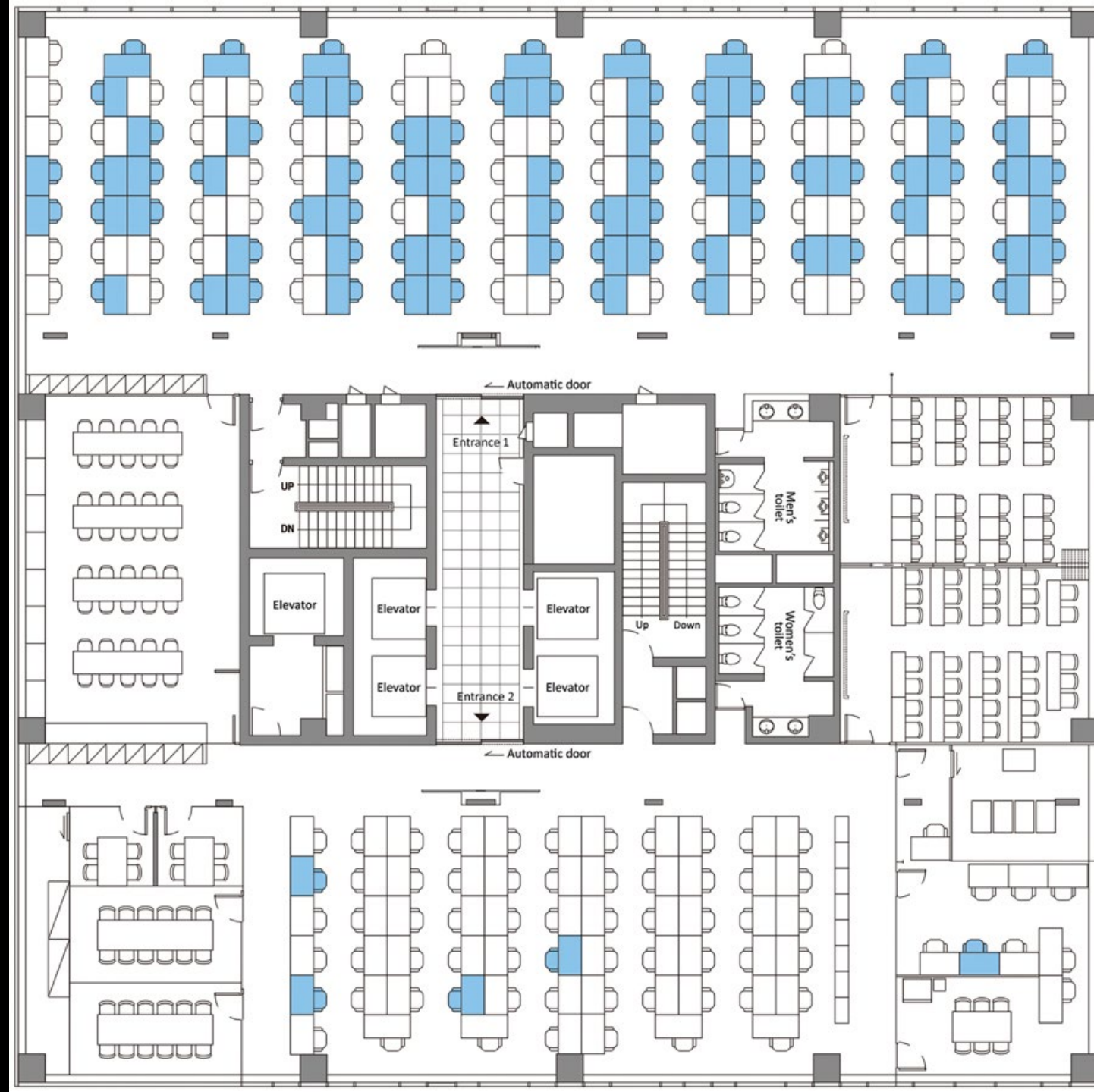


Occupancy Indicator



# WILL OUTBREAKS IMPACT OTHER FLOORS?

- Korean Call Center:
  - 97 of the 811 employees tested positive
  - 94 sat on the same floor





# ATRIUM



ENVIRONMENT

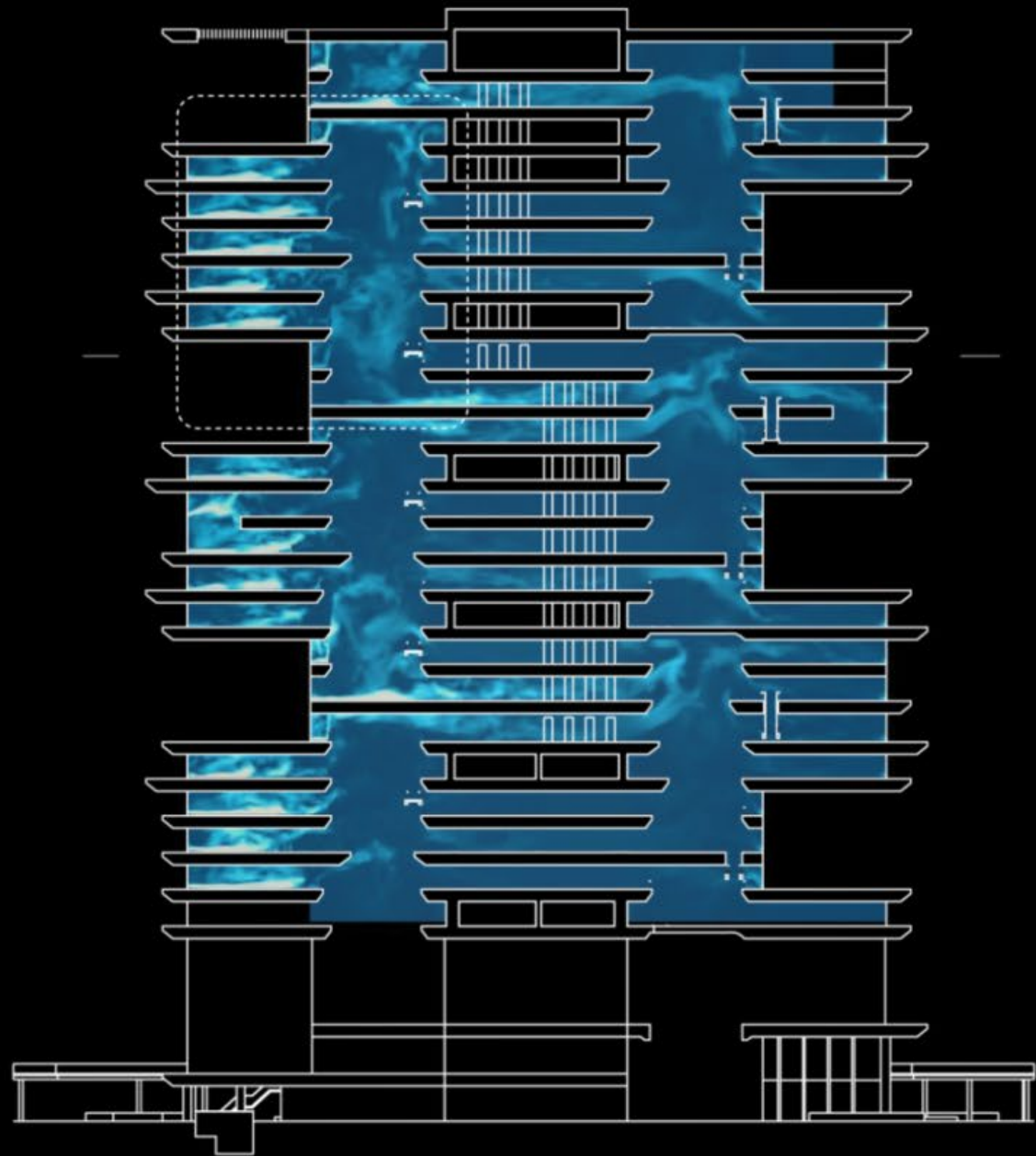
SPACES

**SYSTEMS**

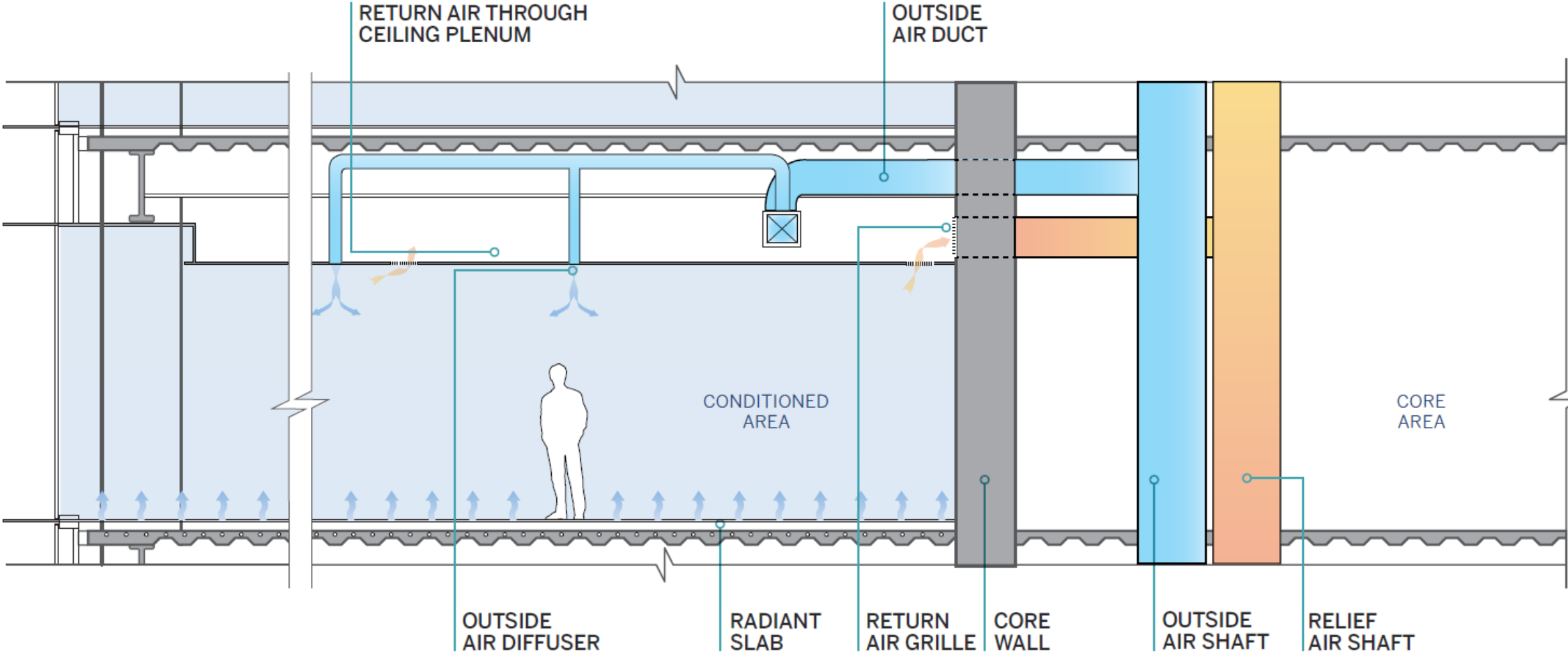




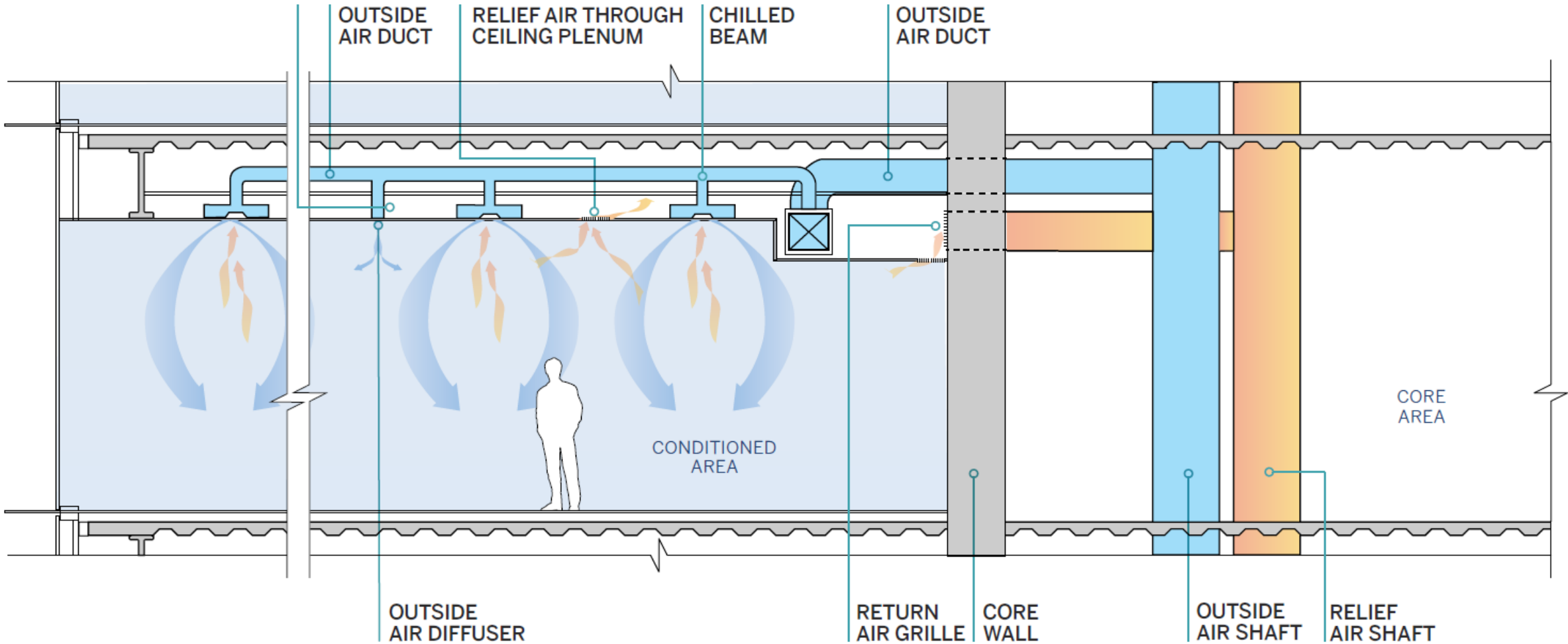




# DOAS – RADIANT



# DOAS – CHILLED BEAM

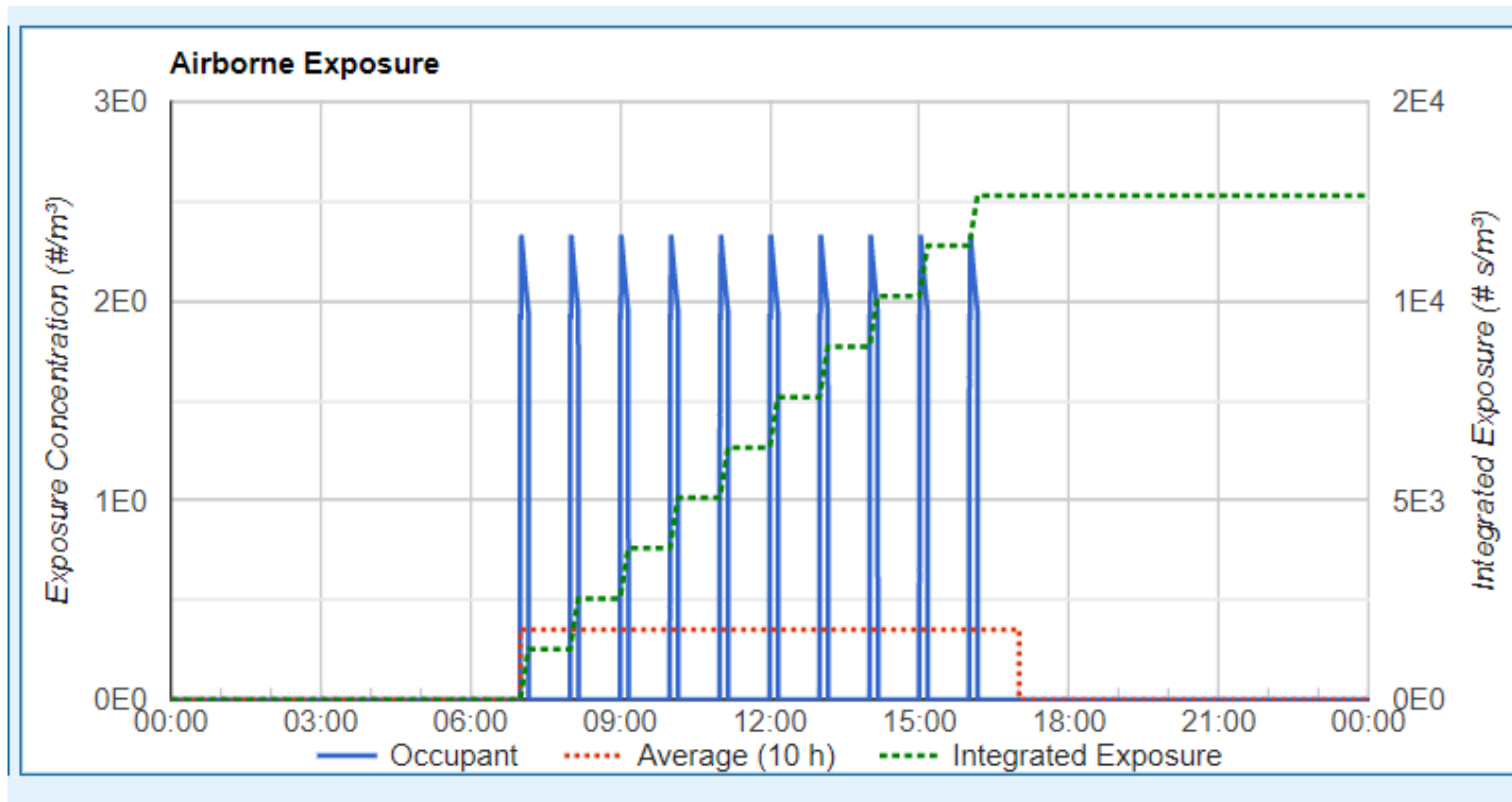




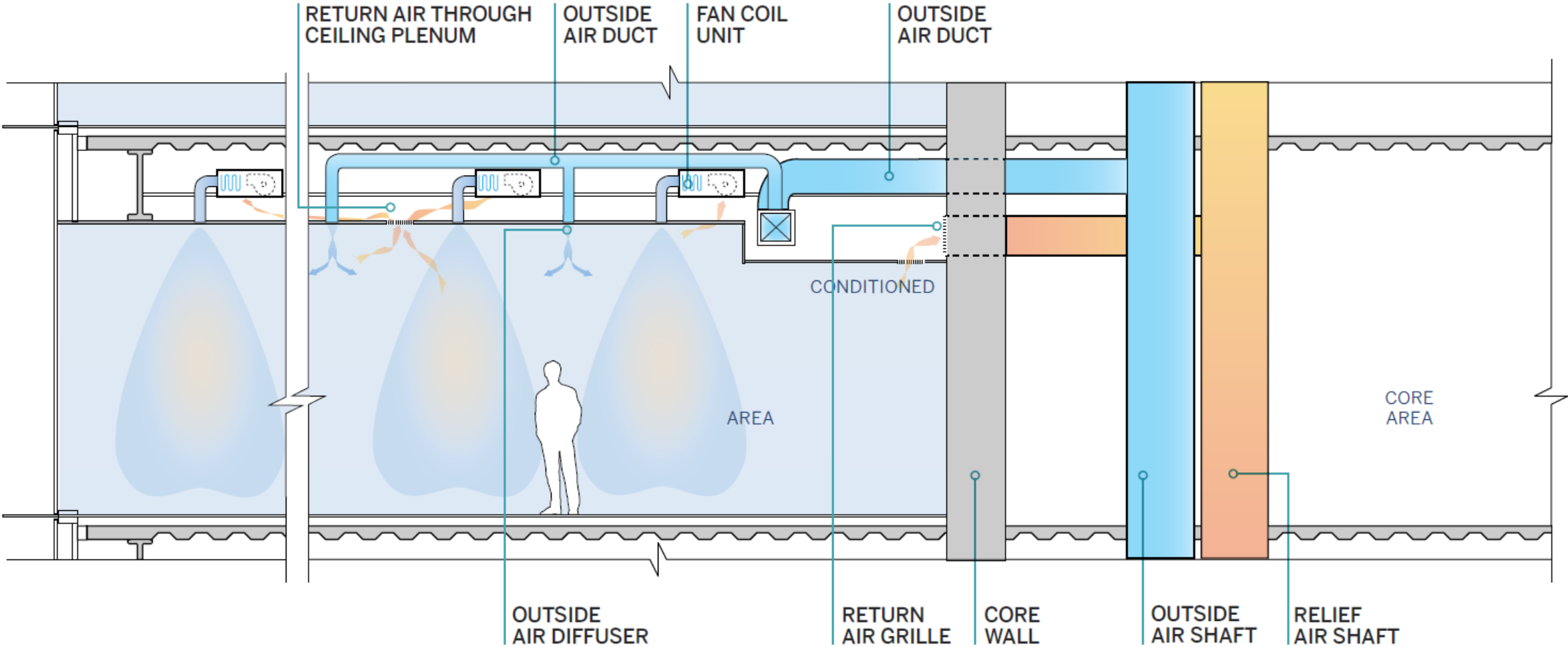
# DOAS - NIST

Integrated Exposure: 1.5E4 (#s/M<sup>3</sup>)

Exposure Concentration: 2.3E0 (#s/M<sup>3</sup>)



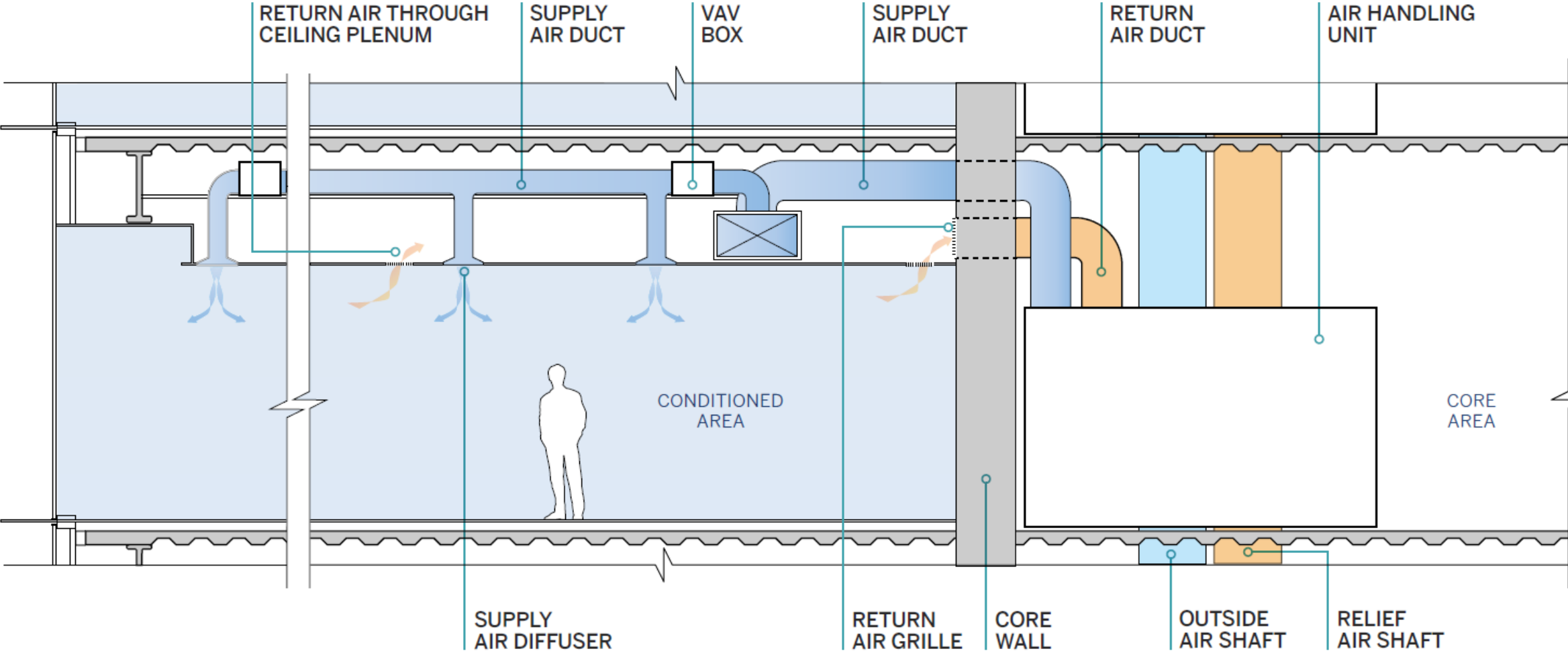
# DOAS – FAN COIL OR VRF



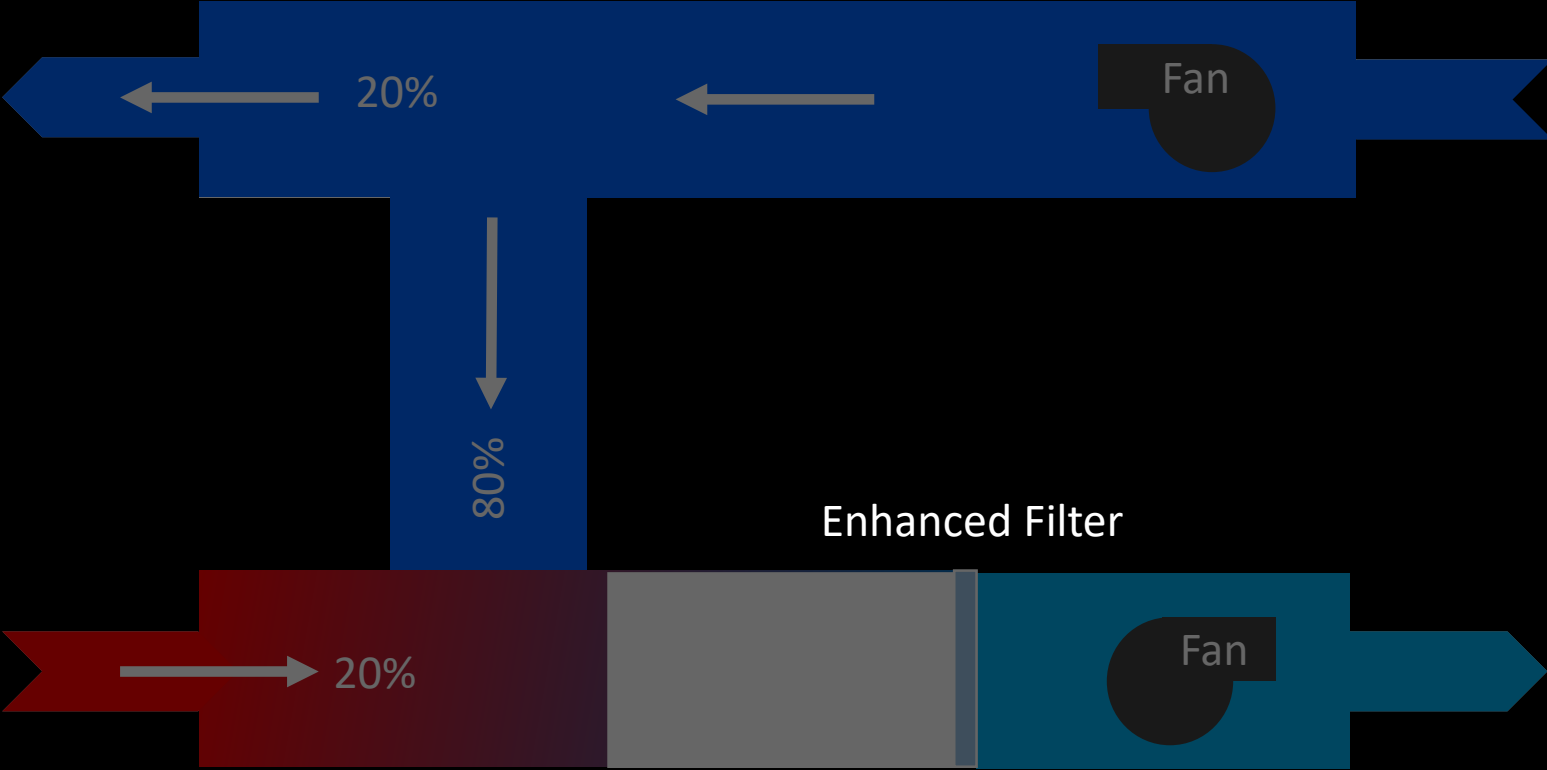
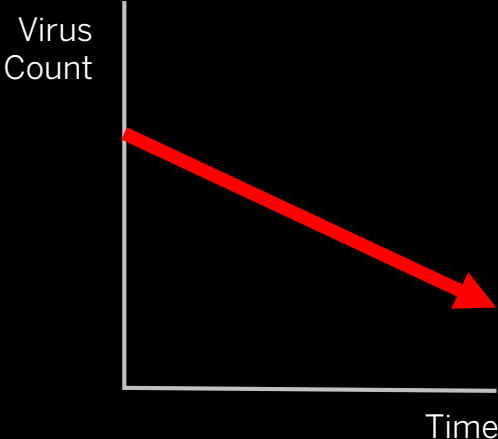




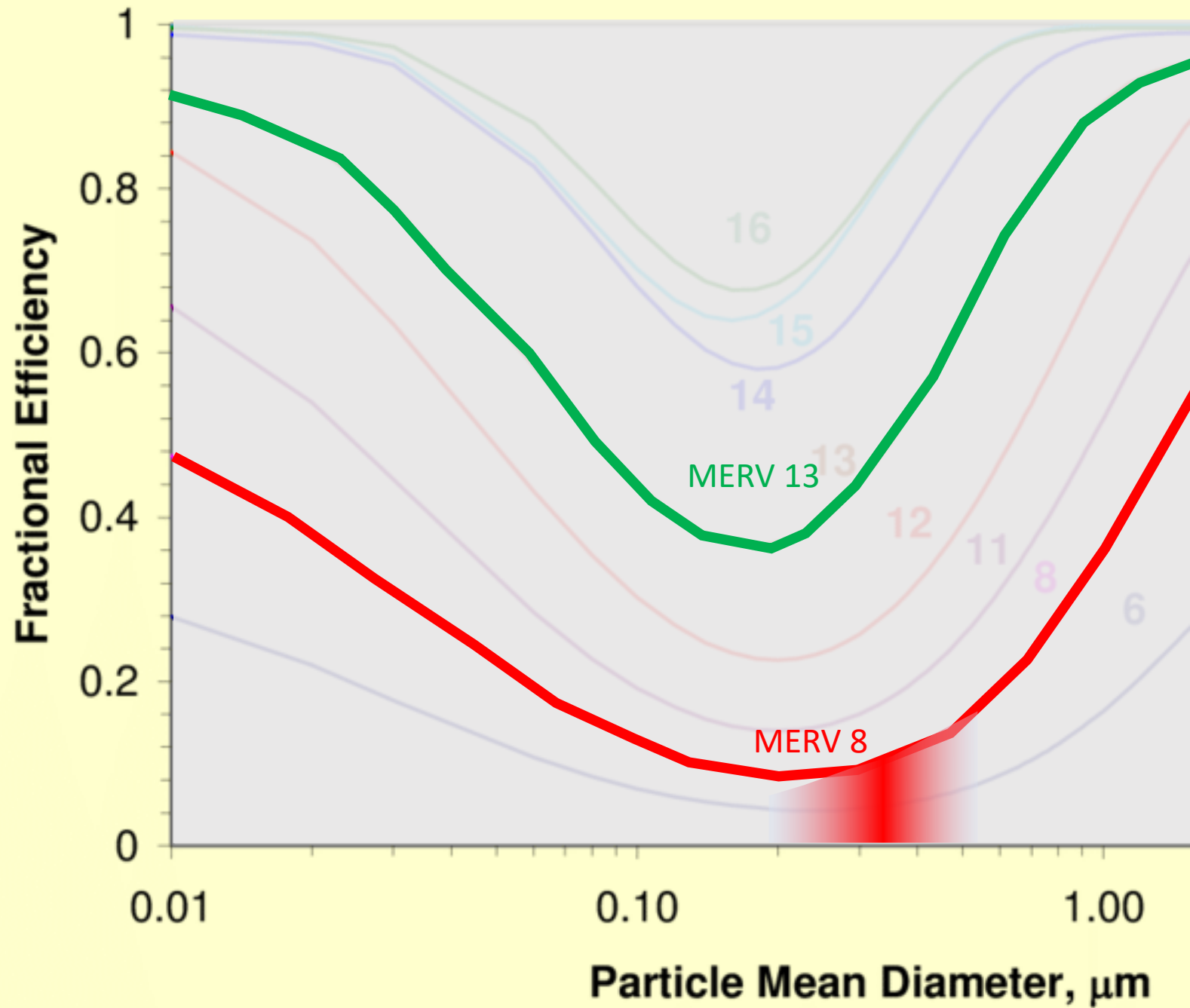
# VAV



# VAV SYSTEM MINIMUM OUTSIDE AIR

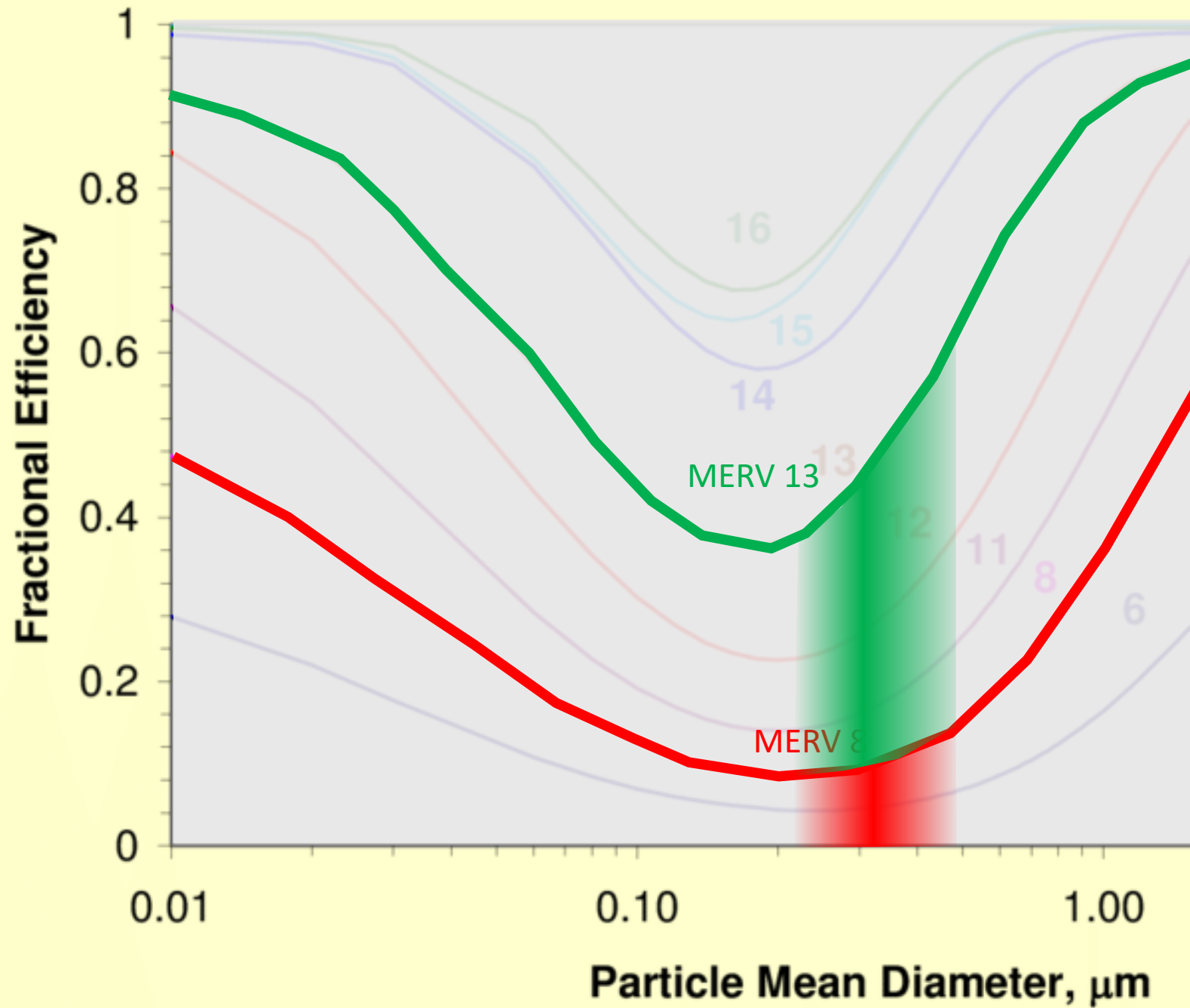


BETTER FILTER  
MERV 8 - MERV 13



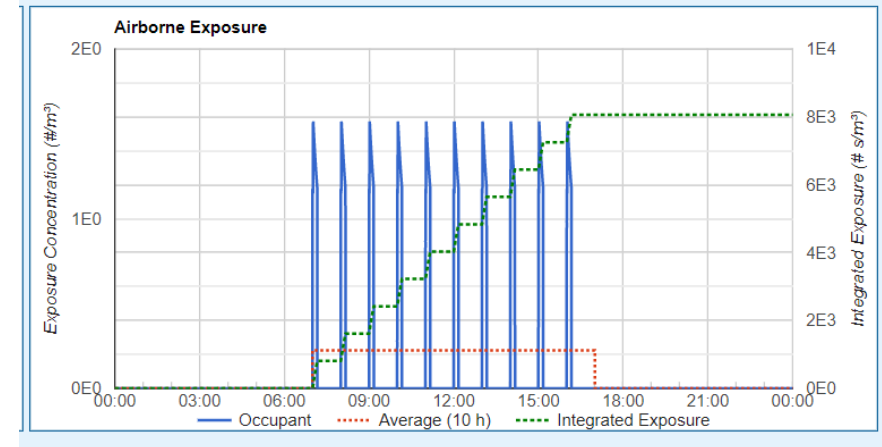


BETTER FILTER  
MERV 8 - MERV 13

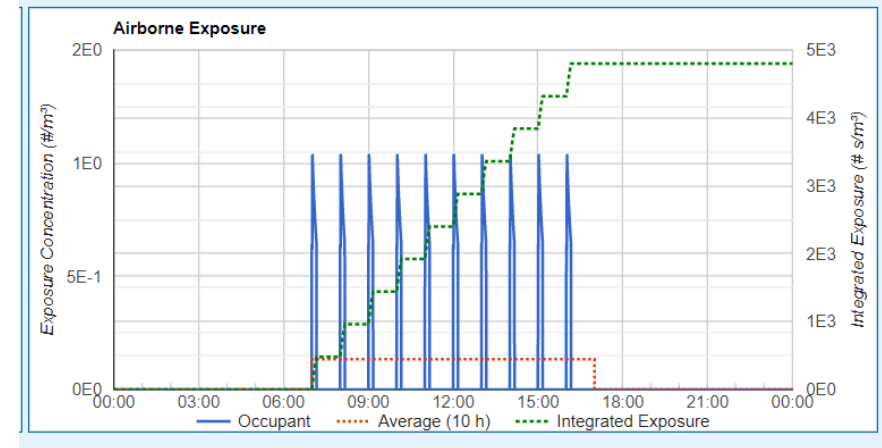


# MERV 8 VS MERV 13

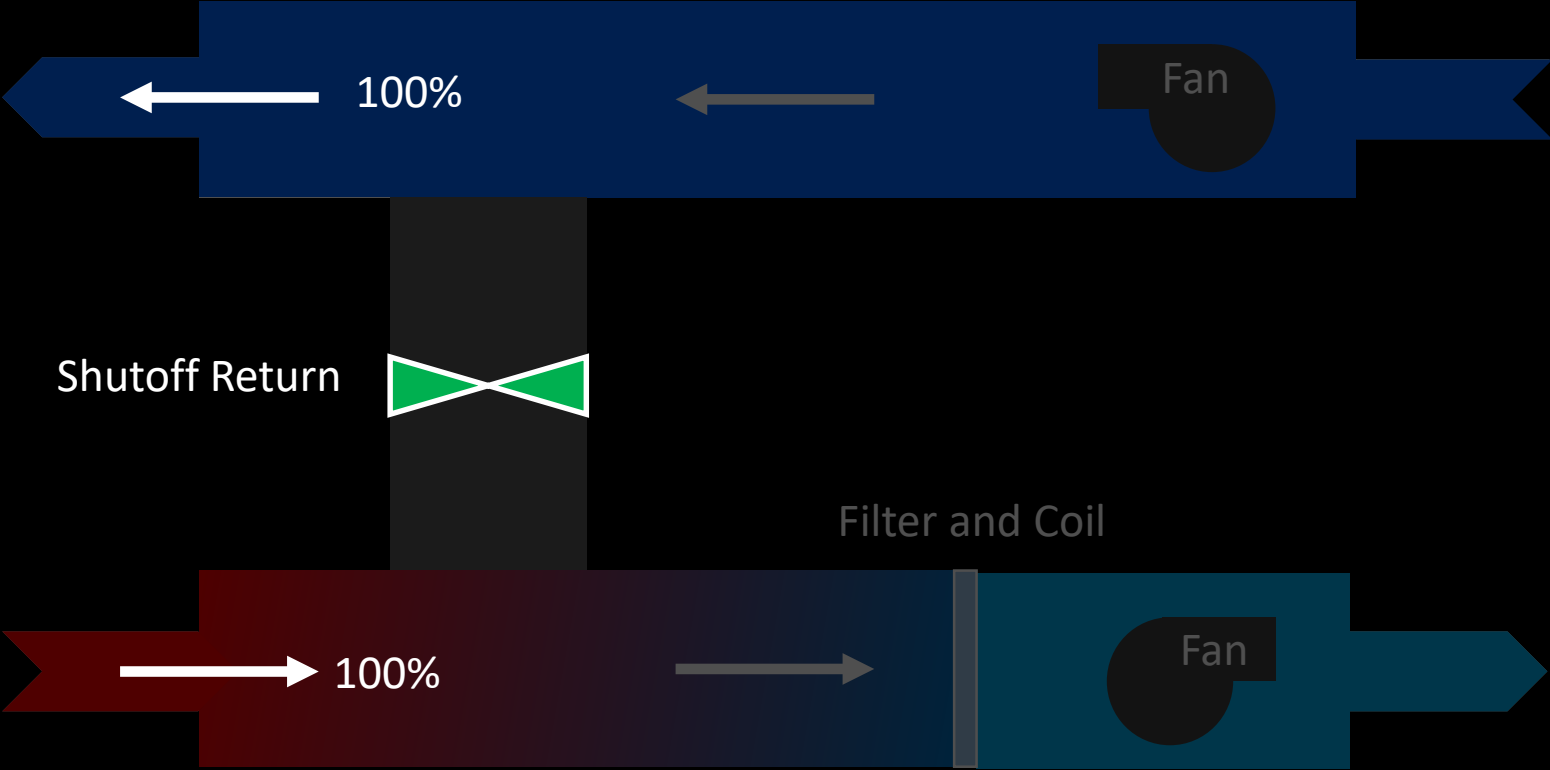
VAV with MERV 8 (Minimum OA)  
 Integrated Exposure: 8.0E3 (#s/M<sup>3</sup>)  
 Exposure Concentration: 1.6E0 (#s/M<sup>3</sup>)



VAV with MERV 13 (Minimum OA)  
 Integrated Exposure: 4.8E3 (#s/M<sup>3</sup>)  
 Exposure Concentration: 1.1E0 (#s/M<sup>3</sup>)



VAV SYSTEM  
100% OUTSIDE AIR

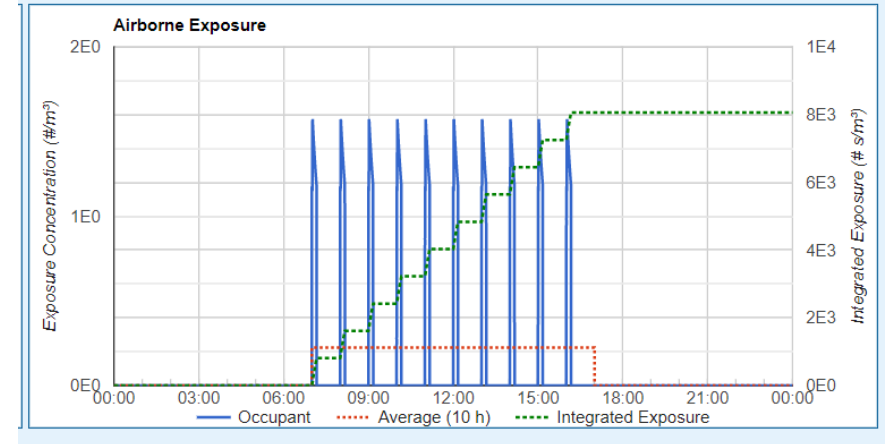




# MERV 8 VS 100% OUTSIDE AIR

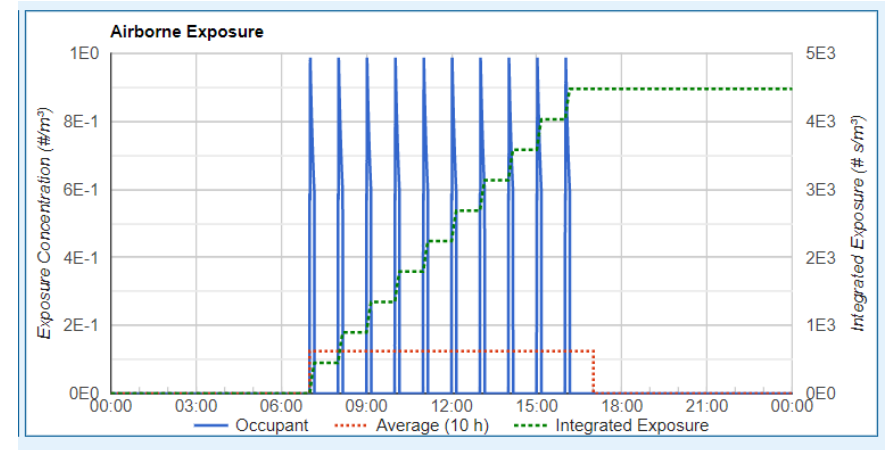
VAV with MERV 8  
Minimum OA

Integrated Exposure:  $8.0E3 \text{ (#s/M}^3\text{)}$   
Exposure Concentration:  $1.6E0 \text{ (#s/M}^3\text{)}$



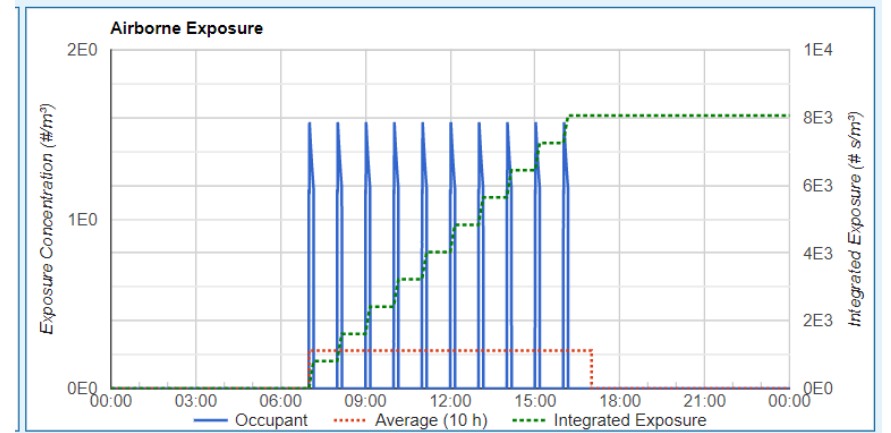
VAV with  
100% Outside Air

Integrated Exposure:  $4.5E3 \text{ (#s/M}^3\text{)}$   
Exposure Concentration:  $1.0E0 \text{ (#s/M}^3\text{)}$

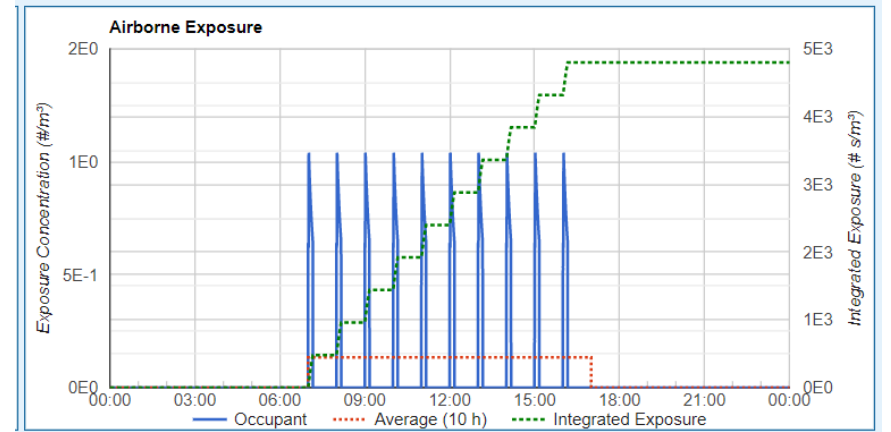


# VAV MINI VS 100% OA

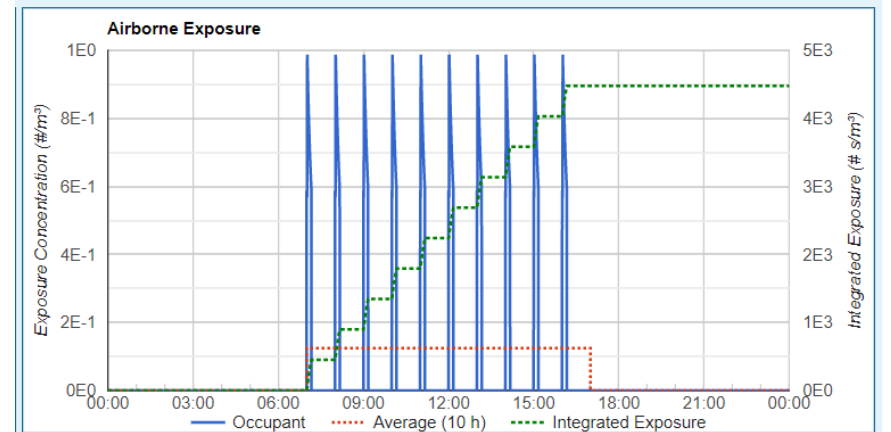
VAV with MERV 8 (Minimum OA)  
 Integrated Exposure: 8.0E3 (#s/M<sup>3</sup>)  
 Exposure Concentration: 1.6E0 (#s/M<sup>3</sup>)



VAV with MERV 13 (Minimum OA)  
 Integrated Exposure: 4.8E3 (#s/M<sup>3</sup>)  
 Exposure Concentration: 1.1E0 (#s/M<sup>3</sup>)



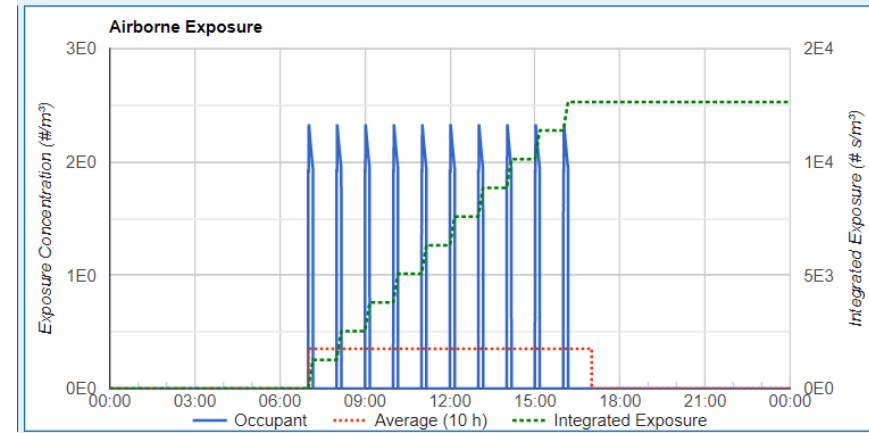
VAV with 100% Outside Air  
 Integrated Exposure: 4.5E3 (#s/M<sup>3</sup>)  
 Exposure Concentration: 1.0E0 (#s/M<sup>3</sup>)



# DOAS VS VAV

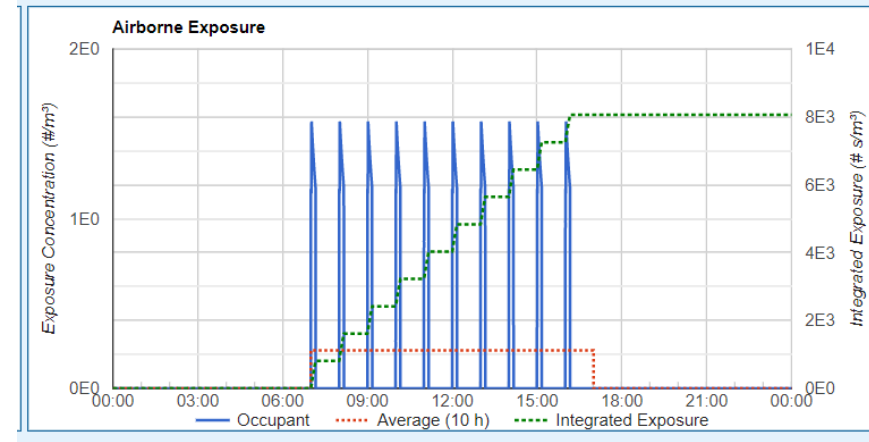
DOAS

Integrated Exposure: 1.0E4 (#s/M<sup>3</sup>)  
 Exposure Concentration: 2.3E0 (#s/M<sup>3</sup>)



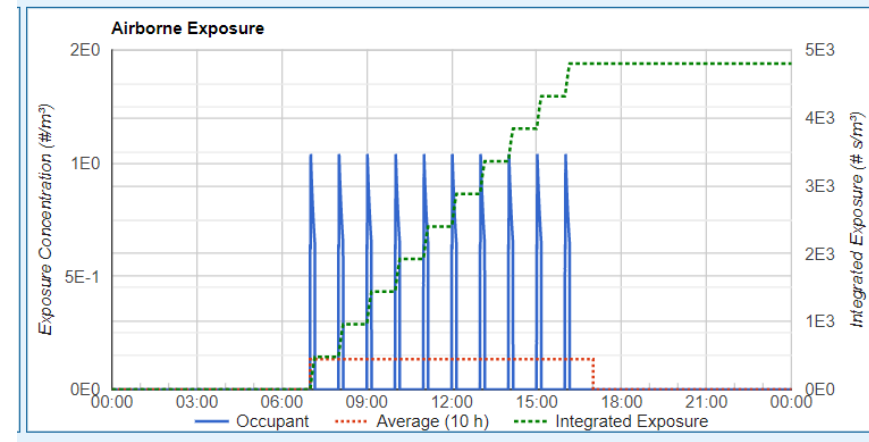
VAV with MERV 8  
 (Same OA as DOAS)

Integrated Exposure: 8.0E3 (#s/M<sup>3</sup>)  
 Exposure Concentration: 1.6E0 (#s/M<sup>3</sup>)



VAV with MERV 13  
 (Same OA as DOAS)

Integrated Exposure: 4.8E3 (#s/M<sup>3</sup>)  
 Exposure Concentration: 1.1E0 (#s/M<sup>3</sup>)



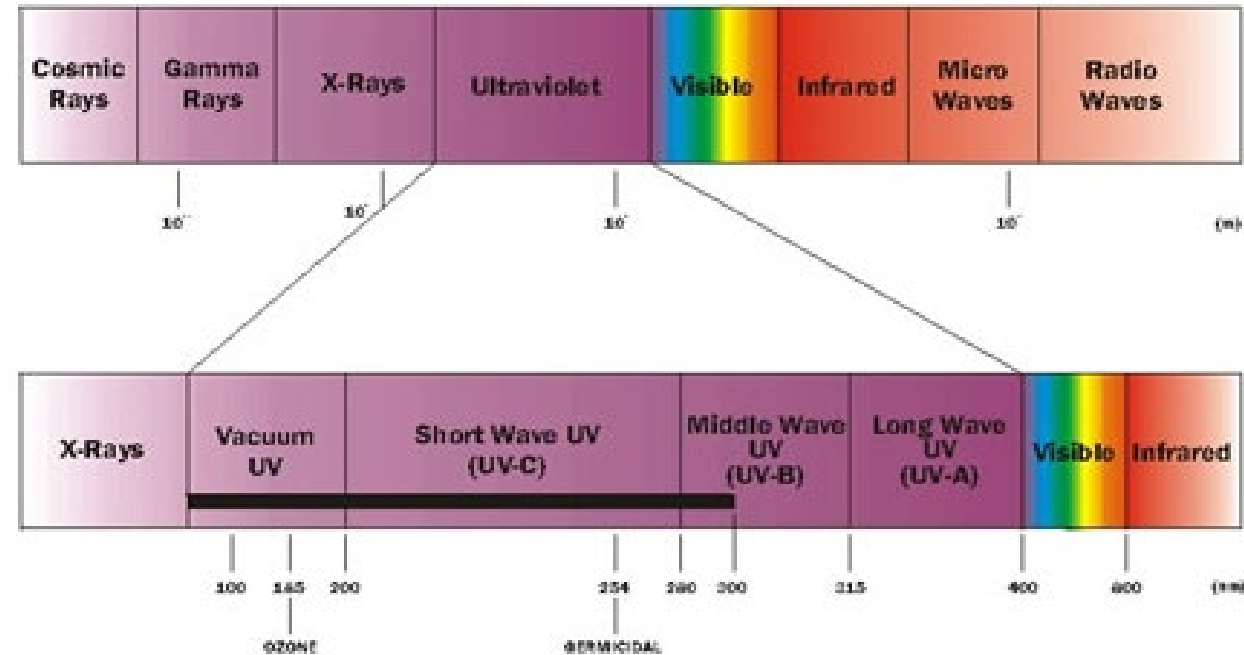


UVC LIGHTS



# EMERGING TECHNOLOGIES

- Emerging light spectrum technologies:
  - 315-400 nm UVA fixtures
  - 220 nm Far UVc lamps
  - 405 nm visible spectrum lamps
- Pulsed Xenon (Pulsed UV)
- Bipolar Ionization/Corona Discharge
- Photocatalytic Oxidation (PCO)



HEALTH THREATS (UN WHO)  
3. **Pandemic**





HEALTH THREATS (UN WHO)  
2. **Chronic Diseases**





# HEALTH THREATS (UN WHO)

## 1. Climate Change



# COMMERCIAL BUILDING DESIGN FOR COVID-19 & BEYOND

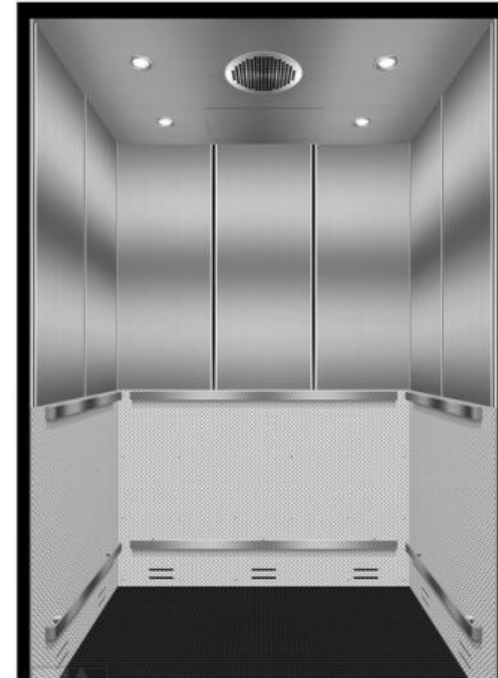
June 18<sup>th</sup>, 2020

Luke Leung, PE, P ENG, LEED Fellow



# ELEVATORS

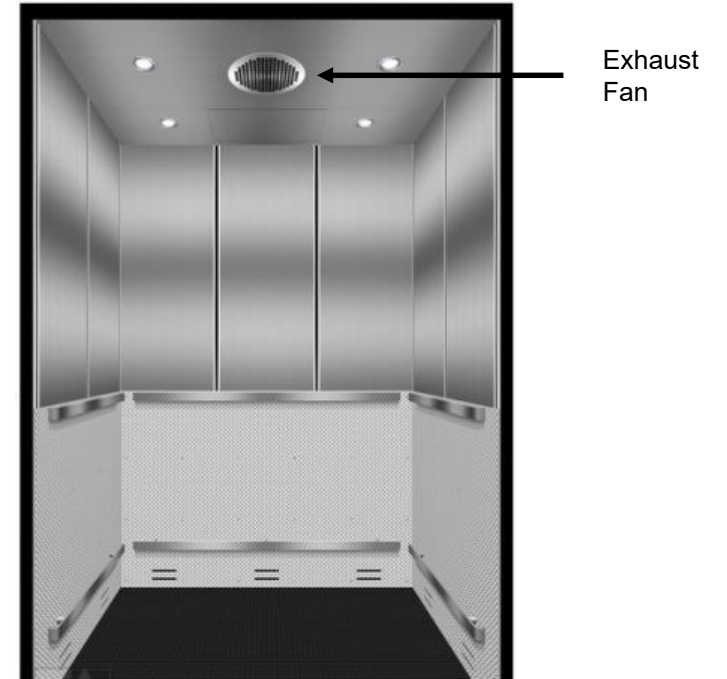
1. Prolong exposure – 15 minutes



<http://www.elitecabs.com/index.php/cab-designs/elite-cab-design1205/freight-and-s?fID=65>

# ELEVATORS

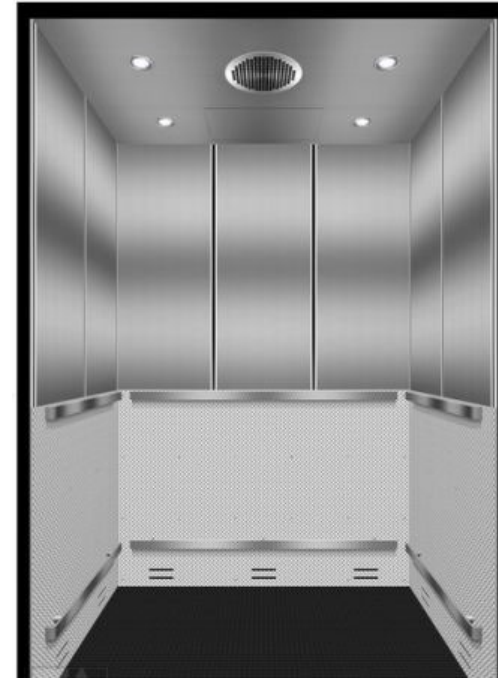
1. Prolong exposure – 15 minutes
2. Turn on elevator lift ventilation fan
  - 6'x6'x8'
  - 95% Elimination of material in the air:
  - 200 CFM ( 340 M<sup>3</sup>/Hr) = 4.3 minutes



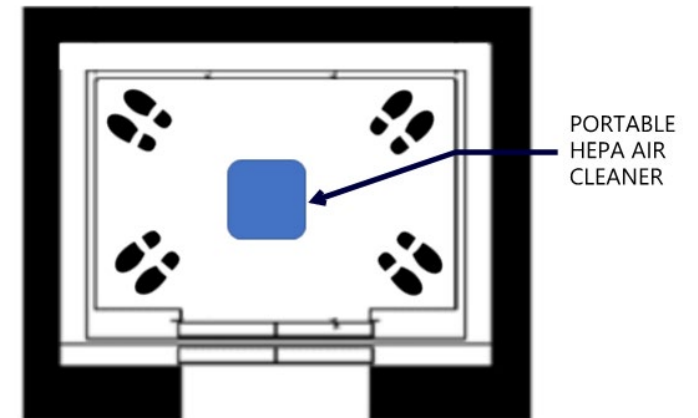
<http://www.elitecabs.com/index.php/cab-designs/elite-cab-design1205/freight-and-s?fiD=65>

# ELEVATORS

1. Prolong exposure – 15 minutes
2. Turn on elevator lift ventilation fan
  - 6'x6'x8'
  - 95% Elimination of material in the air:
  - 200 CFM ( 340 M<sup>3</sup>/Hr) = 4.3 minutes
3. Consider portable cleaner with HEPA filter
4. Open every door



<http://www.elitecabs.com/index.php/cab-designs/elite-cab-design1205/freight-and-s?fID=65>



ELEVATOR