



VALIDATED INFECTION CONTROL IN COMMERCIAL BUILDINGS

Most infections (including COVID19), are transmitted either by direct contact (surface to surface) or by droplet emission (3-6 ft) caused by coughing, sneezing or even normal breathing and talking by a infection positive person. Direct contact transmission can be controlled by good hygiene practices, social distancing, disinfecting surfaces and use of PPEs as suggested by WHO & ICMR.

However, it is the large quantities of microbes expelled through droplets that pose a challenge in any closed or indoor environment. Contrary to popular belief these smaller sized droplets emitted in normal course (less than 5 μm) remain suspended in air for long periods of time and are a major and often undetected cause of exposure.

A. WHAT DETERMINES THE IMPACT OF EXPOSURE

Impact of this exposure is determined by

- Duration (Time)
- Severity (Virulence of the microbes)
- Location (Nose, Upper or Lower Respiratory Tract)
- Concentration microbes in the air space

B. WHY THE POPULAR SOLUTIONS MAY NOT BE EFFECTIVE

Commonly adopted solutions seem to be installation of air purifiers or treatment systems which do not have the capability to take care of the following critical aspects:

Infiltration & exfiltration: unwanted leakages allow ingress from potential contamination sources

Room air movement: controlling air movement between the zones via pressure relationships and attaining optimised mixing efficiency for removal of tiny droplet nuclei generated within the space

Demand Control Ventilation: which ensures optimal multiple space ventilation at any given time for dilution of the contamination.

C.

SOME QUICK MEASURES FOR COMMERCIAL BUILDINGS

Improperly operated (opening after lockdown) and maintained HVAC systems can even become a reservoir for such infections.

A good place to start would be to use the recommendations found in ASHRAE standard 180-2018, Standard Practice for Inspection and Maintenance of Commercial Building HVAC Systems.

What we can do for you:

Validate if existing design is enough for infection control (theoretical analysis) on the basis of inputs provided and data recorded.

Further to above we can provide remote assistance to attain comprehensive air quality for timely mitigation of infection

D.

HOW TO ATTAIN COMPREHENSIVE INFECTION CONTROL?

The solution lies in designing a system using advanced modeling techniques i.e. transient contamination analysis and validation of building performance in terms of

- A. Ambient Air Quality** - where noxious gases & pollutants in the ambient air are measured
- B. Infiltration & Exfiltration** - unwanted leakages are identified and accounted for
- C. Room Air Movement** - optimised for air distribution & mixing (fig. 1)
- D. Indoor Air Quality** - climate & pollutants are measured
- E. Contamination Control**- optimised for proper IAQ

Validation of the system design and analysis is carried out by using an application specific mesh of Portable Neural Sensors.

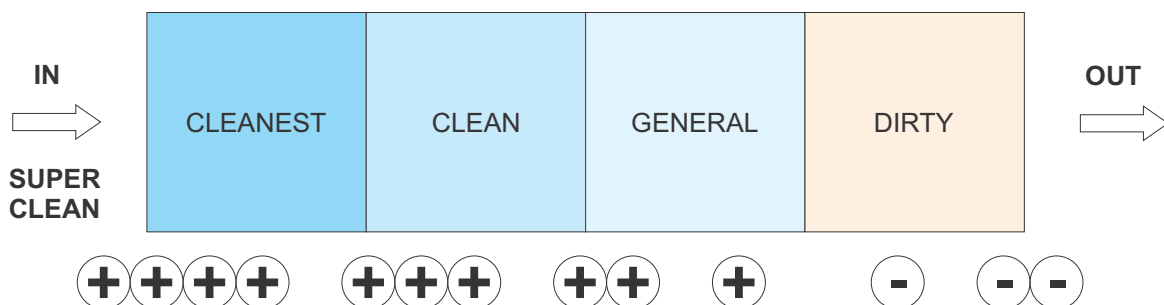


Fig. 1 Controlling Air Movement via Pressure Relationships



E. VALIDATED CONTAMINATION CONTROL

HOW IT WORKS?

Ambient Air Quality

Using WPC historical ambient air quality & wind pressure on exterior we prepare building model with site orientation & GPS pin. (Fig. 2a)

We also identify local sources of outdoor contamination, like moving vehicles, generators, etc. Next the hygiene limits are defined for health and productivity of building occupants. These findings are validated by mesh of portable neural sensor (AAQ) and remote monitoring & analytics software.

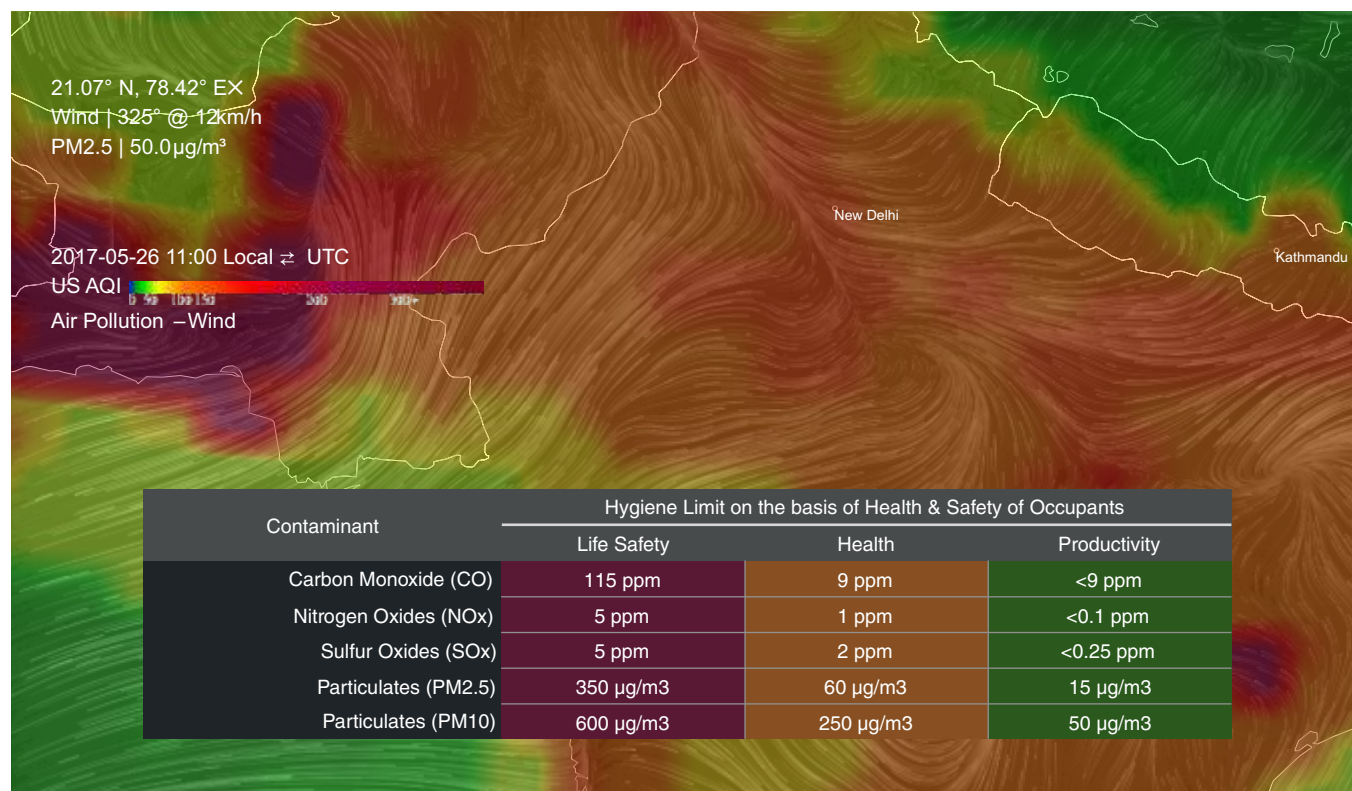


Figure 2a

Infiltration & Exfiltration

Uncontrolled flow of outdoor and exhaust air is predicted using ASHRAE effective leakages, based on various building materials & partitions.

Room-to-room airflows are calculated using multi zone airflow analysis in building systems driven by

- Mechanical means
- Wind pressures acting on the exterior of the building
- Buoyancy effects induced by the indoor and outdoor air temperature difference

These are then validated by mesh of portable neural sensor (Pressure) and remote monitoring & analytics software

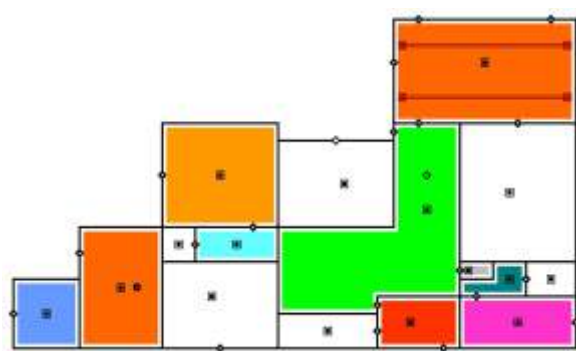


Figure 2b

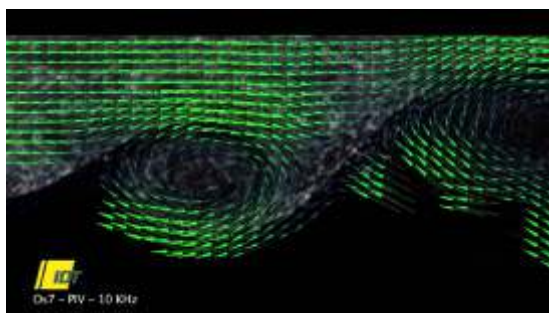


Figure 3a

Room Air Movement

Ideal air movement within the room is displacement flow, however it is not possible to achieve this in office applications.

Therefore our goal is to achieve better mixing efficiency with entrainment flow while choosing right air outlets & their location

Air mixing efficiency is predicted by multi-zone air flow analysis CFD simulation. Validated by mesh of portable neural sensor (Flow) and remote monitoring & analytics software

Indoor Air Quality

Indoor pollutants & contaminant are identified based on interior choices, occupancy & activity.

Hygiene limits are defined for health and productivity of occupants.

Using NIST emission database and multi zone airflow analysis we can predict dispersal of airborne contaminants and hence strategise removal/treatment of same on using the above contamination model, validated by mesh of portable neural sensor (IAQ) and remote monitoring & analytics software.

Contaminant	Hygiene Limit		
	Life Safety	Health	Productivity
Carbon Dioxide (CO ₂)	5,000 ppm	2000 ppm	600-1000 ppm
Total volatile organic compounds (TVOCs)	-	500 µg/m ³	200 µg/m ³
Common Volatile Organic Compounds, Usually Generated Indoors from office interiors, machines, paints, cleaning, etc.			
Aromatic hydrocarbons	Toulene	Ethylbenzene	Trimethylbenzene
Saturated aliphatic hydrocarbons (n-, iso- and cyclo-)	n-Hexane	Cyclohexane	Methyl Cyclohexane
Terpenes	3-Carene	Limonene	-Pinene
Aliphatic alcohols	1-Butanol	2-Methyl-1-propanol	1-Pentanol
Aromatic alcohols	Benzyl alcohol	BHT (2,6-di-tert-butyl-4-methylphenol)	
Glycols, Glycol ethers, Glycol esters	Diethylene glycol	Propylene glycol	Dipropylene glycol
Aldehydes	Formaldehyde	Acetaldehyde	Butanal
Ketones	2-Butanone	Cyclohexanone	Acetophenone
Acids	Acetic acid	Propionic acid	2-Ethylhexanoic acid
Ester	Propyl acetate	Isobutyl acetate	Dimethyl adipate
Chlorinated hydrocarbons	1,4-Dichlorobenzene		
Others	1,4-Dioxane	Hexamethylenetetramine	2-Butanonoxime

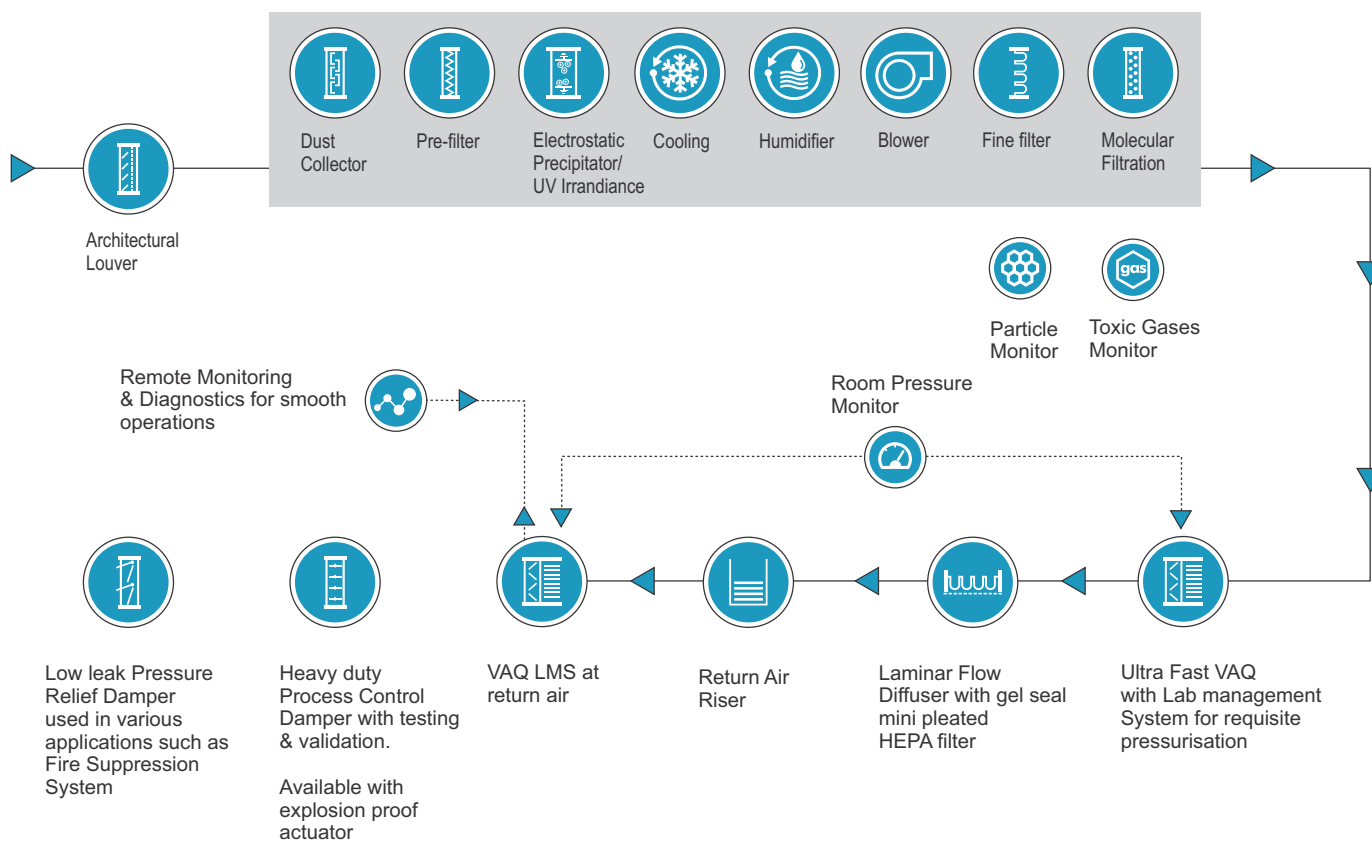


Contamination Control Unit

Connected to a mesh of portable neural sensors for fault detection, diagnostics, and demand control ventilation, the unit has:

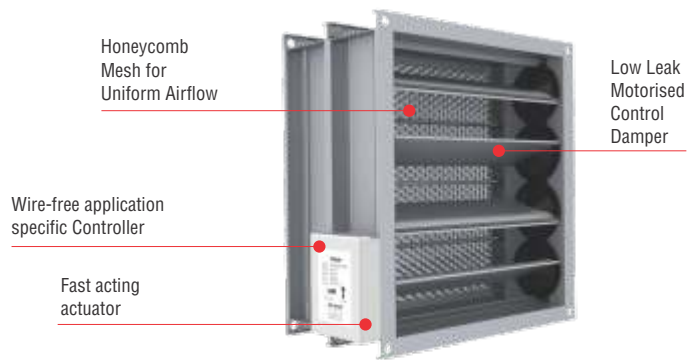
- VAQ Station installed at fresh air/make up air for airflow monitoring.
- Incorporated with smoke extraction features, the unit includes modulating smoke dampers installed at return air, mixed air, & exhaust air
- Equipped with necessary filtration to achieve defined hygiene limit and optimise indoor air quality

Application specific Contamination or Corrosion Control Unit



F. KEY COMPONENTS OF A VALIDATED INFECTION CONTROL SYSTEM

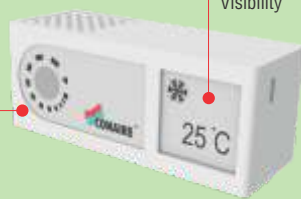
VAQ Station for IAQ Validation



Room Module For IAQ Validation

Effective Individual Climate Control with IAQ

Portable JACK-FREE

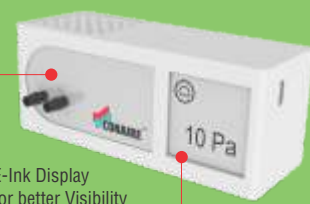


E-Ink Display for better Visibility

Pressure Module for Validation of Infiltration/Exfiltration

Differential Pressure Monitor

Portable JACK-FREE



E-Ink Display for better Visibility

Flow Module for validation of Air Movement

Calibrated Airflow sensor

Portable JACK-FREE



E-Ink Display for better Visibility

PM/Noxious Gas Module for Validation of Ambient Air Quality

Particle Monitoring

Portable JACK-FREE



KEY BENEFITS OF A VALIDATED CONTAMINATION CONTROL SYSTEM

- Solutions can be analysed & validated in the model keeping the guess work out of the picture.
- Even natural ventilation or other passive design can also be analysed & validated
- Minimise energy and provide efficient solutions with guaranteed performance
- Better health, productivity and satisfaction of occupants
- Assured successful design for specific applications like pharma and IT
- Performance driven approach of designing, fulfils even the stringent requirements of various reputed building performance rating councils
- Showcase to tenant & occupants of the building



NEED MORE INFORMATION?

[Click here to review the usefulness of this paper.](#)

If you wish to know more about Validated Infection Control for your application, please get in touch to set up an online meeting or presentation.

+91 99 904 84500

info@conaire.in