

Air Aware: Commissioning for Optimal Indoor Air Quality

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Intertek Building Science Solutions

AIA Quality Assurance



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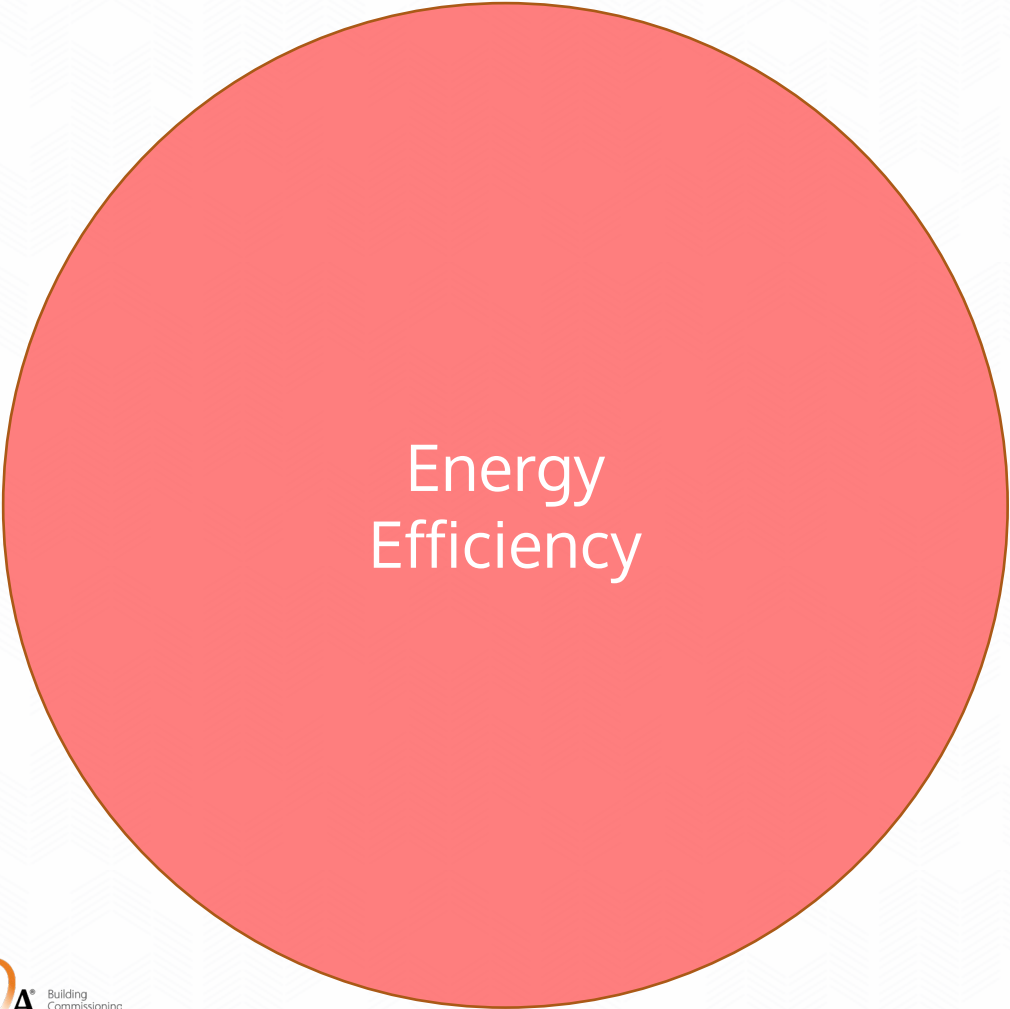
Learning Objectives

1. Define the factors that contribute to IAQ
2. Understand the codes, standards, and other criteria for IAQ
3. Review potential sources for poor IAQ that CxP should look for
4. Consider best practices for validating good IAQ

Course Description

Building owners, managers, and occupants are more aware than ever of the importance of indoor air quality (IAQ). At the same time, expectations for energy performance and carbon emissions reduction are rising, and myths of the tradeoff between energy efficiency and IAQ persist. IAQ is an outcome of a properly designed, constructed, and functioning buildings, just as are energy efficiency and occupant comfort, and commissioning plays a key role in optimizing these synergistic outcomes. This webinar will discuss the role that commissioning providers (CxP) can play to support good IAQ in buildings during design, construction, and operation phases, from establishing IAQ criteria, to identifying issues and guiding solutions.

Conflict or Complement?



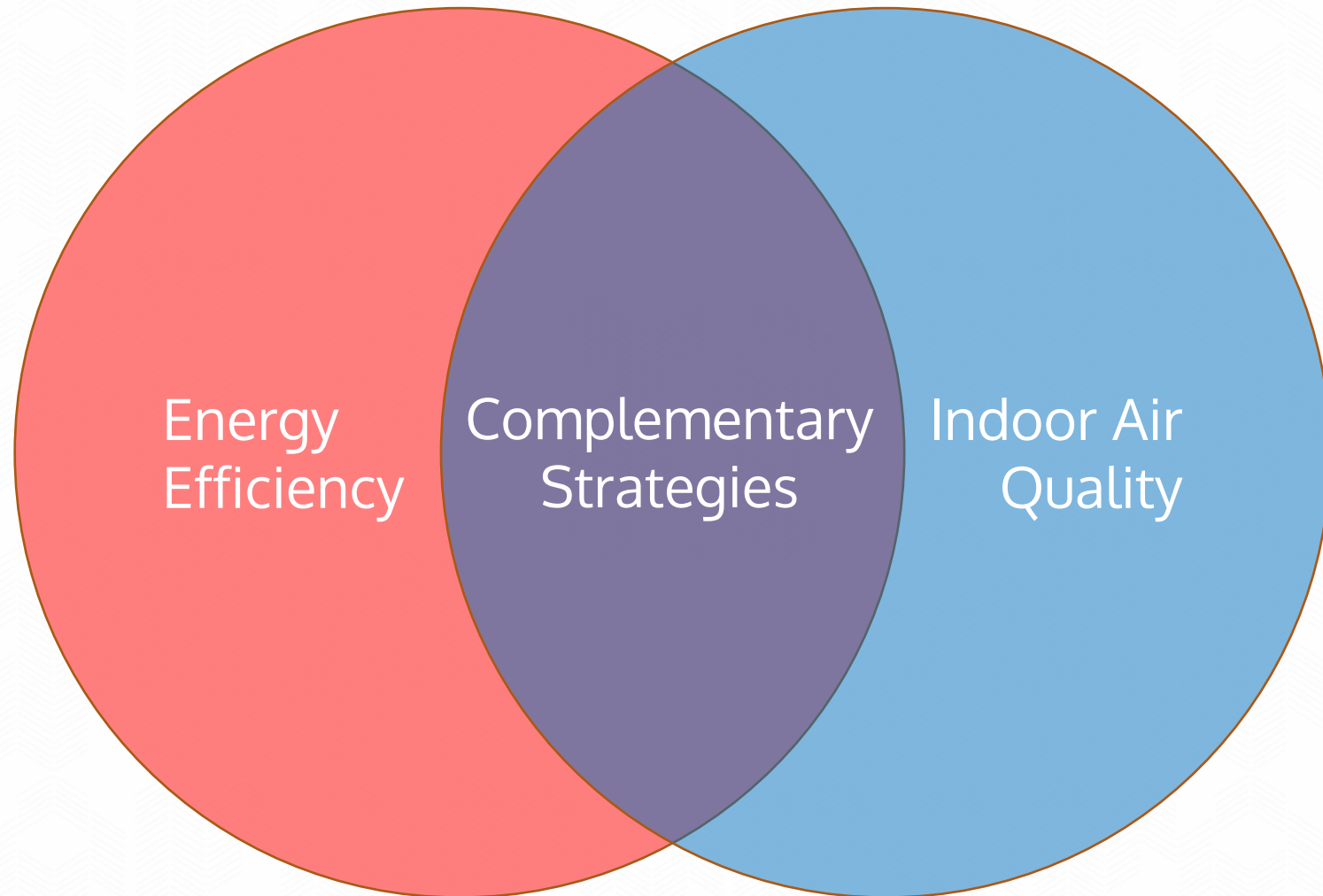
Energy
Efficiency

VS



Indoor Air
Quality

Conflict or Complement?



Air Quality: Old Issues Still With Us



health

Life, But Better

Fitness

Food

Sleep

Mindfulness

Relationships

Audio

Live TV

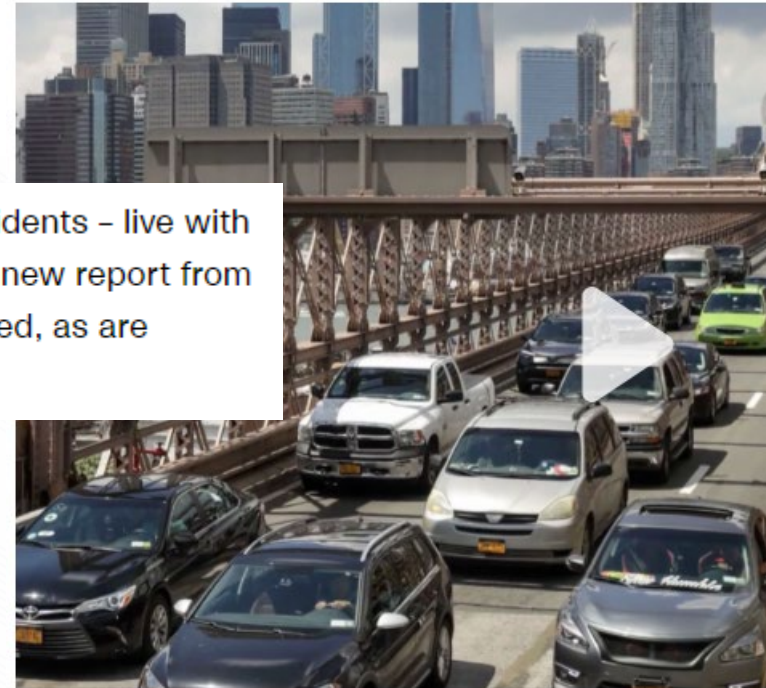
A quarter of Americans live with polluted air, with people of color and those in Western states disproportionately affected, report says



By [Jen Christensen](#), CNN

Published 12:05 AM EDT, Wed April 19, 2023

(CNN) — About 1 in 4 people in the United States – more than 119 million residents – live with air pollution that can hurt their health and shorten their lives, according to a new report from the American Lung Association. People of color are disproportionately affected, as are residents of Western cities.



U.S. EMISSIONS PROPOSALS

EPA: One-third of U.S. greenhouse gas emissions created by transportation

CNN NEWSROOM

Air Quality: Newer Concerns Continue

HIDDEN VIRUSES: HOW PANDEMICS REALLY BEGIN

9 diseases that keep epidemiologists up at night

January 29, 2023 • 7:01 AM ET

By Sheila Mulrooney Eldred



Thinking about the next pandemic keeps lots of researchers busy.

Peter Zelei Images/Getty Images

Just three years ago, on Jan. 30, 2020, the head of the World Health Organization made a landmark [declaration](#): A "novel coronavirus" that had first been identified in China had spread to a degree where it was now a "Public Health Emergency of International Concern (PHEIC)."

The virus now known as SARS-CoV-2 — which causes the disease COVID-19 — is still spreading. But for those who study infectious diseases, talking about possible next pandemics is a necessity.



Air Quality: Emerging Concerns



SCHOOL OF PUBLIC HEALTH

Air pollution may increase risk for dementia



Boston, MA—Exposure to [fine particulate air pollutants](#) (PM2.5) may increase the risk of developing [dementia](#), according to a new meta-analysis from Harvard T.H. Chan School of Public Health.



Wildfires in eastern Canada affecting air quality in major US cities

More than 16,000 people have evacuated the region near Halifax, Nova Scotia.

By [Julia Jacobo](#)

May 31, 2023, 10:36 AM



Healthy Building: What is Health?

The WHO defines **health** as a state of “complete physical, mental and social well-being and **not** merely the **absence of disease** or infirmity.”



Healthy Building

"We've designed buildings for 100-year floods, now we have to learn to design for the 100-year flu."

"In the long run, what's perhaps even more important is making holistic environments that support human immune function."

***Kevin Van Den Wymelenberg, PhD, Dean**
College of Architecture
University of Nebraska*



 THE
CENTRE FOR
CONSCIOUS DESIGN

Discussion | 1 February, 2017

Mark Bessoudo

Conscious Cities Anthology 2017: Bridging Neuroscien

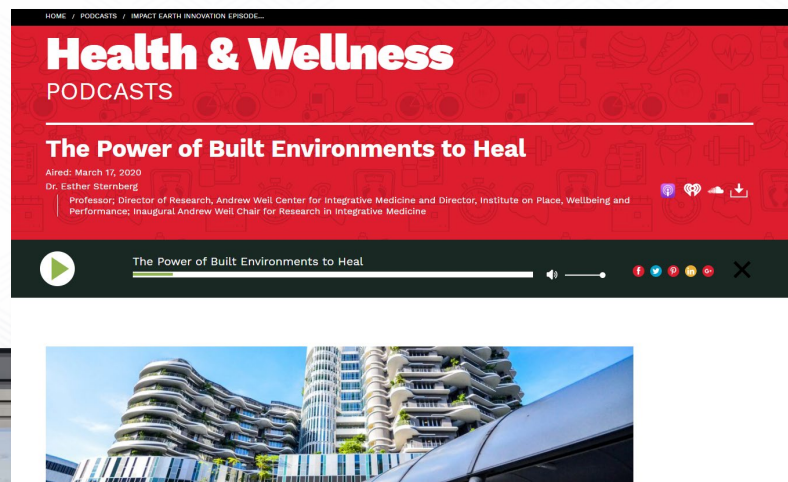
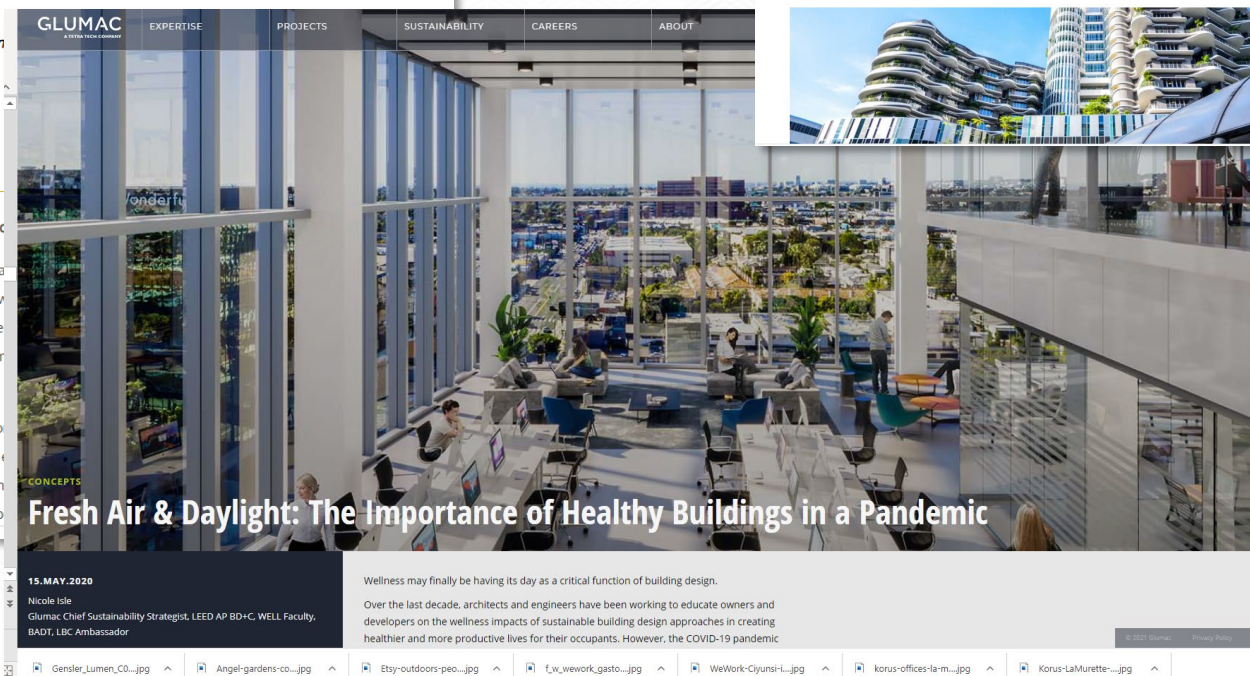
Conscious Cities Journal No.2

DOI: 10.33797/CCI.02.02

1. Health, wellness, and experience as core elements of

The concept of Conscious Cities has been defined as a built environment with a focus on human health and well-being. While there is a growing emphasis on sustainability between our potential to design with the human experience in mind, no means substituting efficiency, there has recently emerged a focus on human health, wellness, and experience.

This refocusing of priorities stems from the recognition that we must learn to better operate the built environment. Modern humans have evolved in a rural, agricultural world, but in the modern industrialized world spending almost 90 percent of the day indoors, we face a host of health and social issues related to lack of physical activity, stress, and poor air quality.



The Convergence of Health, Wellness, and the Built Environment

 Khushbu Sikaria Aug 20, 2020 · 9 min read ★



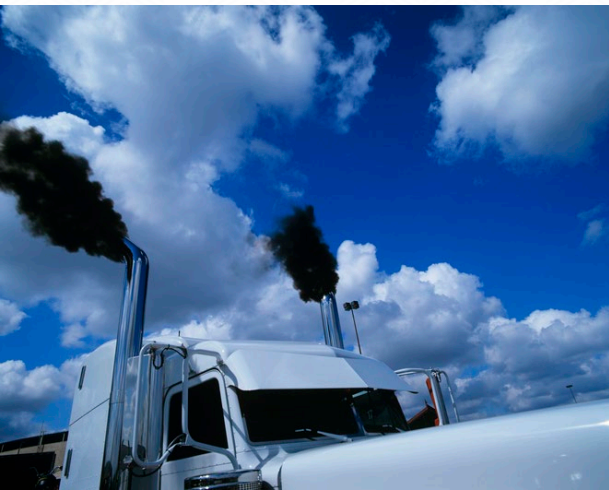
HealthQuarters is a new venture that brings together clinicians, wellness practitioners, and brands for long-term health all in one place.

Access, community, and experience. These words encapsulate three recurring themes in designing and planning multifamily mixed-use developments. The constructs of apartment homes are merely the place to reside within a platform of services, physical and social amenities, and access to transit, lifestyle, and convenience. The most

IAQ: Key Factors

Causes of poor IAQ

- Ambient outdoor air pollution
- Inadequate ventilation
- Insufficient filtration
- Moisture issues
- Indoor pollution sources



JAMIE PANG

MAY 19, 2020

ECO HEALTHY HOME, INDOOR AIR,
LIVING GREEN



GAS STOVES ARE CREATING UNSAFE LEVELS OF INDOOR AIR POLLUTION



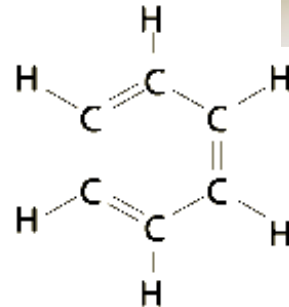
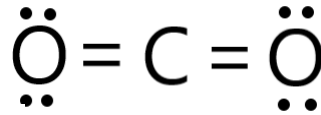
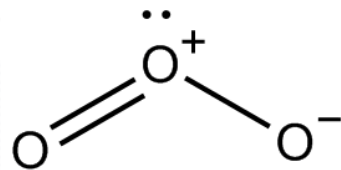
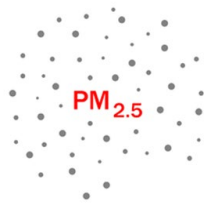
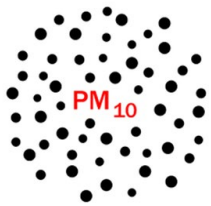
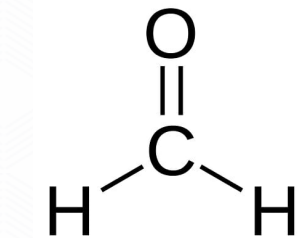
According to a growing body of research, tens of millions of Americans are exposed to unsafe levels of air pollution in their homes. The culprit? Your gas stove. A study released by the University of California, Los Angeles (UCLA) last month concluded that carbon monoxide (CO) and nitrogen dioxide (NO₂), emissions from gas cooking can exceed the national levels set by the Environmental Protection Agency, and can seriously pollute your indoor air.



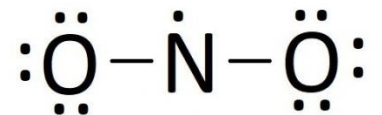
IAQ Parameters

Key Parameters

- Particulate Matter (PM₁, PM_{2.5}, PM₁₀)
- Organic gases (Benzene, Toluene, Formaldehyde)
- Inorganic gases (CO, CO₂, Ozone, Oxides of Nitrogen)
- Radon
- Fungus (mold & mildew)
- Microbes



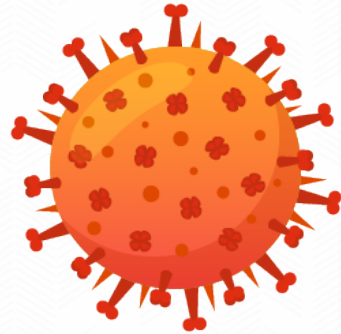
85	86
At	Rn
Astatine (210)	Radon (222)
[Hg]6p ⁵	[Hg]6p ⁶ 10.7485



IAQ Parameters: Pathogenic Organisms

Airborne pathogenic organism:

- SARS-CoV-2
- Rhinovirus
- Influenza
- Chickenpox
- Mumps
- Measles
- Whooping cough
- Tuberculosis
- Diphtheria



INFLUENZA

Contagious 1 day prior to symptoms, 7 days after

Up to 61,000 deaths a year since 2010

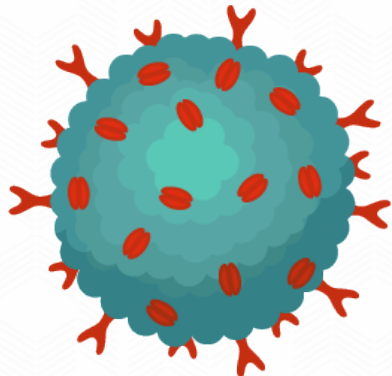
Virus is constantly changing



RHINOVIRUS (*COMMON COLD*)

Adults catch 2-3 colds a year;

Children catch even more



MEASLES

207,500 deaths from measles in 2019

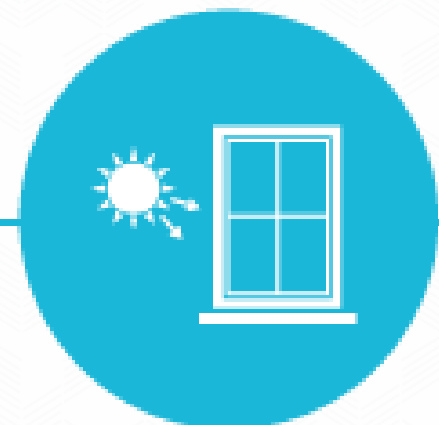
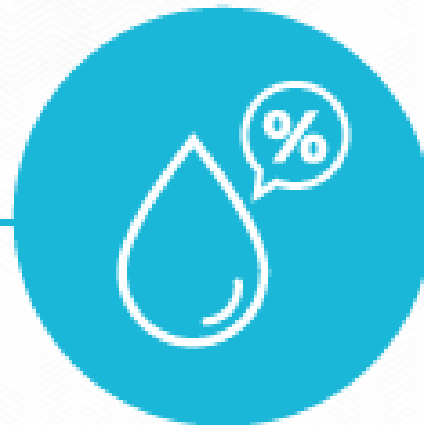
Recent outbreaks in Washington and New York

One of the most contagious viruses in the world

IAQ Parameters: Magnifying/Mitigating Factors

Environmental impacts on IAQ

- Air movement
- Temperature
- Humidity
- Sunlight



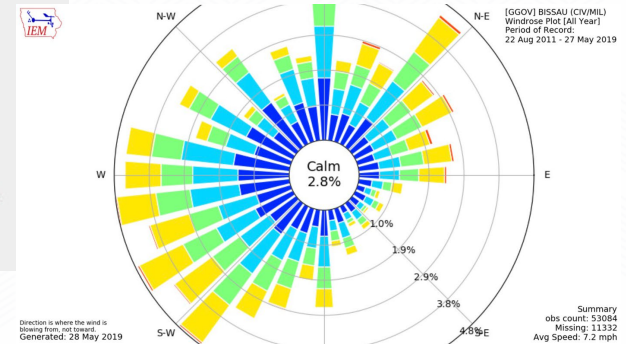
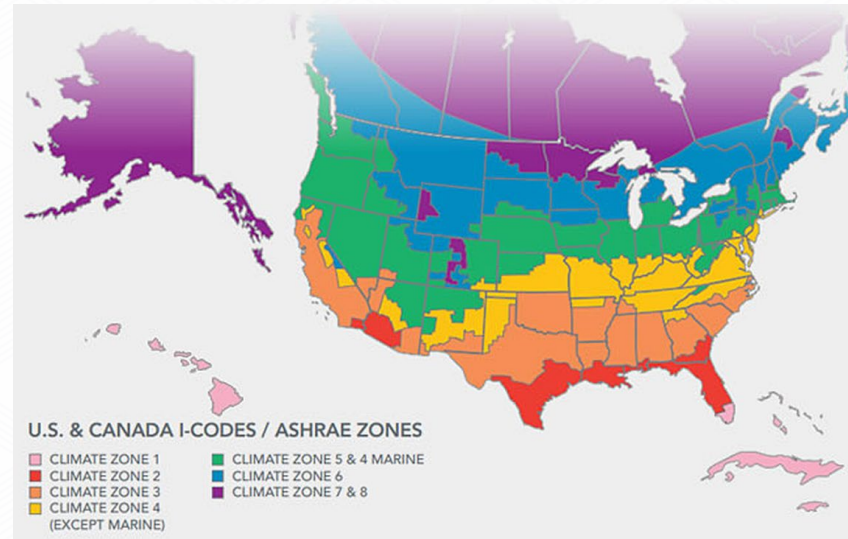
IAQ Parameters: Geographic Consideration

Local climate (microclimate)

- Seasonal variations
- Cold and arid
- Hot and humid
- Temperature inversions
- Prevailing winds

Prevalent natural hazards

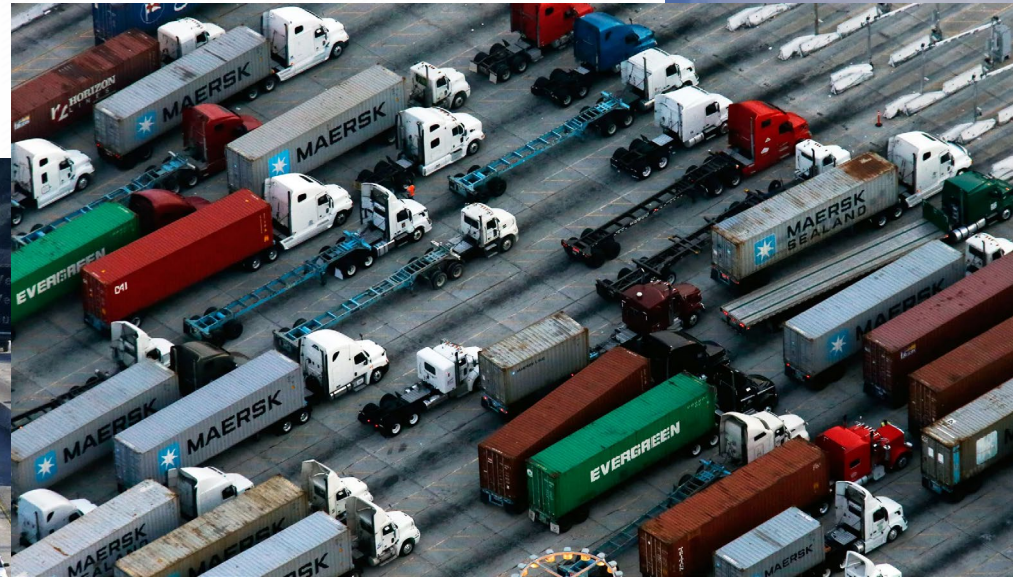
- Wildfires
- Dust storms (Haboobs)
- Volcanos



IAQ Parameters: Geographic Considerations

Human factors - Downwind of:

- Freeways
- Freight hubs
- Industrial areas
- Power plants



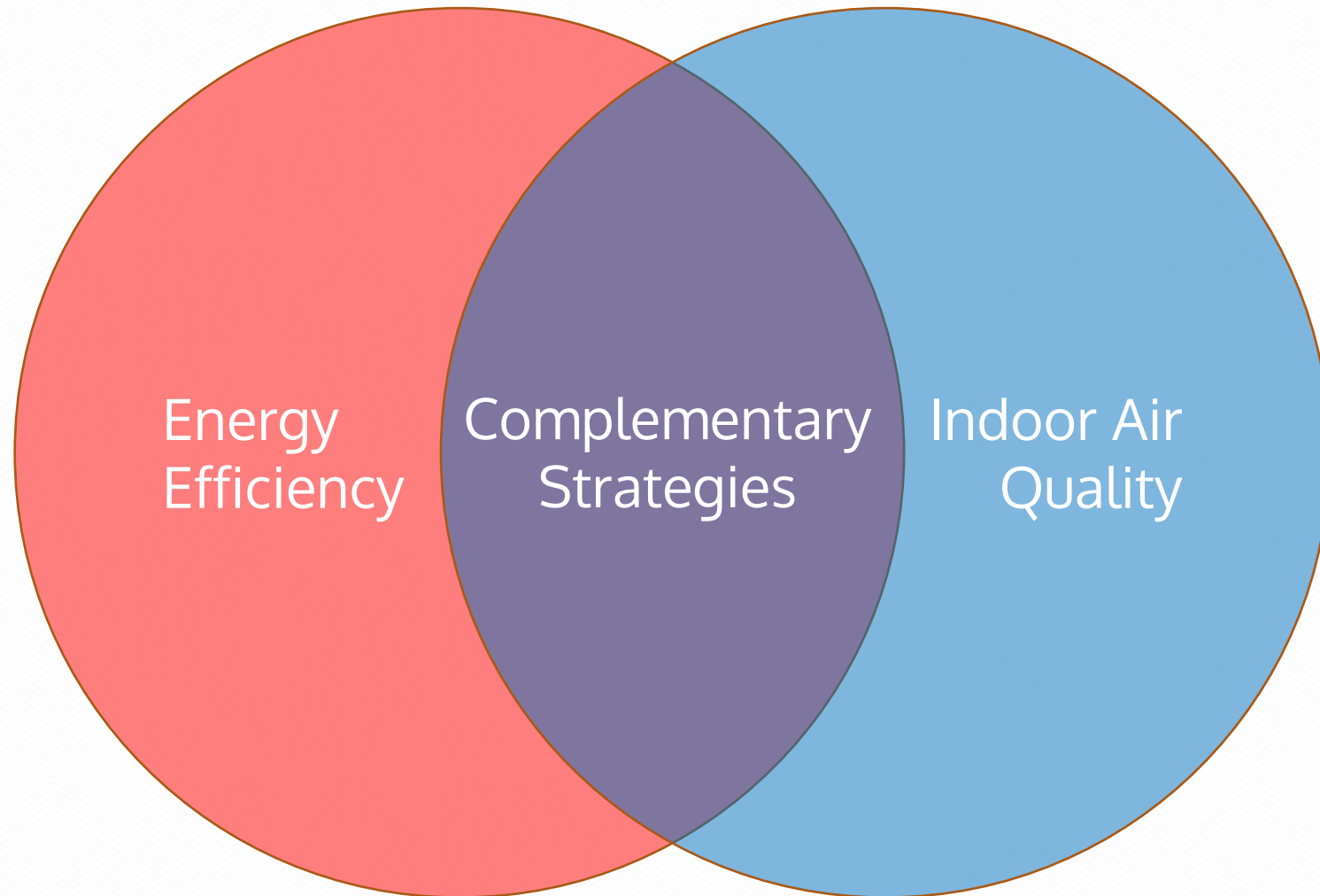
IAQ Parameters: Building Use Considerations

Factors

- Daily and seasonal schedule variation
- Occupant density
- Mix and adjacency of uses
- Pollutant sources from unique uses



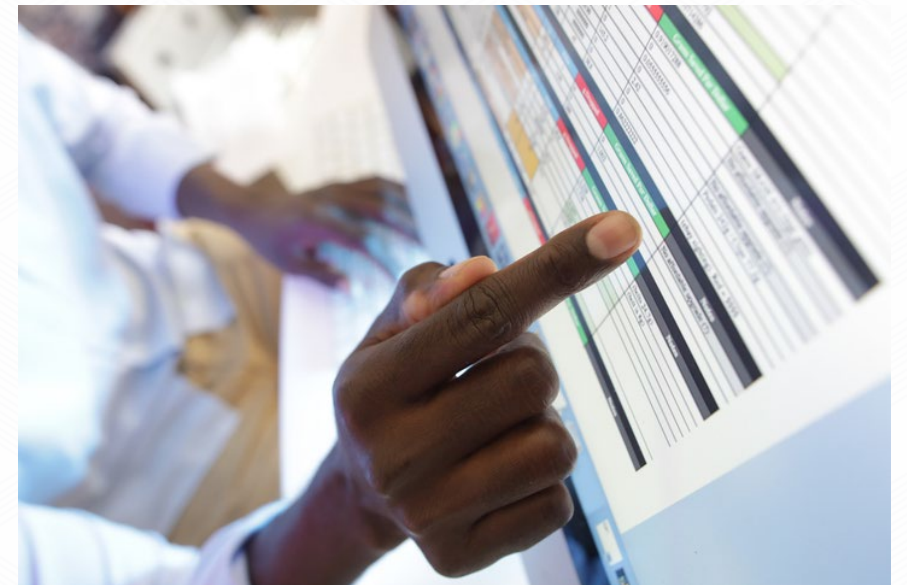
Achieving Energy Efficiency & IAQ



Building Design: IAQ Planning

Pre-design/Design phase tasks

- Clarify owner's IAQ, IEQ & energy goals
- Consider unique health & comfort concerns of expected occupants
- Identify enhanced standards to apply
- Document requirements in OPR and BOD
- Evaluate potential synergies & conflicts between proposed systems/strategies
- Consider permanent IAQ monitoring systems
- Design for ease of maintenance



Building Design: Ventilation

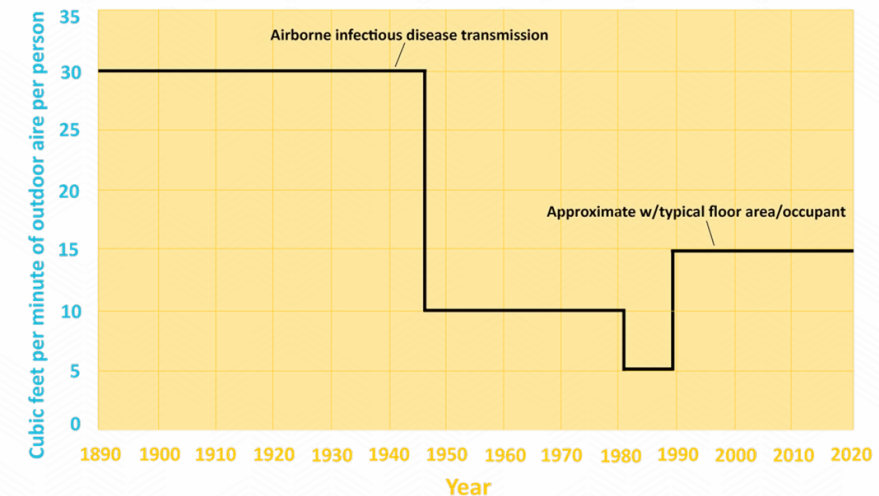
Ventilation standards

- ASHRAE 62.1 – Ventilation for Acceptable Indoor Air Quality
 - Ventilation Rate Procedure
 - IAQ Performance (IAQP) Methodology
- New ASHRAE Standard 241P Control of Infectious Aerosols
- Updated CDC Guidelines – recommended 5 ACH (eACH)

Occupancy Category		People Outdoor Air Rate	Area Outdoor Air Rate	Default Values	
				Occupant Density	Combined Outdoor Air Rate
		m ³ /h Person	m ³ /h m ²	#/100 m ²	m ³ /h Person
Office Building	Break rooms	2.5	0.6	50	3.5
	Office space	2.5	0.3	5	8.5
	Reception areas	2.5	0.3	30	3.5
	Main lobbies	2.5	0.3	10	5.5

2.3. Determined Minimum Air Flow Rate

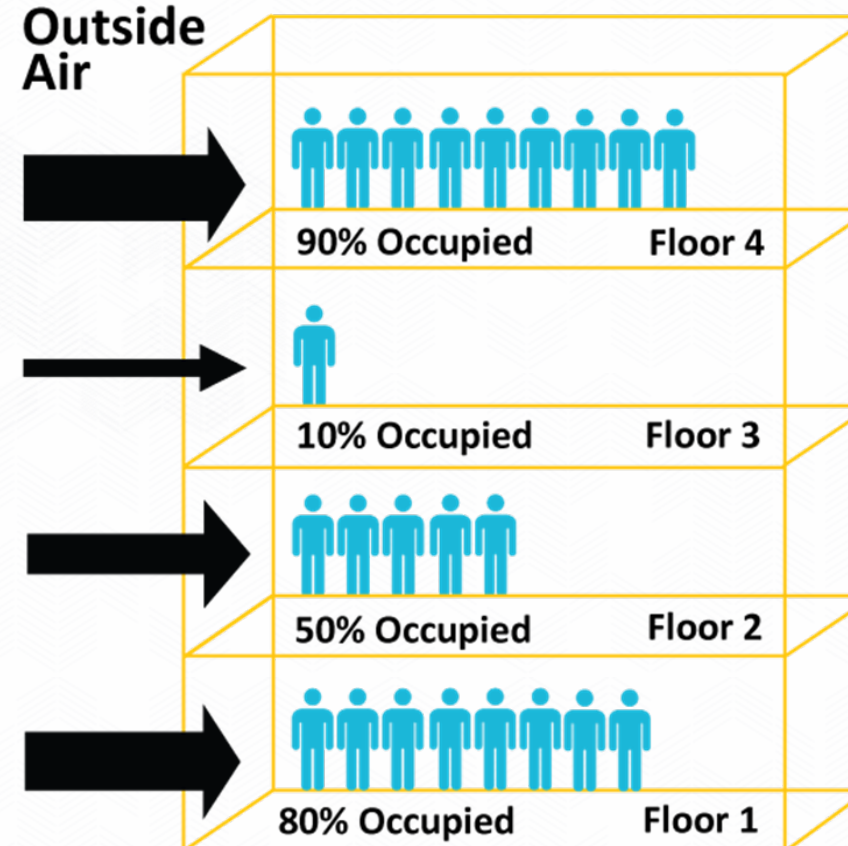
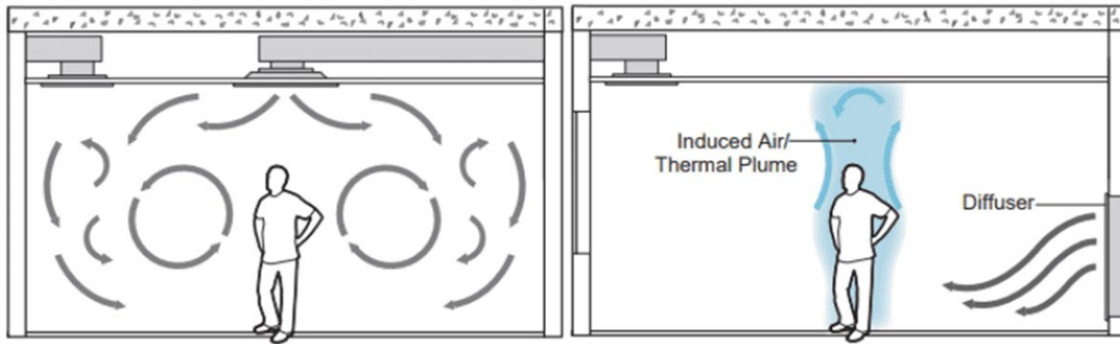
2.3.1. Minimum Air Flow Rate for Indoor Load



Building Design: Systems/Strategies

IAQ enhancement strategies

- Air distribution – alternatives & optimization
- DOAS & energy recovery
- Demand control ventilation
- Smart building
- Operable windows



Adjust fresh air intake based on occupancy

Ventilation demand is determined by CO2 level (ppm)



Building Design: Strategies

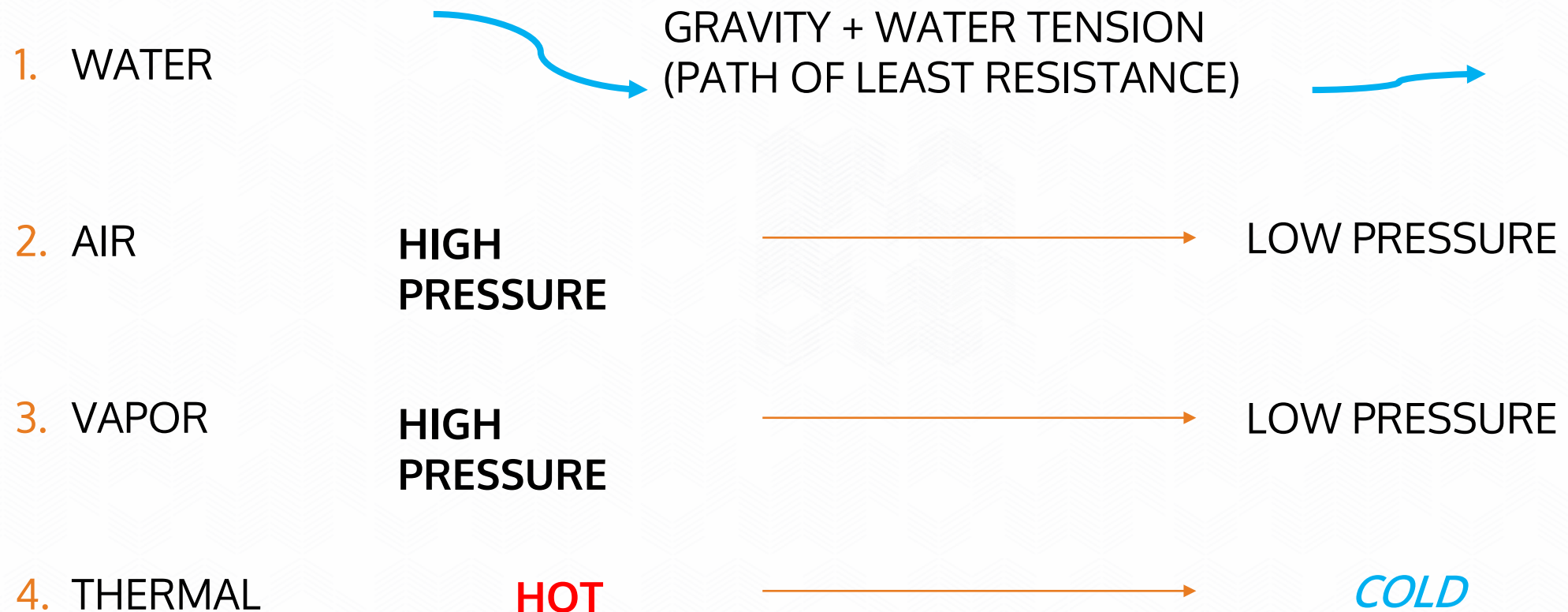
Source elimination

- Design for moisture control (BECx design review)
- Low-emitting materials
 - Paints & coatings
 - Adhesives & sealants
 - Carpets & flooring
 - Insulation
 - Composite wood
 - Furniture

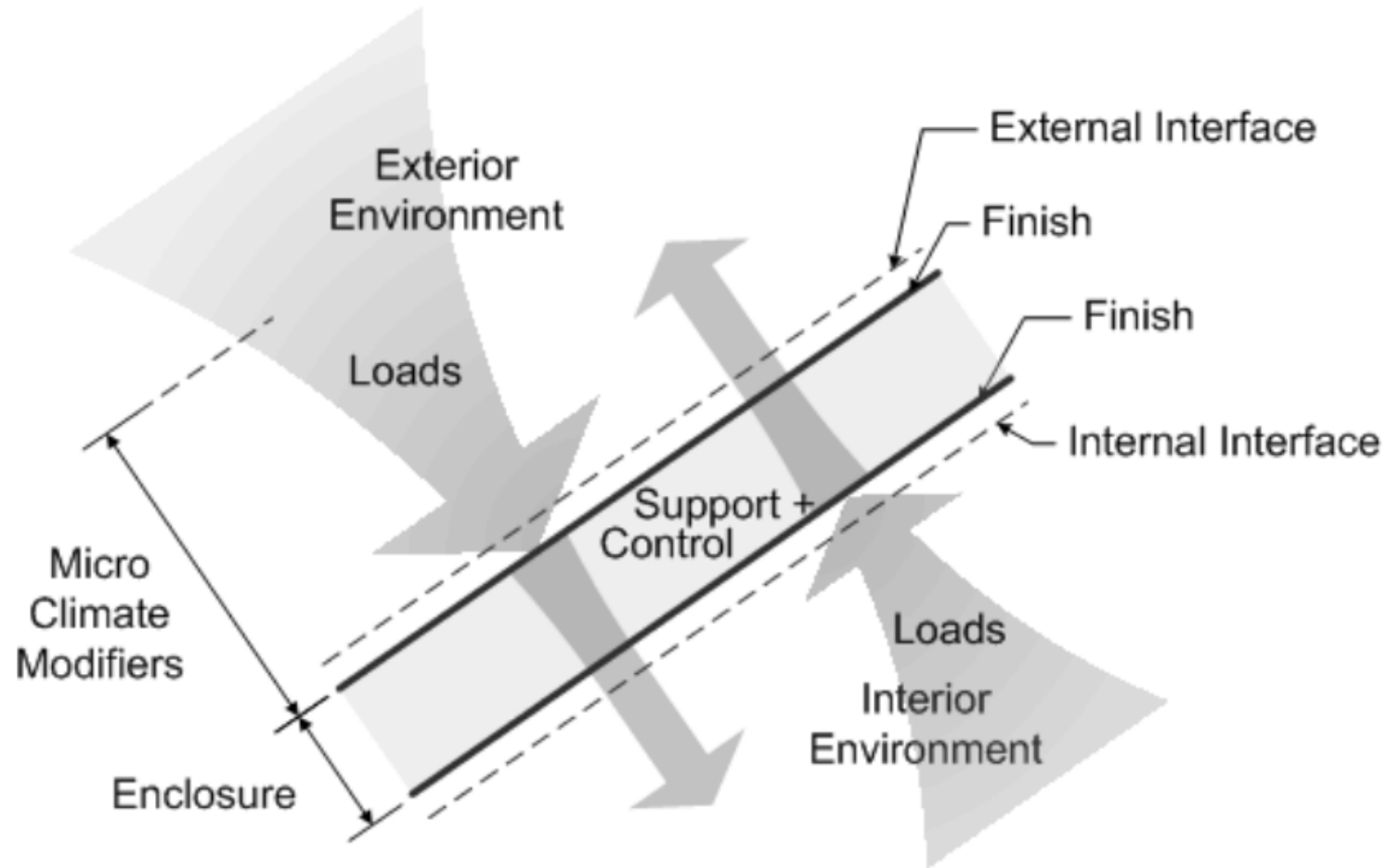


IAQ Parameters: Building Enclosures

Environmental conditions requiring control

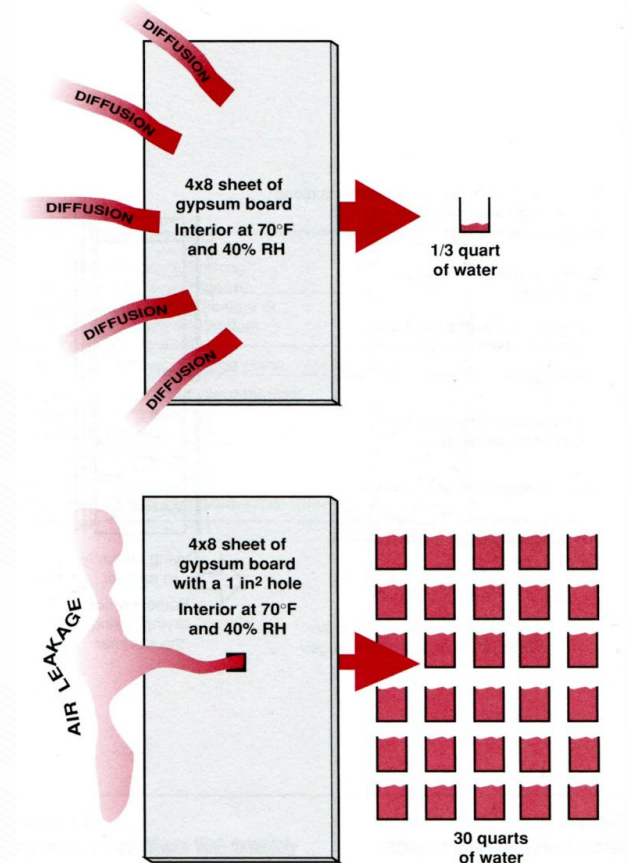
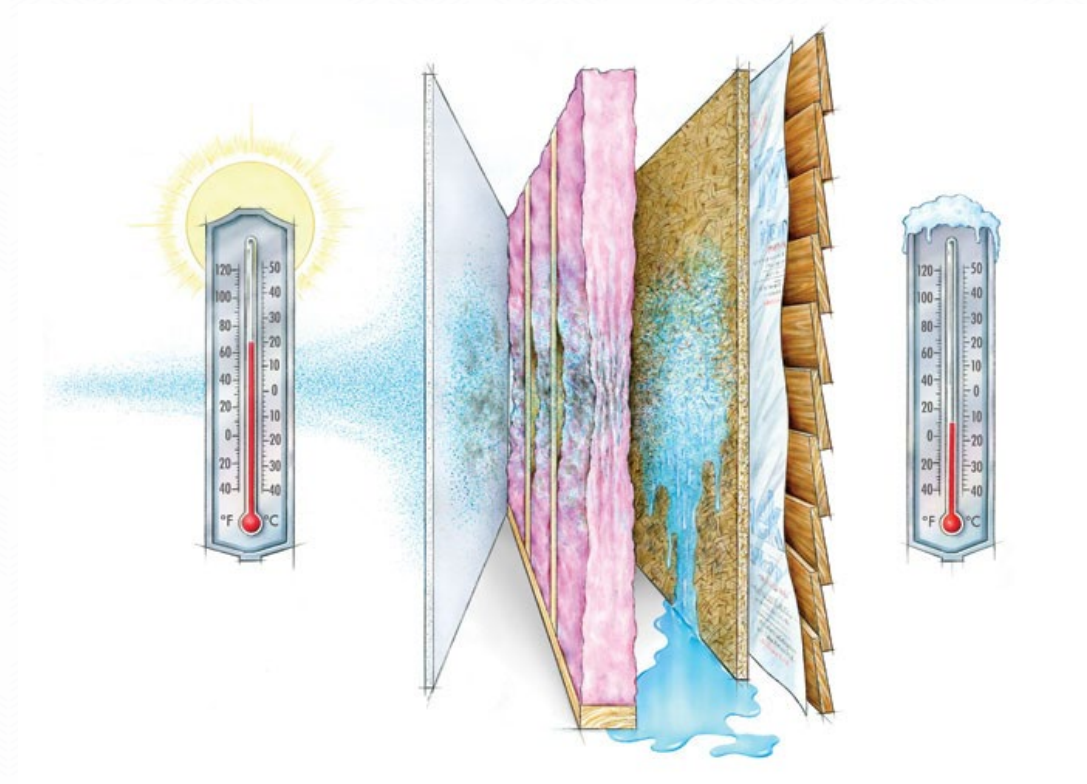


IAQ Parameters: Building Enclosures



IAQ Parameters: Building Enclosures

- Vapor diffusion is a linear process that transports water vapor through a material



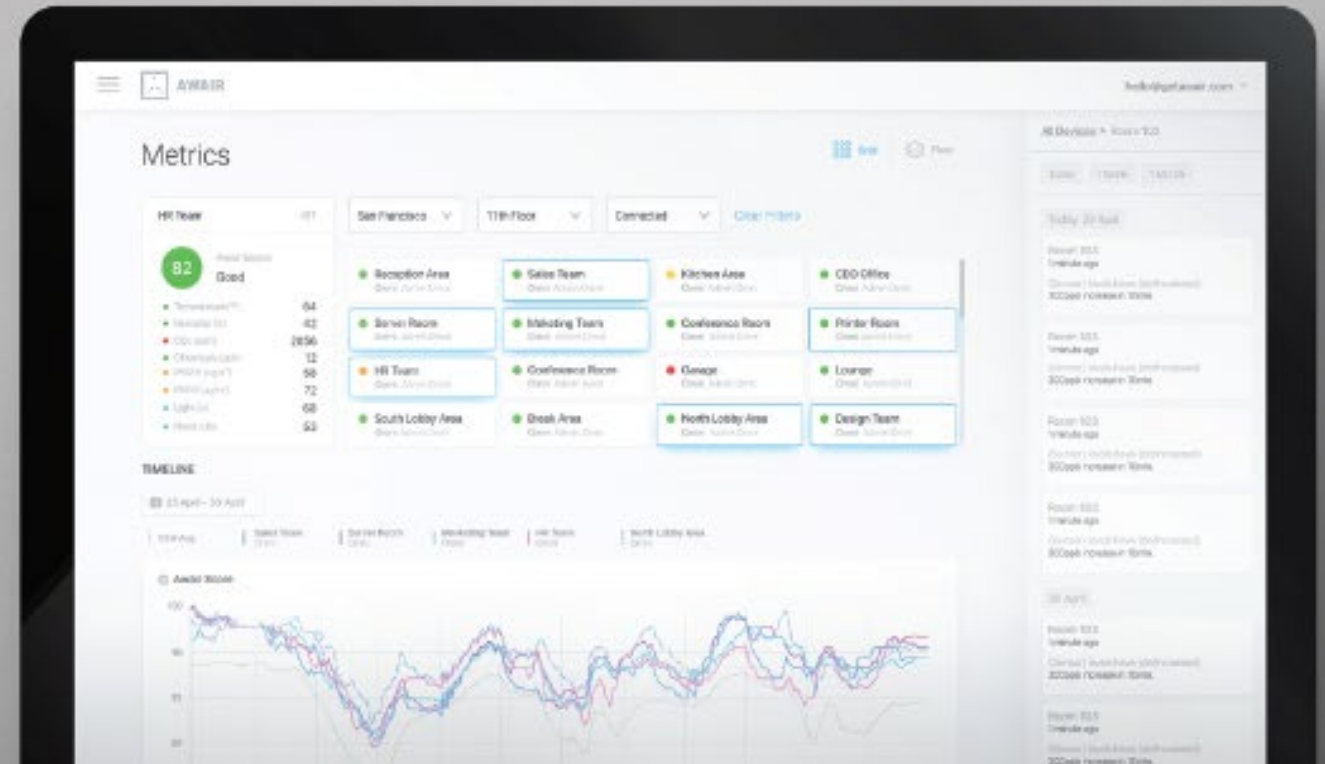
- $\text{Permeance (perms)} = \text{Permeability (perm-inches)} / \text{Thickness (inches)}$

Building Design: IAQ Monitoring

Selecting appropriate system



- On-premises vs cloud
- Stand-alone vs integration
- Parameters to monitor
- Quantity & location of devices



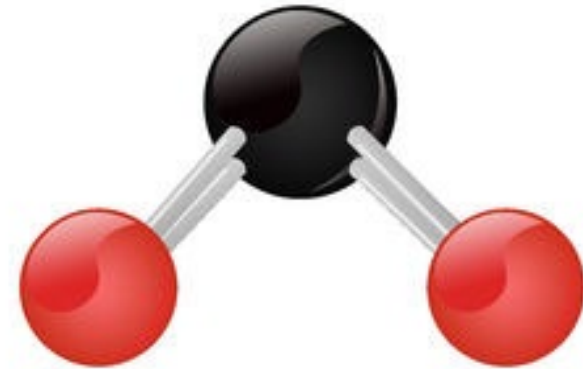
Building Design: IAQ Monitoring

4 Key Parameters to Monitor

- Carbon Dioxide (CO₂)
- Particulate Matter (PM)
- Temperature & Relative Humidity (RH)
- Total Volatile Organic Compounds (TVOC)

and in some cases:

- Carbon monoxide (CO)
- Ozone (O₃)
- Radon



CO₂ is a primary surrogate to monitoring for indoor air quality

- *Previously, recommended limit was 700 ppm above outdoor levels (~1,000 – 1,100 ppm)*
- *Post-pandemic, we ideally want 700 – 1,000 ppm maximum, regardless of the outdoor concentration*

Building Design: IAQ Monitoring

Quantity & location of devices

WELL v2 requires:

- monitor density, minimum 1 per floor or 1 monitor per 3,500 ft² (325 m²)
- >3.3 ft (1 m) away from windows, door, or vents
- 3.6 - 5.5 ft (1.1 - 1.7 m) above the floor

RESET™ Air Standard for Commercial Interiors requires:

- one monitor per 5,382 ft² (500 m²)
- >16.4 ft (5 m) from operable windows, fresh-air diffusers, and air filters

Building Design: Smart Buildings



OCCUPANT AWARE BUILDINGS

High performance/healthy building
Data sharing and analytics
Automation (learn and adapt)

BUILDING AWARE OCCUPANTS

Comfort or experience feedback
Informed service response
Building/portfolio performance



Building Construction: IAQ Implementation

Construction phase tasks

- Include IAQ in commissioning plan
- Submittal review
- Construction IAQ management review
- Building enclosure observation & testing
- HVAC system installation observation



Building Construction: Close-out

Close-out phase tasks

- Whole-building air barrier testing
- Ventilation system test, adjust & balance
- HVAC functional performance testing
- Operation & maintenance manuals
- Post-construction IAQ testing



Building Construction: IAQ Testing

Direct Reading Monitors

- Particle counter
- VOC photoionization detector (PID)
- Ozone monitor
- CO & CO₂
- Relative humidity

Laboratory Testing

- Bioaerosol sampling
- VOC analysis (TO-15 & TO-17)



Building Operation & Maintenance: IAQ Testing

Tracer testing

- Respiratory aerosol proxy
- Quantify dispersion and decay rate
- Complement to ventilation commissioning



Building Operation & Maintenance

Key O&M tasks:

- Filter maintenance
- Cooling tower maintenance
- Monitoring-based commissioning
- Retro-commissioning
- Green cleaning practices
- HVAC system cleaning



Conclusion

- Increased interest in occupant health, comfort and wellbeing
- Many factors that influence IAQ that must be considered
- Evolving standards for IAQ
- Building system and building enclosure Cx providers play key role
- Important activities in all project phases

Thank you!

Alan Scott, FAIA, LEED Fellow, WELL AP, CEM

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