ASHRAE Ireland Section

Indoor Air Quality (IAQ)

an introduction

by Frank Caul and Michael Dawkins

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IAQ - INTRODUCTION

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Indoor air quality (IAQ) is a term referring to the air quality within and around buildings, especially as it relates to the health and comfort of building occupants.

Indoor air is becoming a significant environmental issue and an increasingly more concerning health hazard than **outdoor air.**

IAQ can be affected by **microbial contaminants** (molds, bacteria), **gases** (including carbon monoxide, radon and volatile organic compounds) and **particulates**.

SICK BUILDING SYNDROME

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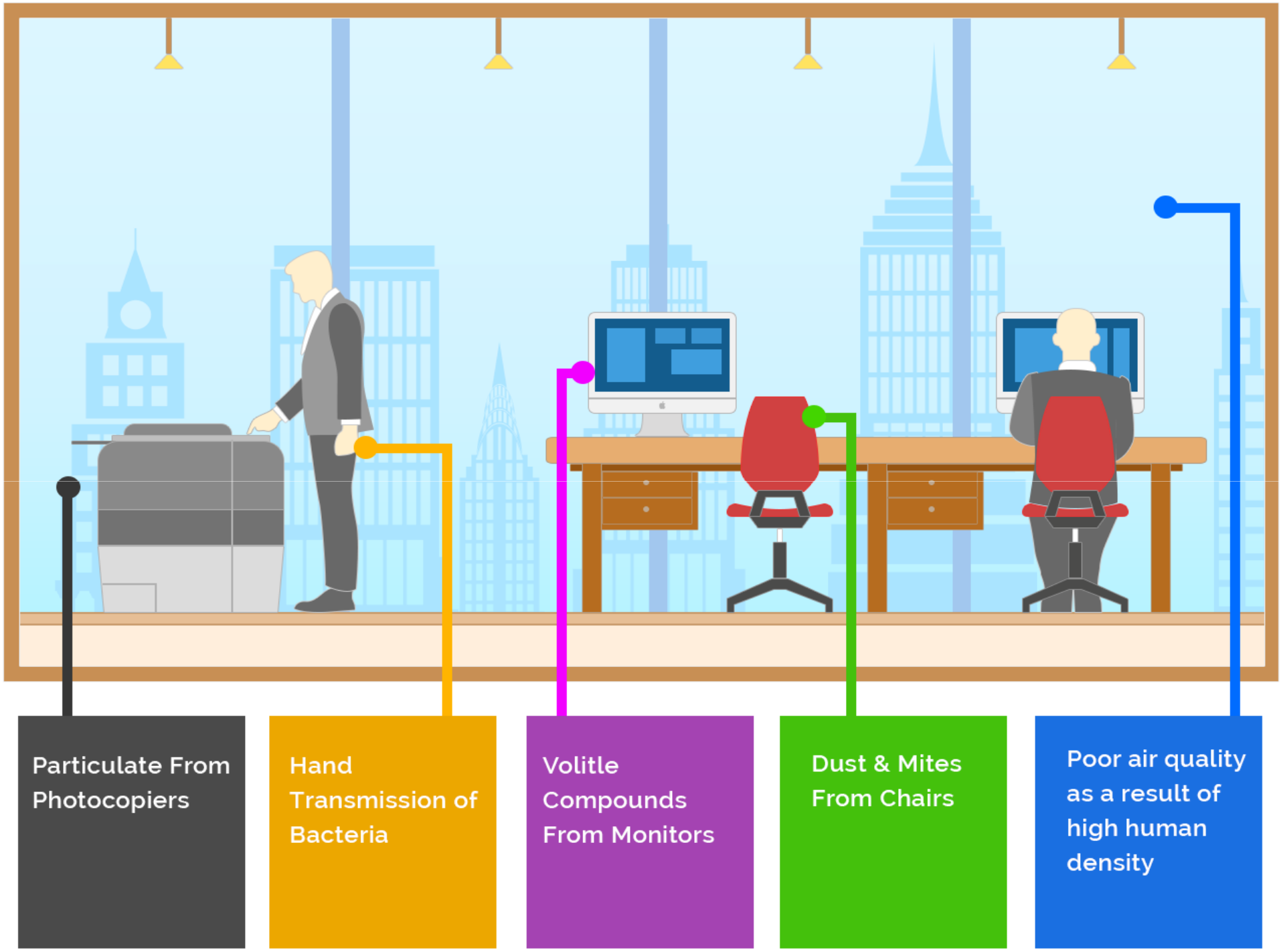
Modern **office equipment** (e.g., photocopiers, laser printers and computers), **cleaning products**, paints and **glues** (VOC) and outdoor air **pollution** can also increase the level of indoor air contamination.

The reactions to these contaminants have led to the phenomenon of **sick building syndrome (SBS).**

Use of **ventilation** to dilute contaminants, **filtration**, and **source control** are the primary methods for improving indoor air quality in most buildings.


Particulate From Photocopiers
Hand Transmission of Bacteria
Volitle Compounds From Monitors
Dust & Mites From Chairs
Poor air quality as a result of high human density

IAQ - ASSESSMENT

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Determination of IAQ levels involves the collection of **air samples**, temperature and humidity **monitoring** and analysis of **air flow inside buildings**.

An IAQ investigation attempts to isolate and mitigate one or more problems of the office building environment, systematically narrowing the range of possibilities.

The investigation generally includes **staff consultation**, observation, information gathering, **testing and measuring**.

AIR QUALITY INDICATORS

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Air Quality Indicators include:

- Temperature
- Humidity
- Fresh Air vs Occupancy levels
- Ventilation and Air Changes
- CO2 levels and odours
- Microbial contaminants and Legionella
- Volatile organic compounds (VOCs)
- Particulates
- Filtration levels
- HVAC conditions

OUTDOOR AIR CLASSIFICATION

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According to the new CEN EN 13779 the **outdoor air** is categorized in 3 levels, from ODA 1 (where the air is pure) to ODA 3 which may contain high concentration of both gases and particles (typical of city centres).

The European standard also classifies the **indoor air quality** in four "classes", from IDA4 - low air quality buildings to IDA1 - high air quality buildings (ie. Healthcare).

Carbon dioxide (CO2) is a normal constituent of the atmosphere at 330-350 ppm.

Outdoor Air concentration levels according to EN13779

Air Quality	Concentration Levels					ODA
Areas	CO2 ppm	CO mg/m3	NO2 µg /m3	SO2 µg /m3	PM10 µg/m3	
Rural areas	350	<1	5-35	<5	<20	1
Small Towns	400	1-3	15-40	5-15	10-30	2
City Centres	450	2-6	30-80	10-50	20-50	3

CO2: Carbon dioxide – CO: Carbon monoxide – NO2: Nitrogen dioxide – SO2: Sulphur dioxide – PM10: Particulates

INDOOR AIR CLASSIFICATION

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The European standard also classifies the **indoor air quality in four "classes"**, from IDA4 - low air quality buildings to IDA1 - high air quality buildings.

CO_2 concentration in indoor air provides generally a good indication of effective ventilation, but not of absolute air quality.

NIOSH considers indoor levels of CO_2 exceeding **1,000 ppm** a marker suggesting inadequate ventilation.

ASHRAE recommends CO_2 levels not exceeding **700 ppm above outdoor levels**.

The UK standards for schools set the limit to **1,500 ppm in classrooms**.

EU Typical CO_2 indoor levels range **is 600 to 1000 ppm above outdoor ambient levels.**

Indoor Air Quality (EN13779)

Cat.	Quality	CO_2 above outdoor air (ppm)	Default value (ppm)	Fresh Air Rate (l/s/person)
IDA 1	High	≤ 400	350	> 15
IDA 2	Medium	400 - 600	500	10 - 15
IDA 3	Moderate	600 – 1000	800	6 – 10
IDA 4	Low	> 1000	1200	< 6

VENTILATION AND FRESH AIR

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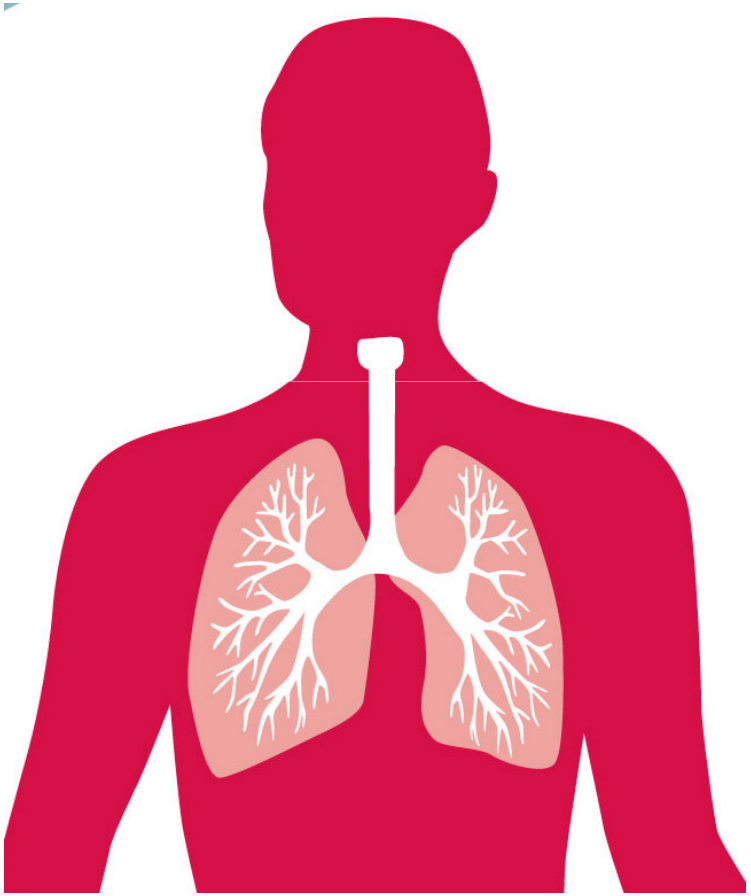
Outside air must be introduced in order to dilute workplace-generated contaminants and odours, according to occupancy rates and activities and in balance with energy conservation requirements.

Standard offices should receive **10 L/s per person of fresh air (never below 7.5 l/s).**

We all need approximately 800 lt. of air to breathe per hour to survive!

ASHRAE also recommends that air movement velocity should not exceed 0.25 m/s in Summer.



FILTRATION

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Fresh air, especially in urban areas, **needs to be filtered** in order to meet internal air quality standards.

Recommended filtration for a **moderate internal air quality** is achieved using primary panel filters with efficiency of G4 and secondary bag filters with efficiency F7.

Active carbon filters may be needed in high polluted areas.

If filters are not **replaced regularly**, dusts, molds, pollens and other accumulated contaminants can be released indoor.

Clean filters also reduce energy usage.

TEMPERATURE, HUMIDITY, NOISE

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Temperature and relative humidity are two of several parameters that affect indoor comfort.

Satisfaction with the thermal environment can also be influenced by such factors as radiant heat, air velocity, occupant activity level, and clothing.

Recommended Sound Pressure range according to EN13779

Use	Recommended Sound Pressure Range dB(A)
Single office	30-40
Landscape office	35-45
Conference room	30-40
Auditorium	20-35
Cafeteria / Restaurant	35-50
Classroom, Crèche	35-45
Department store	40-50

ASHRAE typical recommended indoor design conditions

Area	Indoor Design T/RH Winter	Summer
Offices, conference rooms, gen. areas	20-24°C 20-30%	23-26°C 50-60%
Cafeteria	21-23°C 20-30%	25°C 50%
Department Store	16-22°C	21-25°C
Healthcare Facilities	21-24°C 30-60%	21-24°C 30-60%
Classrooms	20-24°C 30-60%	23-26°C 30-60%
Guest Rooms	22-24°C 30-40%	23-26°C 50-60%
General Museums	19-23°C 45-55%	
Kitchens	21-23°C	28-31°C
Storage	17-18°C	
Toilets	22°C	
Mechanical rooms	16°C	

FUTURE TRENDS: "WELL" STANDARD

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"Our built environment has a profound impact on our health, well-being and productivity."

The WELL Building Standard® (WELL) is a performance-based system for measuring, certifying and monitoring features of the built environment that impact human health and well-being, through air, water, nourishment, light, fitness, comfort and mind.

THE SEVEN CONCEPT OF WELL

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WELL measures attributes of buildings that impact occupant health by looking at seven factors, or Concepts, relevant to occupant health and well-being.

The first one is Air:

"Optimize and achieve indoor air quality. Strategies include removal of airborne contaminants, prevention and purification".

BUILDING VS PERSONNEL COSTS

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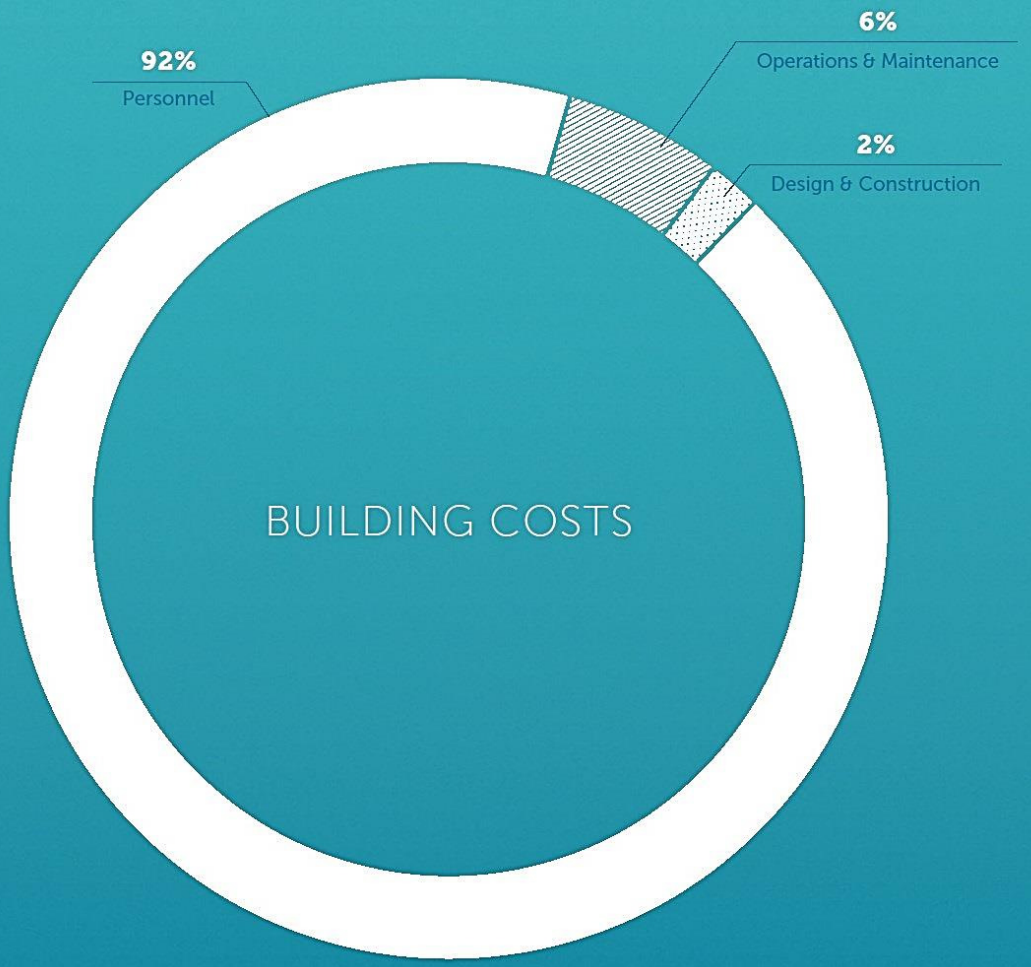
Over 30 years of the life of a building personnel costs significantly outweigh any other building and operational cost.

Therefore, long term value can be generated by addressing occupant health in both commercial and residential spaces.



LEGISLATION REFERENCE

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The most internationally used standard for HVAC and indoor air quality are:

- ***ASHRAE Standard 62.1:2007. "Ventilation for acceptable indoor air quality".***
- ***ASHRAE Standard 55:2004. "Thermal Environmental Conditions for Human Occupancy".***
- ***prEN13779:2007 (European Standard). "Ventilation for non-residential buildings - Performance requirements for ventilation and room-conditioning systems".***
- ***prEN15251:2007 (European Standard). "Indoor environmental input parameters for design and assessment of energy performance of buildings addressing indoor air quality, thermal environment, lighting and acoustics".***
- ***CR 1752:1998, Ventilation for buildings - Design criteria for the indoor environment.***

CONCLUSION

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Thanks for your attention!

Comments

Questions & Answers