



**Kuwait Institute for Scientific
Research**

KISR
Kuwait Institute for Scientific Research

معهد الكويت للأبحاث العلمية

INDOOR AIR QUALITY IN SCHOOLS

Dr. Abdul R. Khan & Mrs. Layla Al-Awadi
Environmental and Live Science Research Center.

18 May, 2014

IAQ changing attitude to work and making you lazy and increasing apatite



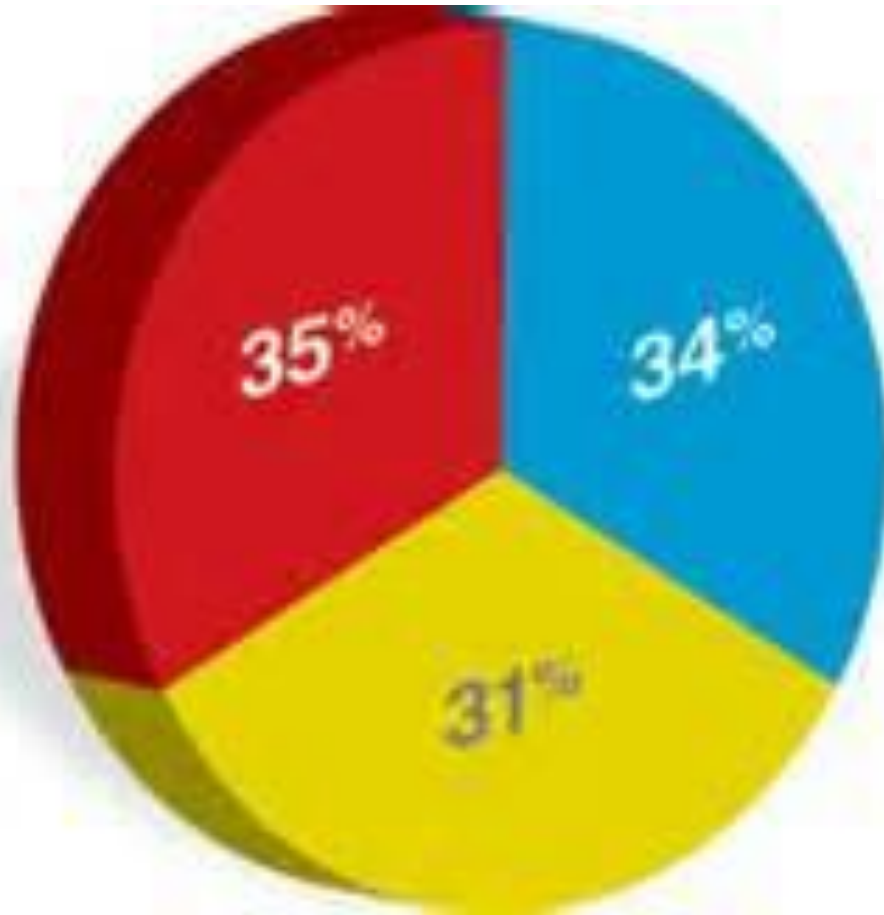
IAQ is responsible for aggressive attitude




In Light CO₂ Control



Particulate Matters Measurements



What's in your air?

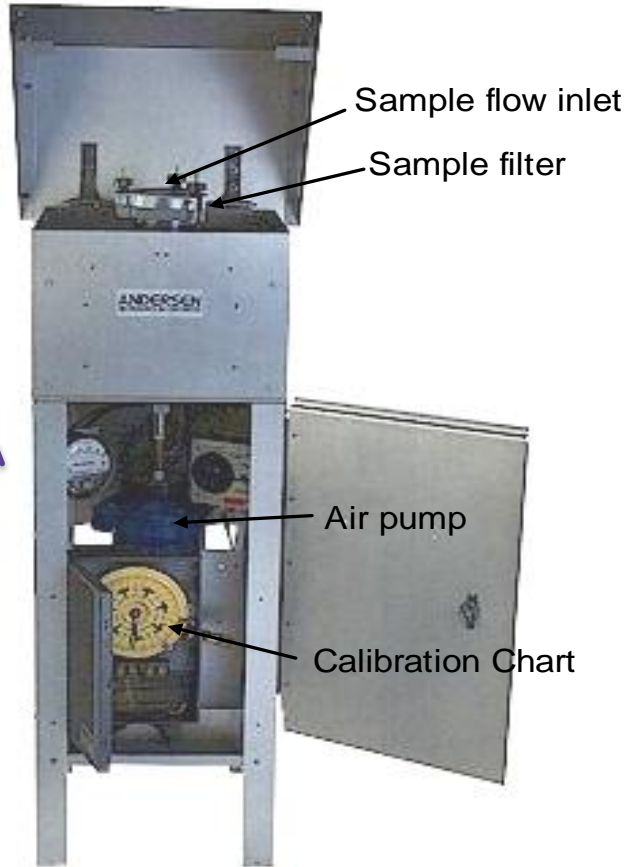
-  **Particulates: dirt, dust, pollen, spores, pet dander, candle soot**
-  **Bio aerosols:
Virus, mold, bacteria
Living micro organism**
-  **Volatile Organic Compounds:
Odor causing contaminants,
Chemical gases, solvents**



**Best practice for
good IAQ**

Measurement Devices

Particulate matter suspended in the air can be sampled by High volume sampler or sequential



Ultra-clean pre-evacuated silicon coated SUMMA SS canisters used to collect ambient air samples



Poly-Urethane Foam (PUF) Sampler used in the study

GC-FID/ECD
or MS



Gas Chromatograph / Mass Spectrometer

Recommended Strategies KISR

for Good Indoor Air Quality

- **Manage contaminants at the source**
- **Use local exhaust for problem areas**
- **Use outdoor air to dilute and replace contaminated air**
- **Control exposure by managing time, amount and location of products used**
- **Filter the air**
- **Educate everyone on IAQ**
- **Designate an indoor air quality coordinator for sitting, design, construction, and operation**

Recommended Practices for School Sitting

- **Conduct an Environmental Site Assessment**
- **Analyze the local climate**
- **Analyze nearby air quality and emission sources**
- **Analyze for radon and other factors**
- **Document findings**

Recommended Practices for School Design

- **Ensure the design team knows about IAQ**
- **Prepare an indoor pollutant source control plan**
- **Follow IAQ codes and standards**
- **Provide funding and schedule for IAQ**
- **Plan the site and building for IAQ**
- **Design for control of radon and other contaminants**
- **Design for control of sewer gas**
- **Design an effective entry mat system**

- **Protect the quality of air near air intakes**
- **Size HVAC for maximum occupancy according to standards**
- **Provide flexibility to adjust HVAC for changes in building occupancy and use**
- **Take special precautions when using natural ventilation**
- **Control microbial growth through HVAC design**
- **Provide exhaust for special use areas**
- **Keep duct insulation contained and dry**
- **Properly select, install and maintain air filtration**
- **Control interior temperature, humidity and other conditions**
- **Properly select and place control systems**
- **Where feasible, use central HVAC AHUs that serve multiple rooms**
- **Design HVAC to facilitate operation and maintenance**
- **Integrate IAQ measures with energy management**
- **Target and evaluate materials, finishes, and furnishings**
- **Identify cancer-causing agents and reproductive toxins**
- **Consider meeting emission rate guidelines**
- **Precondition furnishings and materials**
- **Document design decisions**

Recommended Practices for Construction

- **Control moisture, VOCs and dust**
- **Monitor construction**
- **Commission the building**
- **Monitor air quality**
- **Train maintenance staff**
- **Document design and construction**
- **Flush air before and after occupancy**
- **Take precautions during remodeling or renovation**

Recommendations for Controlling General Contaminant Sources

- **Develop an asthma management plan**
- **Prevent and eliminate mold**
- **Enforce tobacco use policies**
- **Control cleaning and maintenance materials**
- **Control dust**
- **Use integrated pest management**
- **Control asbestos**
- **Monitor for radon and control as necessary**

Recommended Practices for Controlling Contaminant Sources in Classrooms, Offices and Special Use Areas

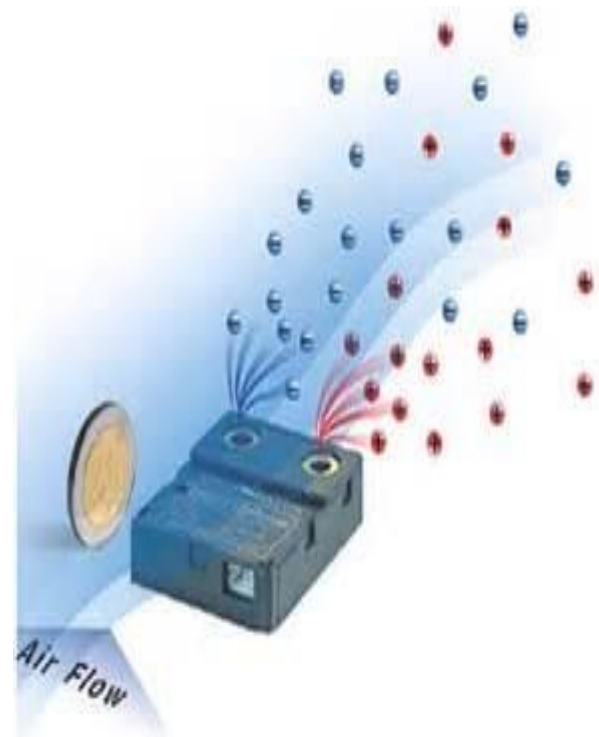
- **Encourage good personal hygiene**
- **Maintain clean classrooms and offices**
- **Properly ventilate staff work rooms and printing rooms**
- **Clean and ventilate food handling areas**
- **Use special precautions for locker rooms**
- **Provide special ventilation and control materials and practices in science rooms**
- **Ventilate and control materials and practices in art and theater rooms**
- **Do not keep pets in the classroom**
- **Eliminate the use of VOC rich products (markers, air fresheners other highly scented products)**
- **Provide special ventilation and control materials and practices in vocational art areas**
- **Provide special ventilation and control chemicals and practices in swimming pools**

Recommended Practices for Controlling Contaminant Sources in Classrooms, Offices and Special Use Areas

- **Encourage good personal hygiene**
- **Maintain clean classrooms and offices**
- **Properly ventilate staff work rooms and printing rooms**
- **Clean and ventilate food handling areas**
- **Use special precautions for locker rooms**
- **Provide special ventilation and control materials and practices in science rooms**
- **Ventilate and control materials and practices in art and theater rooms**
- **Do not keep pets in the classroom**

Recommended Practices for Organizing to Maintain Good Indoor Air Quality

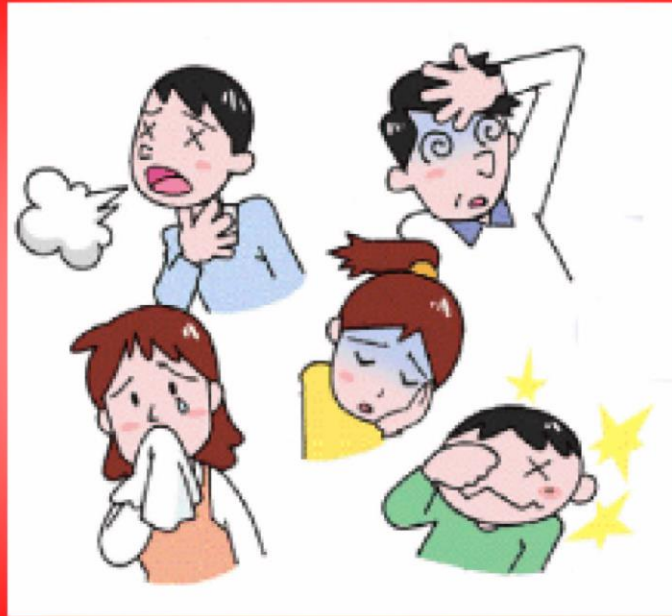
- **Designate an IAQ Coordinator for building operations**
- **Prepare an IAQ management plan**
- **Provide training and education**
- **Communicate with staff, students, parents, and other interest groups**
- **Be proactive in managing IAQ problems**



Eye or Throat Irritation

Headache
Dizziness

Nausea Feeling Sick



Lassitude, Fatigue

Difficulty
in
Breathing

Difficulty in Concentration

Dry or Itchy Skin



Sick Building Syndrome

HOW INDOOR AIR POLLUTION
IS POISONING YOUR LIFE—
AND WHAT YOU CAN DO



The **SICK BUILDING SYNDROME**

BY NICHOLAS TATE

What Is Sick Building Syndrome?

Sick building syndrome (SBS) is a situation in which occupants of a building experience acute health effects that seem to be linked to time spent in a building, but no specific illness or cause can be identified. The complaints may be localized in a particular room or zone, or may be widespread throughout the building.

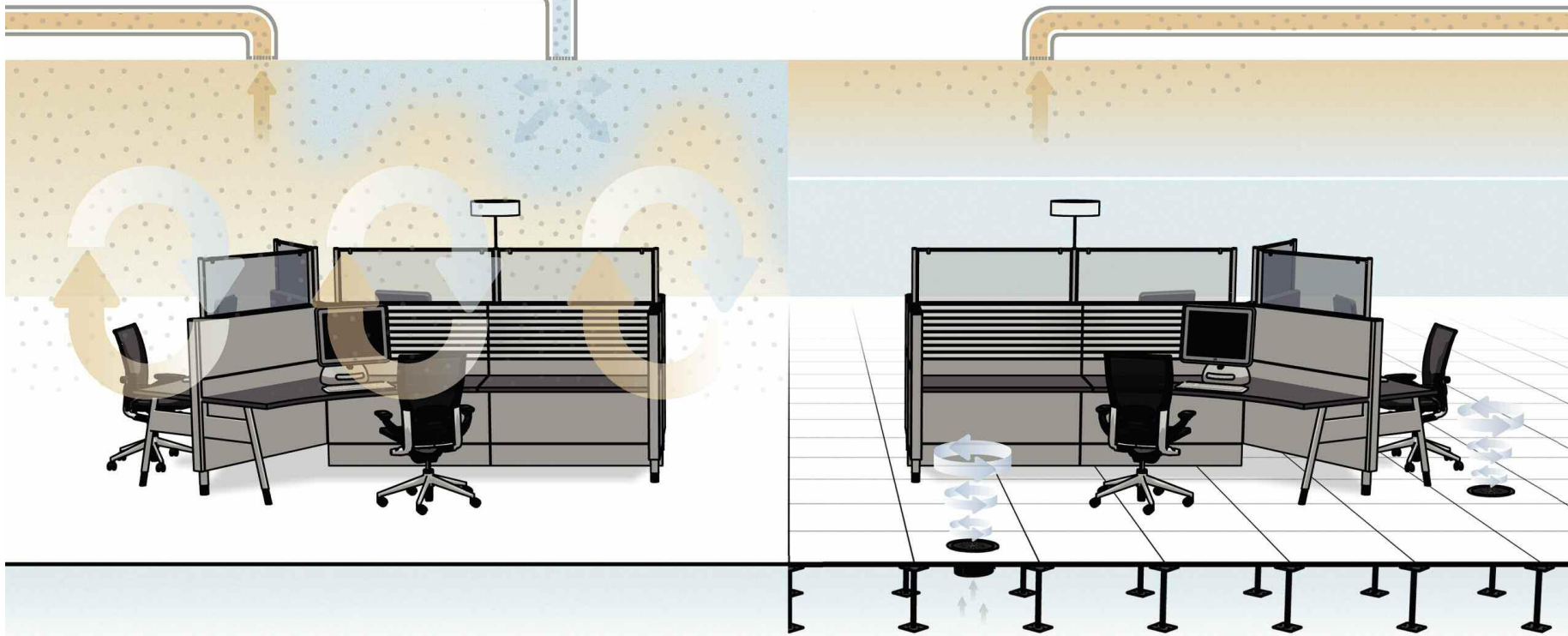
Frequently, problems result when a building is operated or maintained in a manner that is inconsistent with its original design or prescribed operating procedures. Sometimes indoor air problems are a result of poor building design or occupant activities.

Choose the right type of setup

A



B



Warning Signs

- **Do you feel fatigue, sleepy, exhausted and stressed all the time?**
- **Do you have frequent headaches, flue symptoms, skin, throat or eye irritations?**
- **Do you feel like something is sucking out all your power at work or at home?**

Air quality standards used in the study

Parameter	Hourly $\mu\text{g}/\text{m}^3$		Daily $\mu\text{g}/\text{m}^3$		Annual $\mu\text{g}/\text{m}^3$	
	AAQ	IAQ	AAQ	IAQ	AAQ	IAQ
NH₃	850	850	---	---	148	148
SO₂	444	783.5	157	523.3	80	157
NO₂	225	225	112	112	67	67
Particulate Matter	---	---	350	350	90	90





IS YOUR WORKPLACE MAKING YOU SICK?

SICK BUILDING SYNDROME COULD BE
CAUSING YOUR MYSTERY SYMPTOMS

SYMPTOMS: Symptoms mimic many diseases!

Most symptoms are inflammatory and allergic in nature.

You may experience:

itchy/watery eyes • chest tightness • wheezing
sniffing • sneezing • dry/hacking cough
chronic headaches • dizziness • chills • fever
memory impairment • difficulty concentrating

HOW TO TREAT SICK BUILDING SYNDROME NATURALLY

- Switch to Green Cleaning Products
- Check for Hidden Sources of Mold
- Get Some Plants
- Invest in an Air Purifier
- Choose Hypo-allergenic Beds, Carpets, etc.
- Take Immune-Boosting Supplements

AVAILABLE SUPPLEMENTS

Diamond Nutritional's Foundation Vitamins

Diamond Nutritional's Probiotic Formula, Diamond Nutritional's
Vitamin D3, **Diamond Nutritional's Foundation Vitamins.**

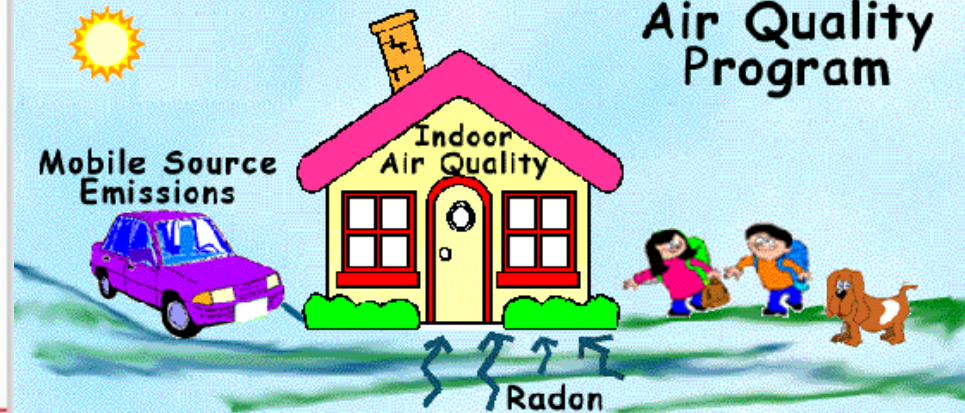
JOIN
OUR MAILING LIST

*If left untreated, it may manifest itself as a long
list of symptoms which may prompt your doctor to
prescribe medications that you don't really need!*

www.AskDrMaxwell.com

DESIGNED BY: WHAT IF IDEAS DESIGN LLC

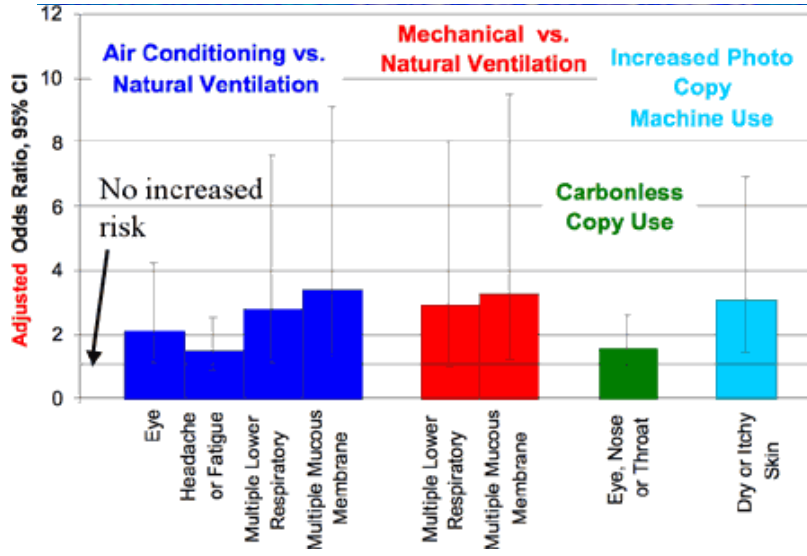
Air Quality Program



Is Your Building Making You Sick?

A Training Workbook for Working People





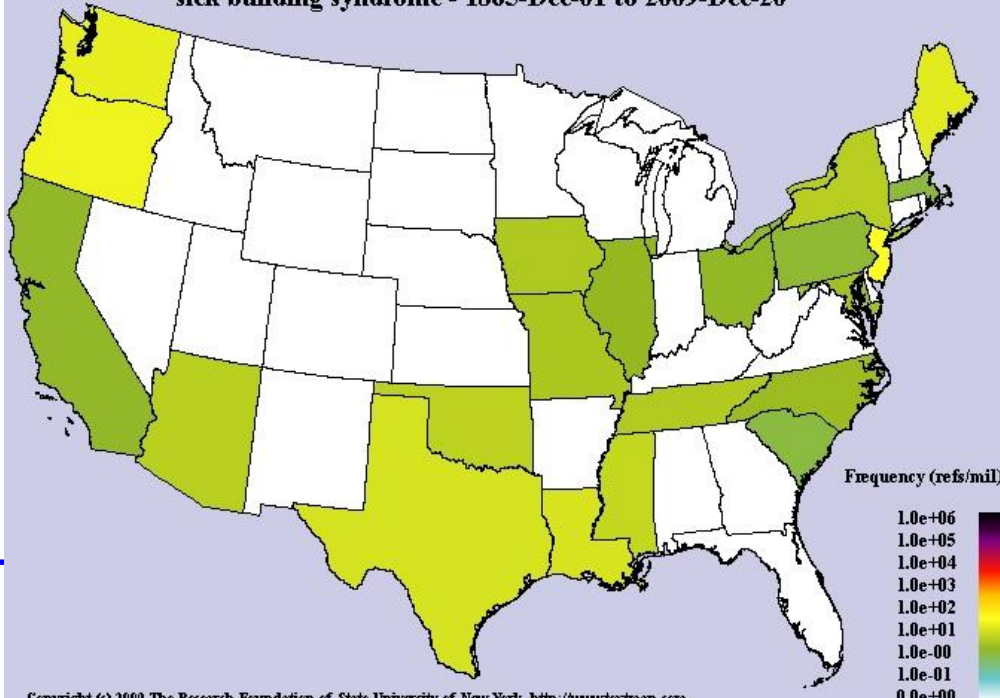
Application		Occupancy (people/1000 ft ²)	Cfm/person	Cfm/ft ²
Food and Beverage Service	Dining rooms	70	20	
	Cafeteria, fast food	100	20	
	Bars, cocktail lounges	100	30	
	Kitchen (cooking)	20	15	
Offices	Office space	7	20	
	Reception areas	60	15	
	Conference rooms	50	20	
Public Spaces	Smoking lounge	70	60	
	Elevators			1.00
Retail Stores, Sales Floors, Showroom Floors	Basement and street	30		0.30
	Upper floors	20		0.20
	Malls and arcades	20		0.20
	Smoking lounge	70	60	
Sports and Amusement	Spectator areas	150	15	
	Game rooms	70	25	
	Playing floors	30	20	
	Ballrooms and discos	100	25	
Theaters	Lobbies	150	20	
	Auditorium	150	15	
Education	Classroom	50	15	
	Music rooms	50	15	
Hotels, Motels Resorts, Dormitories	Bedrooms			30 cfm/room
	Living rooms			30 cfm/room
	Lobbies	30	15	
	Conference rooms	50	20	
	Assembly rooms	120	15	



Information Courtesy National Coalition for Indoor Air Quality



sick building syndrome - 1865-Dec-01 to 2009-Dec-20



Good daylight in schools leads to a **10%** increase in overall performance among pupils

20% faster progression in mathematics in schools

26% faster progression in reading in class

Workers have **25%** better memory function when they have views from their buildings

There are gains of up to **11%** in productivity in offices with fresher air

Offices with access to daylight and operable windows experience an increase of up to **18%** in productivity

Green buildings can deliver

- Decrease in waste output **70%**
- Reduction in energy use **30-50%**
- Reduction in water usage **40%**
- Decrease in carbon emissions **35%**

Sources: World Health Organization, Heschong Mahone Group, World Green Building Council, Exeter university, Stern Review, UN, Olympic Delivery Authority, Salford university, Carnegie Mellon University

The construction and maintenance of buildings and other structures is responsible for about **half** of British carbon dioxide emissions

Office plants can increase staff productivity by **38%** can boost staff well-being by up to **47%** and increase creativity by **45%**

Foundations for the aquatics centre, handball arena and the Olympic stadium in London used concrete with more than **30%** of recycled materials

Table 1. Existing Criteria for IAQ Sources: Healthy Buildings and the U.S. Department of Commerce



Parameter	Criteria	Reference
Outdoor airflow rate	10L/s (20cfm) per person	ASHRAE 62-1989
	2.5L/s (5cfm) per person	BOCA National Mechanical Code 1990 Section M-1603.2-1
Pressure relationship between zones	Restrooms mechanically exhausted with no recirculation	ASHRAE 62-1989 BOCA National Mechanical Code
	Restroom design exhaust capacity ≥ design supply capacity	BOCA National Mechanical Code 1990 Section M-1602.9.3
Carbon dioxide	1000ppmv	ASHRAE 62-1989
Carbon monoxide	9ppmv 8-hr average	ASHRAE 62-1989
	35ppmv 1-hr average	US EPA-Nat. Ambient AQ Std.
	<9.6ppmv limited/no concern	WHO Continuous exposure
	>26ppmv matter of concern	ASHRAE 62-1989
Formaldehyde	17ppmv annual average	BOCA National Mechanical Code 1990 Section M-1603.2-1
	26ppmv 24-hr average	
Formaldehyde	0.4ppmv, target level for home	HUD Std. For manufctd homes
	50ppbv limited/no concern	ASHRAE 62-1989
Particulates	100ppbv matter of concern	WHO long/short term expos
	50µgm ⁻³ annual mean (PM ₁₀)	ASHRAE 62-1989
	150µgm ⁻³ daily mean (PM ₁₀)	US EPA-Nat. Ambient AQ Std.
	60µgm ⁻³ annual mean (PM ₁₀)	BOCA National Mechanical Code 1990 Section M-1603.2-1
Radon	150µgm ⁻³ daily mean (PM ₁₀)	
	4nC _i m ³ action level for homes	ASHRAE 62-1989 US EPA 1988 Technical guidance
Total VOCs	Comfort range: <200µgm ⁻³ Multifactorial exposure ranges: 200-3000 µgm ⁻³ Discomfort range:	Indoor Air '91 This is not a standard, but is based on combination of field and controlled climate chamber tests.
Thermal comfort	Predicted Percent Dissatisfied (PPD≤10%)	ASHRAE 55-1992
		ISO Standard 7730

**Thank
You**

Question Please