

**SUGGESTIONS FOR AVOIDING INDOOR AIR
QUALITY COMPLAINTS**

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Over the years, the Building Performance Division of Public Works Canada (PWC) has been working on methods not only for remedying indoor air quality (IAQ) problems, but for avoiding their creation in the first place. This paper summarizes these methods in the form of suggestions to be used by anyone involved in the design, lease, purchase or construction of new accommodation, also those who operate and maintain buildings and those who occupy office space. Of course, they will also be of use to people who are involved specifically in the diagnosis and cure of IAQ problems.

INTRODUCTION

The suggestions contained in this paper are aimed at the maintenance of a productive working environment. It is not enough that the air be pure, it must also seem to be pure. As a result, many of the suggestions are designed to encourage the perception of a good overall working environment with emphasis on indoor air quality, ventilation and thermal control.

Most of these suggestions are not mandatory. Indeed, some cannot be used in all buildings. As a result, they should not be interpreted as a statement of PWC policy, but rather as a series of ideas you might consider depending on your particular situation. If you are trying to establish a complaint free environment, however, all of the suggestions described will help stack the odds in your favour.

This paper presents suggestions pertaining to the management of office space. It discusses base building characteristics considered desirable, and comments on maintenance, operation, and the fit-up and end use of a building. Poor IAQ can be the result of errors at any stage. This serves to emphasize the importance of team effort and communications in the delivery of good IAQ.

MANAGEMENT OF OFFICE SPACE

New Construction: Occupants' needs and operational requirements must be well established before the design of a new building or major retrofit takes place. These requirements should include building design features described below. When construction is completed, one of the most important activities to ensure occupant satisfaction is effective commissioning to verify that the building works as it was intended and that the team that is going to take over the operation of the building is well briefed.

Preventive Maintenance: It is important that a building be maintained in the

state that it was in when it was delivered and properly commissioned. Once the tenant becomes truly dissatisfied, you are "behind the eight ball". A level of quality which might not have originally caused complaint may never be considered satisfactory again. A comprehensive set of procedures for routine maintenance of a building (i.e., the PWC Preventive Maintenance Support System) is required. This includes checking systems and their components, as well as the maintenance activities described below.

Preventive Diagnosis: The conditions causing most indoor air quality complaints can easily be avoided by regularly carrying out some simple investigative procedures, and taking corrective action if necessary. At PWC, a three stage approach has been developed, starting with a checklist to be used by a property manager on a preventive basis. The checklist focuses on the ventilation system, potential pollutant sources and complaint locations, indicating inspections to carry out and questions to answer. The information collected is easily interpreted. Using this checklist, it should be possible to correctly identify 60-80% of problems before they become issues. The second stage involves the use of simple test kits designed for regional technicians. Again, 60-80% of the problems which are left should be correctly identified. Finally, the Technology Building Performance Division can provide advice and services for those very few problems that are truly difficult to crack.

Feedback/Communications: If an IAQ problem is found, let the occupants know about it, and tell them what you are doing about the situation. If there are difficulties in finding the cause of the problem and it seems that the solution may take some time, you will find that the occupants can be remarkably patient if they know that action is being taken. Similarly, let them know when the problem is solved. Otherwise, they may never give you credit for your actions, and perhaps become more disgruntled and distrustful with time. Any occupational health and safety committees in the building should also be kept fully informed.

BUILDING DESIGN FEATURES

Outdoor Air Rates: The current ASHRAE minimum recommended outdoor air ventilation rate is 10 l/s/person. Buildings with an economizer cycle will supply much more outdoor air than that during most of the year. This both saves on cooling bills and provides a valuable margin for error.

Outdoor Air Intake: The building outdoor air intake must not be near or downwind of a pollution source. This normally means that it should not be at or near ground level.

Flexibility: A building changes uses many times during its life. When a change occurs, it is important that the ventilation system can be adapted accordingly. The ventilation system should be designed with excess capacity in order to respond to changes in occupant density or outdoor air requirements. Leave space free in shafts so that low level pollution sources (i.e., printing shops) can later be vented to the outside.

Pollution Migration: Parking garages, loading docks, kitchens, printing shops and laboratories all tend to "leak" pollutants into the rest of the building. Even at low levels, these can become a source of annoyance, sometimes in the form of an unpleasant odour, to the occupants. Make sure that these areas are negatively pressurized compared to the rest of the building and exhausted to the outside. Don't forget to check for leaks regularly.

Maintenance Accessibility: If the components of building systems are not readily accessible, they will not be well maintained.

Operable Windows: Occupants like to have control over their environment and will often tolerate poorer conditions if they are in control. If the building is small, or has small window surface area, or the climate is not severe, consider installing windows that open.

Building Materials Selection: New building materials (i.e., carpets, textiles, paints and glues) tend to give off odours which may irritate some occupants. To counteract this, choose less offensive materials, overventilate in the early stages of occupancy, or consider a building "bake-out". Bake-out involves heating the building to speed up release of solvents (it has been successful in reducing VOC emissions in most buildings tested, but it cannot be used in all situations). Taking action on this problem is important, since the first impression is a lasting impression.

MAINTENANCE

Cleanliness: Occupants perceive a clean building as a well maintained and operated building. The cleaning contractor is a major player in the perception of cleanliness. The ventilation system should also be cleaned regularly, since it can become a strong source of IAQ pollutants itself.

Wet areas: Wet areas such as humidifiers, cooling towers, cooling coils and sometimes air intakes can become breeding grounds for all sorts of nasty biological contaminants. They must be cleaned and disinfected regularly. Mould growth is not limited to ventilation systems. It can occur to dangerous levels in carpets or even inside flat roofs if there has been a leak.

Filters: Dirty filters not only restrict air flow, but are breeding grounds for undesirable fungi when wet.

Calibration: To ensure that the building is really doing what you think it is doing, sensors in a building's control and monitoring system should be recalibrated at least once a year. This includes carbon monoxide sensors in underground parking garages,

Timing: Maintenance activities that generate odour or pollution should take place in the spring or the fall when the amount of outdoor air coming into the building is highest. These activities (i.e., carpeting and painting) should be performed at night with the ventilation system fully operational so as to cause minimum discomfort and disruption to daytime occupants.

Quantities: A little is good, so a lot is better? When it comes to substances like carpet shampoo and pesticides this is definitely not true. Quantities recommended by the manufacturer should not be exceeded. Otherwise chemical concentrations can build up and present very significant IAQ problems.

OPERATION

Operating Manual: For the consistent, trouble-free operation of a building, an operating manual is essential. The manual must include such information as energy conservation procedures, methods of operation in each seasonal mode, design setpoints for control systems, guidance for life safety modes, scheduled outdoor air supply rates, and any other designed-operational modes.

Outdoor Air Rates: It is not enough that a building be designed to take in sufficient outdoor air (see ASHRAE 62-89, "Ventilation for Acceptable Indoor Air Quality"). Frequent checks are required to verify that it is operating in that manner. Buildings designed to deliver less outdoor air than ASHRAE's latest recommendation will be more acceptable if adjusted to maximize outdoor air, particularly in winter and summer.

Temperature and Humidity Control: If the thermal conditions in a building are poor, resulting in complaints of stuffiness, the perception of the occupants may be that there are ventilation and air quality problems. To the extent possible, the building should be operated within the requirements of ASHRAE 55-81, "Thermal Environment Conditions for Human Occupancy".

Hours of Operation: In order that the building will seem to be fresh and well-ventilated (remember the importance of first impressions), the following schedule is suggested:

Pre-ventilation: Monday	3 hours
Tuesday to Friday	2 hours
After long weekend	4 hours
After very hot weekend	4 hours

The ventilation system should not be shut down until two hours after the end of the working day.

It may be possible to shorten these times if the building has an economizer cycle. Conversely, it may be necessary to lengthen the times if it doesn't.

OFFICE PLANNING AND BUILDING USE

Commissioning: When building use changes, it is important that appropriate alterations be made to the building systems. These changes may include increasing quantities of supply or exhaust air, changing distribution patterns and rebalancing. The environmental performance of the areas affected should be checked prior to occupancy. As stated earlier, commissioning can only be effective if a good brief has been prepared outlining the new use of the space and the pollution and heat generating activities that will take place.

Building Use Documentation: Every building has its own unique features. Documents that outline the following should be provided: the capabilities and limitations of the building systems, actions tenants should not take which might defeat the ventilation system capabilities, suggestions on how to promote good IAQ in the workplace, and space layout limitations.

Carpets, Furnishings and Finishes: Carpets, furnishings and finishes can be strong sources of odours and irritants. Not only can less offensive materials be sometimes selected, but some items can be pre-aged in a warehouse prior to installation.

Office Layout: Office layout can have a great effect on system performance. For example, if significant changes are made to occupant density, if a number of heat loads are added (i.e., desk top computers) or if walls are moved, it will often be necessary to make changes to the ventilation system. With some ventilation systems, if a forest of high open office screens are used that seal to the floor, the ventilation air will be cut off - perhaps not to such a degree that air chemistry is affected, but to such a degree that the occupant will no longer feel air flow and will think that the ventilation is poor. This is also an area where other types of environmental performance may become important and must be considered. For example, an employee with a powerful computer in the workstation may be too warm because of poor air circulation or insufficient cooling. The perception will be that the ventilation is not very good. If that person then gets a headache because of an unrecognized lighting glare problem, he or she is likely to conclude that the cause is poor air quality.

Ventilation for Special Equipment: Many types of office equipment generate fumes which, although not a threat to human health, will create the impression of stuffiness or poor air quality. If possible, choose alternate equipment, ventilate to the outside or locate the equipment near air returns so that a concentration cannot build up.

Preparing for Occupancy: During the first six months or so of a new building's life cycle, or after a retrofit, materials will tend to outgas. Also, the building will not be completely tuned to its actual use until commissioning is completed. During this time, therefore, it would be wise to increase outdoor air and operate the ventilation system for a longer period each day. The best time to move in is during a free cooling season.

Interference with Ventilation Systems: In order to not interfere with the building systems, the occupants should be advised to:

a) Keep supply and exhaust vents clear of obstructions. Air vents blocked with furniture, papers, files, books, or other obstructions will not function properly.

b) If there is no air movement or if it is too drafty, occupants should inform the building manager rather than trying to alter air flow themselves. The building manager can then correct the problem in a way that will not interfere with the comfort of other occupants.

c) Do not install window sills over perimeter supply air units if this prevents air flow over the window surfaces. In winter, this can result in condensation and mould growth.

d) Occupants should not use personal humidifiers as these are seldom maintained and can be a source of airborne biological or particulate contaminants.

SUMMARY

Most of the suggestions made in this paper may seem to be very basic or even just common sense. It is surprising, however, just how often investigations of problem buildings have shown that even the most basic items have been ignored.