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Paper 3

**Indoor Air Quality Guide for Property Managers
in Office Buildings**

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Management for acceptable indoor air quality in office buildings requires that the buildings are properly designed, operated and maintained, and that property managers have the knowledge necessary to respond to changes in building operation and use. Although most property managers are non-technical people, with clearly defined guidelines they are capable of achieving this objective.

This paper presents an IAQ guide for such a purpose. The guide has been tested by four property managers for accuracy in detecting potential problems and ease of use. Four office buildings were used for this purpose. The results are discussed.

INTRODUCTION

The indoor air quality (IAQ) issue has come to the fore, in part, because of an increase in environmental awareness and general expectations of today's building occupant. Employee representative associations have also helped increase the focus on all aspects of the working environment, including air quality.

At the same time, the property manager's and building operator's task of providing a productive working environment has become increasingly complex due to greater use of synthetic materials in construction and furnishings; tighter building construction; and more sophisticated heating, ventilation, cooling and control systems. Ironically, the very complexity of the environmental control system often results in a diminished ability of occupants to directly control the environment which surrounds them. In some cases this can contribute to the occupants' frustration and perhaps even suspicion regarding environmental quality.

Managing buildings for good air quality requires a well coordinated effort by the building management team - operators, maintenance support and technical staff - spearheaded by the property manager. Although most property managers are non-technical people, with clear guidelines they are capable of handling this complex task. This paper describes one such guide. The proposed guide has been tested in four high-rise, air-conditioned office buildings by each building's property manager. The test results are discussed.

THE GUIDE

The primary focus of this guide is on indoor air quality and the directly related issues of ventilation, temperature and humidity¹. Other environmental factors such as noise, lighting and space layout are covered briefly. The Guide can be divided into two parts: Part I, basic information and Part II, checklists for conducting walk-through inspections. Details are discussed below.

PART I - BASIC INFORMATION

Part I of the guide presents all the information and the action plans required by property managers to effectively manage their buildings for acceptable IAQ. It also includes the definition of IAQ used in the guide and describes the role of property managers to help them understand their responsibilities in dealing with IAQ related issues.

Definition of Indoor Air Quality Levels Used in This Guide

The levels of indoor air quality can be classified into three categories: unhealthy and unsafe, healthy and safe, and comfortable and productive (Figure 1). The first two are defined strictly from a health and safety viewpoint, based on various health and safety standards established mainly for industrial workers. The US Occupational Safety and Health Association (OSHA) and the American Conference of Governmental Industrial Hygienists (ACGIH) have published two such standards^{2,3}. The third category is introduced to reflect the fact that under certain conditions, many office workers in a healthy and safe environment may still experience various symptoms of discomfort, such as mucous membrane irritations, headaches and fatigue. As these symptoms can adversely affect employees' well-being and productivity, for office buildings it is more appropriate to look beyond basic health and safety to employee comfort and productivity.

Two standards have been developed by the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) for this purpose. Standard 62-1989⁴ prescribes a maximum CO₂ concentration of 1000 ppm and a minimum outdoor air supply rate per person of 10 L/s to provide an acceptable air quality in normal office buildings. Standard 55-81⁵ sets the conditions for an acceptable thermal environment by specifying air temperature, air velocity, relative humidity and mean radiant temperature. Given the differences in seasonal clothing, the ASHRAE Standard 55-81 defines two thermal comfort zones - one for winter and the other for summer. The recommended temperature and relative humidity ranges satisfying the majority (80%) of healthy people are 20-27 C with 20-70% R.H. Guidelines are given in the Standard for determining if specific combinations of temperature, relative humidity, air velocity, and mean radiant temperature lie within the seasonal comfort zone.

With the current level of knowledge for detecting, controlling and assessing health impacts of various indoor air contaminants, both individually and in combination, ASHRAE^{4,5} recognizes that it may not always be possible to satisfy everyone. The above standards are intended to result in 80% or more of a building's occupants being satisfied with their environment.

Role of Property Managers

The fundamental responsibility of property managers with respect to indoor air quality is to ensure their buildings are operated to meet established environmental standards. To fulfill this role, they must be knowledgeable about indoor environmental standards, indoor air quality issues,

potential air contaminant sources, and the environmental control systems in their building. They should also understand the roles and interrelationships of the various parties involved in the indoor air quality issue - the building owner/operator, health authorities, regulatory agencies, and the occupants - to be able to handle occupants' complaints about indoor air quality, investigate the causes, and coordinate any corrective action.

It should be stressed that property managers are not health professionals, and should therefore avoid becoming involved in assessing and analyzing suspected health problems. These should be referred, in consultation with the employee, to the responsible health authority. The property manager should work hand in hand with the responsible health official to seek a successful solution.

Action Plan for Prevention of IAQ Problems

The most effective way to maintain an acceptable indoor air quality in buildings is to adopt a preventive approach by regularly conducting a walk-through investigation together with an assessment of the building systems and its operating activities (such as the inventory of chemicals used for cleaning, plant maintenance, etc.). Such walk-through inspections allow potential environmental problems to be identified and corrective actions taken before they become real problems. A five-step plan, as shown in Figure 2, has been developed for this purpose. Step 1 is to recognize the importance of such a proactive management program and to know what is involved in implementing such a plan. The effort and time required to properly implement such a program is significant; the property manager has to be totally committed to the program to ensure its success. Once the property manager is committed to such a program, Step 2 is to become knowledgeable about the elements of the IAQ issue, such as the basic concepts of the operation of the building's HVAC systems, the definition of indoor air quality, and the common causes and solutions to indoor air quality problems. Such information enables the property manager to professionally address environmental problems and intelligently discuss these matters with specialists, occupants and union representatives.

The next step is to prevent environmental problems by regularly inspecting the building's systems and assessing operational activities which can affect the indoor air quality. Frequent building walk-through inspections will help ensure potential problems are identified promptly. They also provide an opportunity for property managers to encourage occupants to participate in a program to improve the air quality in their work place, for example, by not blocking ventilation outlets. Ideally, a walk-through inspection should be conducted every three months (one

inspection per season). At a minimum, a walk-through inspection should be conducted once a year. It can be combined with other visits or inspections such as overall building condition or building performance reviews.

The fourth step is to address and correct any deficiencies found during the preventive inspection. Experience has shown that communication between inspection personnel and building occupants is something that cannot and should not be avoided. Occupants should be made aware that the inspection is preventive in nature and that any necessary corrective measures will be undertaken without delay. Guidelines for communication with occupants are included.

Action Plan for Management of IAQ Complaints and Problems

Figure 3 outlines the steps required to handle occupant's complaints. Upon receiving an IAQ related complaint, the first step is to document and analyze the nature of the complaint. This will usually help the property manager to distinguish between minor local incidents and significant general complaints, and to take the appropriate actions.

Three levels of investigation are recommended for handling occupants' complaints. Level 1 investigation should be carried out by the property manager in consultation with the building operator. There is often not one single cause but rather a combination of causes, so the property manager should not arbitrarily discontinue the investigation when one deficiency is found.

If the results of the Level 1 investigation are inconclusive, the next step is to initiate follow-up IAQ investigations by technical specialists, at a progressively increasing level of expertise as required (i.e., Level 2 and 3 investigations). As most IAQ problems will likely be identified with a Level 1 investigation, the property manager should not normally launch a Level 2 or 3 investigation without first having undertaken a Level 1 investigation. Guidelines for initiating Level 2 and 3 technical investigations are included.

The three levels of investigation are intended to address complaints related to building occupants' comfort and productivity. For health and safety related concerns, the appropriate health and safety authority should be contacted for advice. At the same time, the property manager should initiate a Level 1 and subsequently, if necessary, Level 2 and 3 investigations, to confirm whether or not the building or its ventilation systems may be contributing to the health complaints. The property manager should establish a close liaison with the health authority during a health and safety investigation.

The next two steps involve taking remedial actions to correct problems identified during IAQ investigations and then verifying their effectiveness. Again, dialogue with all parties involved should take place throughout all the stages described above.

PART II - INDOOR AIR QUALITY INSPECTION CHECKLISTS

Two checklists are included: one is very detailed and one is simplified. The detailed checklist includes the kind of information related to the building and its use that does not require frequent updating. Also included are the necessary forms for recording information related to the building, its HVAC systems and maintenance procedures, major renovations, and the nature of occupants' complaints. This checklist is, therefore, intended to be used for the first preventive inspection and for Level 1 investigations of occupant complaints. The simplified checklist is used for regular follow-up inspections. It has been derived from the detailed one by removing those questions related to the building characteristics that have been recorded in the first walk-through inspection, and that will not usually change.

The first walk-through inspection will be the most time consuming. The detailed checklist provides a guide for the walk-through inspection, identifies where special attention is required and the degree of urgency to be given for each corrective action. Each question on the checklist is to be answered by a "tick" in the "Yes" or "No" columns. Action symbols are used throughout the checklist to indicate the urgency of action to be taken. When the answer to the question is "No" this indicates that a satisfactory condition exists and no remedial action is required at the time. Precautionary measures may, however, be indicated for follow-up consideration. When the answer to the question is "Yes" some form of remedial action is likely needed. The urgency is indicated by "x" for immediate attention and "o" for precautionary action. Questions that do not have indicator symbols are included in the checklist to provide information that may be useful in troubleshooting potential problems.

In addition, some of the questions are marked with a symbol 'z' to indicate that they are applied to individual ventilation zones. In cases where occupant complaints are limited to one ventilation zone, the inspection should initially focus on these questions.

VALIDATION

The proposed guide was applied to four high-rise, air-conditioned office buildings to check its accuracy and ease of use in detecting potential indoor air quality problems. Each building was inspected by its respective property manager using the detailed checklist only. None of the property managers were involved in the development of the guide; nor were they given any extra instructions on how to use it.

The participating property managers all found that the guide and the checklist were useful and easy to follow. As all these buildings had been checked independently by the building specialists of Public Works Canada prior to the property managers' inspections, the specialists' results were used to evaluate the accuracy of the property managers' inspection results. Because of the greater number and more general nature of the findings in the property managers' reports compared to a lesser number of more specific observations in the specialists' reports, only 56 answers could be selected for comparison (11 to 17 answers were selected for each building). Of the 56 answers compared, 39 or 70% were in agreement. Some of the disagreements were due to the fact that some of the deficiencies identified by the building specialists had already been corrected before the inspections by the property managers. One example was that the air filters in the HVAC systems had been replaced between the two inspections.

The results suggest that non-technical property managers can use the guide and obtain IAQ inspection results that are comparable to that conducted by building specialists.

SUMMARY

A guide has been developed for assisting non-technical property managers in conducting walk-through building inspections for preventing and solving problems related to indoor air quality in office buildings. The proposed guide was tested by the property managers of four high-rise, air-conditioned office buildings. The results indicated that the proposed guide was easy to use. The property managers' inspection results agreed well with those obtained by building specialists who had conducted similar inspections on the four buildings independently.

ACKNOWLEDGEMENT

This guide was prepared by an interdisciplinary team from Public Works Canada and the National Research Council.

Synthesis of the overall framework for Property Managers to manage indoor air quality was led by D.W. Patton, Director, Property Management Policies, Public Works Canada. Development of the comprehensive Indoor Air Quality Inspection protocol and technical descriptions in the manual was spearheaded jointly by F. Vaculik, Senior Maintenance Engineer (Mechanical), Public Works Canada and by C.Y. Shaw, Senior Research Officer, National Research Council, in consultation with G.K. Yuill, Consultant. The inspection protocol was validated by the property managers of four office buildings operated by Public Works Canada.

Finally, the draft manuscript was reviewed and revised by H.F. Hull, former Property Management executive, and edited by Corporate Communications Branch, Public Works Canada.

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5. ASHRAE. 1981, "ASHRAE Standard, 55-81, Thermal Environmental Conditions for Human Occupancy", The American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc.

Figure 1

Conceptual Relationship
Between Health and Safety,
Comfort and Productivity Standards for Indoor

Air Quality & Client Satisfaction

Occupants' Degree of Satisfaction

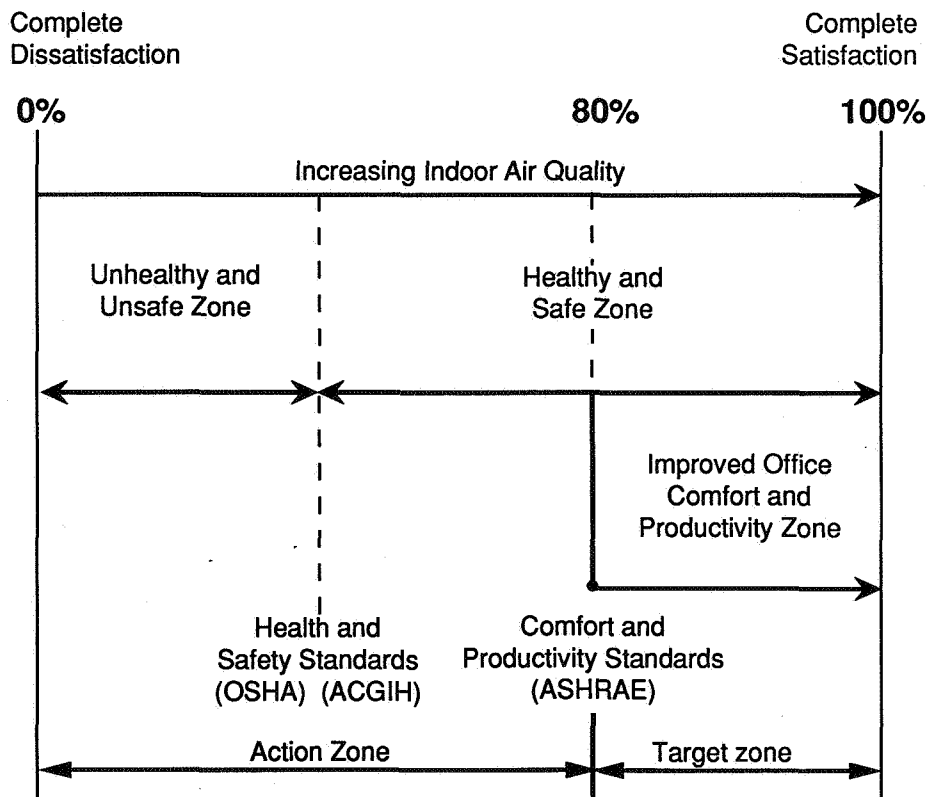


Figure 2

**The Property Manager's
Action Plan for
Effective
Prevention
of Indoor
Air Quality
Problems**

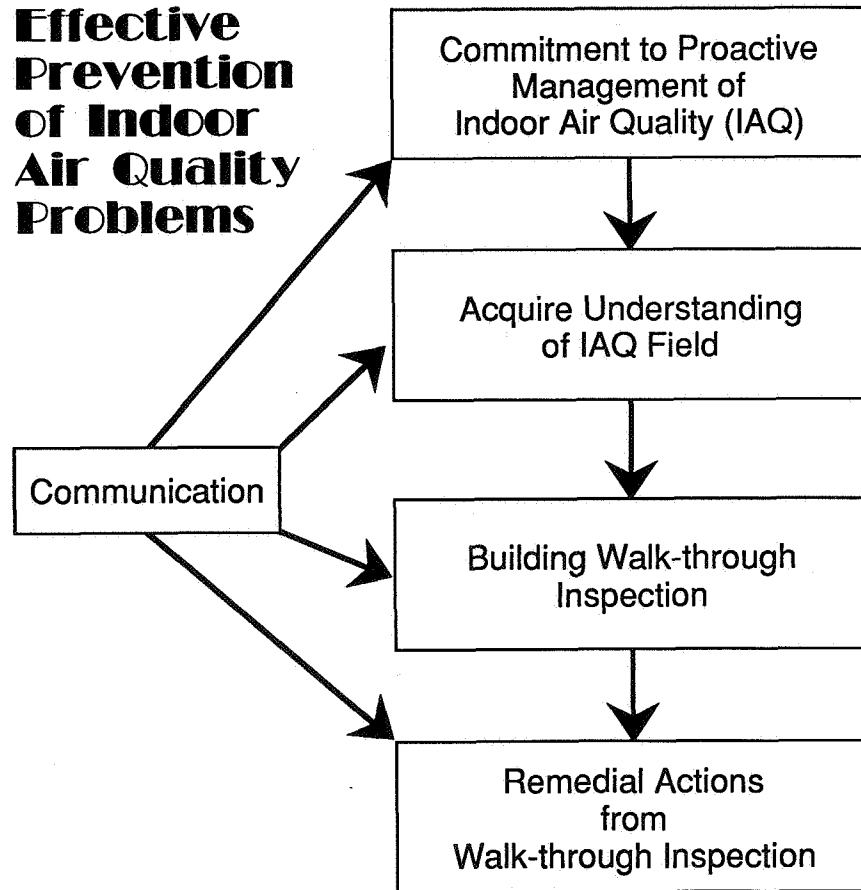
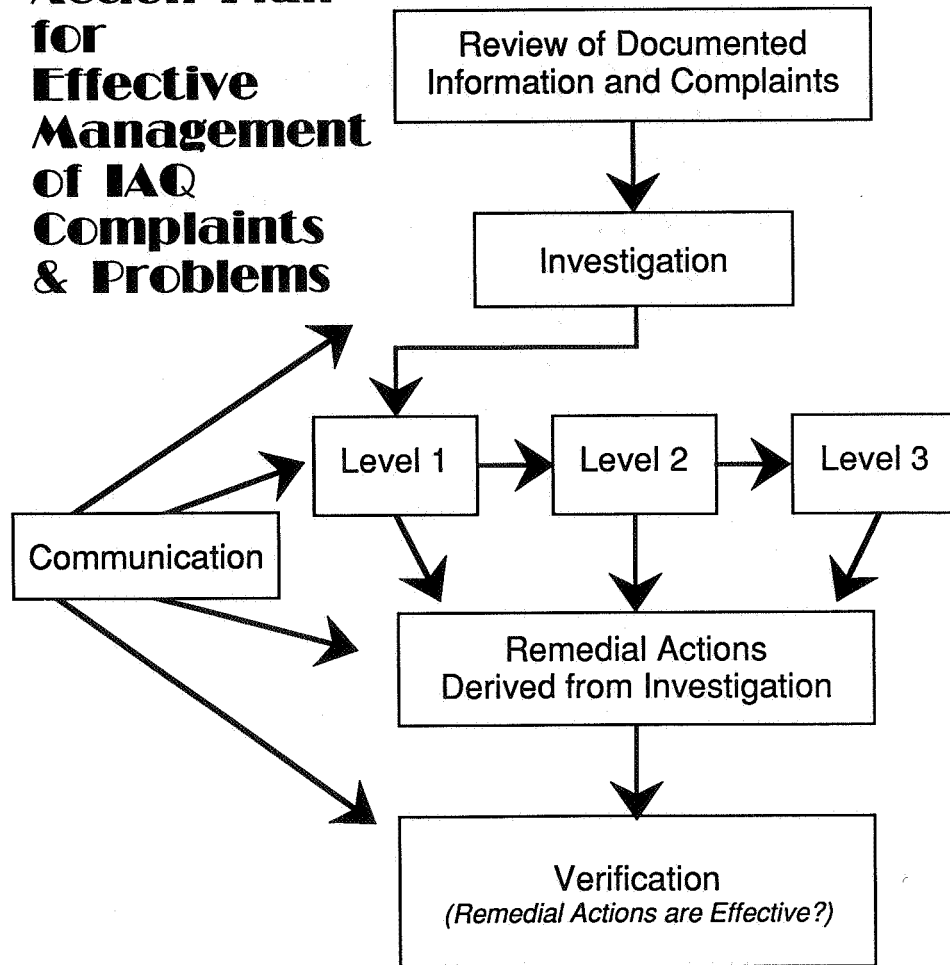


Figure 3

**The Property Manager's
Action Plan
for
Effective
Management
of IAQ
Complaints
& Problems**



Discussion

Paper 3

M.Masoero (Politecnico di Torino, Italy)

In developing your checklists for property managers, have you made any use of the work on Energy Auditing of buildings that was completed by IEA a few years ago?

D.Patton (Public Works Canada)

The checklist was developed by the National Research Council in conjunction with G K Yuill Consultants, who I am sure would be aware of the information available from the Energy Auditing work.

A.Sandelewski (Tekne SpA, Italy)

Did you notice any difference in the various kinds of HVAC systems (CAV, VAV, fan-cooled) as far as IAQ problems are concerned? Was there any type which consistently drew complaints?

D.Patton (Public Works Canada)

No. We have noticed no particular trends. However, when VAV systems were first introduced in Canada there were some features which caused problems, e.g. diffusers could close completely when temperature conditions were satisfied, stopping air flow altogether. These features have been corrected in current VAV systems. Free cooling is a very desirable feature in Canada.

J.Satish (Zurich, Switzerland)

Are there any regulations in Canada which require the maintenance of ventilation systems? This is mandatory for heating systems in Switzerland for example. People are more likely to do something either if they have to or if they get return on investment.

D.Patton (Public Works Canada)

No. Not in the same sense that regulations call for maintenance and testing of certain safety building components such as elevators, fire alarms and emergency generators. In Federal buildings the Department of Labour Regulations do, however, require that building environments meet certain performance standards.

E.Arens (Univ of California, USA)

Could the inspection/monitoring of the air quality in the building be assigned to the worker/occupants rather than (or in conjunction with) the property managers?

D.Patton (Public Works, Canada)

In practice one of the indicators of air quality is feedback/complaints from building occupants. In that sense occupants are continuously monitoring the quality of air. In the event of an investigation of an IAQ problem, it is important to keep occupants fully informed and to involve them if possible. This builds a relationship of trust. Accordingly I would not rule out tenant participation on an IAQ inspection with the property manager.