CASE STUDY

IAQM's indoor air quality guidance

Carl Hawkings summarises the IAQM's guidance on the assessment, monitoring, modelling and mitigation of indoor air quality.

An Institute of Air Quality Management (IAQM) survey of its members in 2019 identified that 40 per cent were working on indoor air quality in some capacity and a further 22 per cent thought that indoor air quality would become part of their work in the future. The importance of this area of work to members led the IAQM to extend its membership to those working primarily in this area.

An indoor air quality subcommittee was established in October 2019, comprising experts in the field and members of the IAQM committee experienced in producing guidance for members to use in their day-to-day work. The subcommittee also organised IAQM's first indoor air quality conference in 2021.

The lack of professional guidance for the assessment of indoor air quality was identified early on and work started on drafting IAQM's guidance at the beginning of 2020. From an early stage, IAQM worked closely with the Chartered Institution of Building Services Engineers

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(CIBSE) Air Quality Working Group, some of whose members were also members of the IAQM subcommittee. The guidance is supported by CIBSE, with contributions from them on mitigation measures and case studies.

A full draft of the guidance was produced by early 2021 and sent to external reviewers (including academics and government specialists). Following consideration of their very useful and insightful comments, a consultation draft is now available to IAQM members and non-members with expertise in indoor air quality.[1]

DRAFTING THE GUIDANCE

The subcommittee had several discussions on the scope of the guidance, including the below.

All indoor environments? (e.g. workplaces, airports, trains, care homes, houses, schools, cars, buses, domestic kitchens). Worker exposure limits (WELs) legally apply to all workplaces.[2] However, the WELs were originally designed to apply to healthy, working-age adults in industrial locations and may provide less protection than other guidelines, such as those from the World Health Organization (WHO), which set out to protect the health of the general population. The boundary between the work of industrial hygiene specialists and indoor air quality specialists is blurred and difficult to precisely define. The subcommittee agreed that the indoor air quality (IAQ) guidance would be applicable for all new and existing buildings but should not be used to override legally applicable and enforceable considerations. The general assessment approach may also be applicable to the assessment of air quality in vehicles.

All aspects of indoor air quality? (e.g. comfort aspects [temperature, relative humidity], pathogens [viruses, bacteria], all gaseous pollutants and particulate matter). It was decided to focus the guidance on gaseous pollutants and particulate matter relating to health impacts (not dust nuisance). While other issues affecting the quality of the indoor environment are briefly discussed, it was agreed that the guidance would not provide advice on comfort and pathogens, especially related to areas already well covered in the law (e.g. legionella).

Many locations indoors are a mix of both occupational and public spaces (e.g. care homes, taxis, restaurants), where the health of workers is regulated by legislation but that of others is not. Some guidance and legislation on air quality relate specifically to indoor *or* outdoor air; some relate to *both* indoor and outdoor air. Some government guidance (e.g. for schools[3]) does cover non-workplace exposure, i.e. of the children and visitors.

The overarching principle of the IAQ guidance is to address the gaps that exist and not to overlap with air quality legislation (which relates to outdoor exposure of the public) or occupational legislation (which is largely related to workers but does touch on exposure of the general public, as employers have a duty of care to protect visitors to places under their control).

Derive a specific methodology to assess indoor air quality? The subcommittee thought this a good idea and followed a similar approach to existing IAQM guidance. A method was drafted, revised and tested against a several case studies (which are in Appendix E of the IAQ guidance[4]). It was quite exciting to have a blank canvas and to be able to think about different ways to approach the problem. Credit goes to Kieran Laxen for developing a useful and practical starting point for the subcommittee to develop.

Other scope considerations. It was then decided, given that many IAQM members may be new to indoor air quality, that the IAQ guidance should summarise indoor air quality monitoring methods, assessment criteria, modelling and mitigation measures.

IAQM'S IAQ GUIDANCE

The IAQ guidance has seven chapters, as set out in **Box 1**. It also has a number of appendices, including how to convert between units of concentration, case studies, monitoring equipment, testing protocols and more. There is also an extensive bibliography/reading list with more than 80 references, which was greatly enhanced by our external reviewers. The main guidance has been kept intentionally short (about 30 pages) so that it can be read cover to cover.

ASSESSING INDOOR AIR QUALITY

Because IAQM has developed a new approach, the rest of this article is dedicated to a summary of the methodology for assessing indoor air quality. Anyone with knowledge of IAQ is encouraged to test the method and comment to IAQM as part of the current consultation (closing 19 July 2021). Once published, it will hopefully become the default method for non-occupational exposure to IAQ (if the widespread acceptance of other IAQM guidance is any indication). Now is your chance to ask for changes if it does not work for you!

It was largely developed with new-build or major refurbishments in mind, although the method is also applicable to other situations, such as in response to complaints from occupants of existing buildings. The method applies to people, but also to inanimate objects such as computers in data centres, food preparation areas in kitchens or microelectronics in clean rooms.

The source–pathway–receptor concept is applied; if one or more of these three elements is not present then that is where the assessment stops (**Figure 1** shows how to determine whether an indoor air quality assessment is required). Once it has been determined that an indoor air quality assessment is required, a four-stage process is applied and it is stressed that cooperation between the wider project team (architects, building services engineers and designers) is essential.

Stage 1: scoping study. This involves collation and review of all available information, including a walkthrough of an existing building. The aim is to identify the pollutants of concern in the specific context of the building under assessment, and the level of assessment required (i.e. no further assessment, simple assessment or detailed assessment).

BOX 1. IAQ GUIDANCE – SUMMARY

1. Introduction: sets out the scope and purpose of the guidance, the context, why indoor air quality is important and the purposes of an indoor air quality assessment.

2. Background: takes the reader through the main indoor air quality pollutants (i.e. nitrogen dioxide [NO_2], particulate matter, radon, volatile organic compounds [VOCs], aldehydes, formaldehyde, acrolein, terpenes, ozone [O_3], carbon monoxide [CO] and carbon dioxide [CO_2]) and their health effects and chemistry; the important factors relating to exposure; and interactions with other indoor conditions (ventilation rates, humidity, temperature etc).

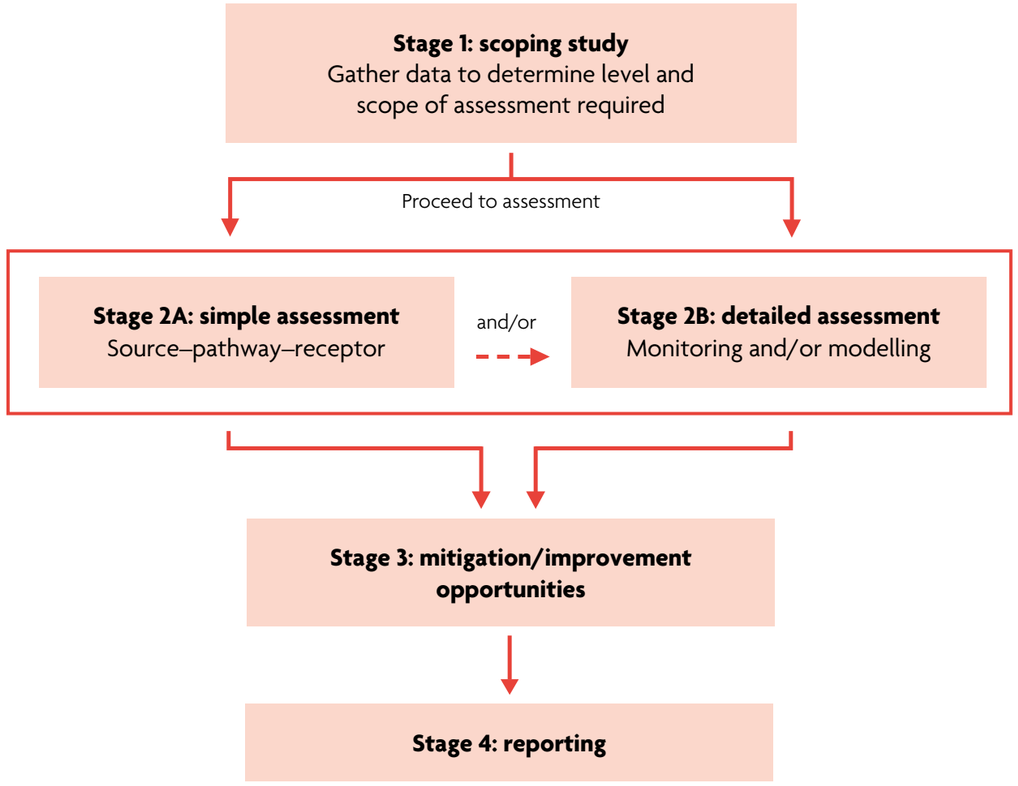
3. Assessment criteria: runs through the organisations and references where criteria can be found, summarises them and introduces an appropriate hierarchy if there are more than one criterion. It also discusses what to do if no published criteria exist for the pollutant under consideration.

4. Assessment approach: presents the source–pathway–receptor model as it applies to indoor air quality and details a methodology that can be used to assess indoor air quality in a way that demonstrates a logical and step-wise approach. This gives the professional an opportunity to document their judgement and will hopefully help indoor air quality assessments to be more standardised.

5. Monitoring: covers the how/what/when/where of indoor air quality pollutant sampling.

6. Modelling indoor air quality: gives a brief introduction to the models available, and their advantages and disadvantages.

7. Improvement measures: introduces a hierarchy of improvement measures, starting with removal of pollutant sources and ending with removal of receptors. Discusses examples of how to improve indoor air quality and how to implement them.



▲ **Figure 1. The stages of an indoor air quality assessment.**

Stage 2: assessment. This is divided into two:

Stage 2A: simple assessment/source–pathway–receptor review. Assesses the risk to receptors that harm will arise from exposure to a pollutant.
Stage 2A involves four steps:

a) The magnitude of the hazard arising from the ingress of outdoor pollution, which is ranked on a scale of 0 to 5 based on a combination of the quality of outdoor air in relation to air quality guidelines and potential pathways (Table 4.1 in the IAQ guidance);

b) The magnitude of the hazard arising from indoor sources of pollution, ranked on a scale of 1 to 5 based on the type of emission source and pollutant and potential pathways (Table 4.2 in the IAQ guidance);

c) The magnitude of the exposure, taking into account (a) and (b), the pathway(s), duration, the response to exposure being chronic or acute, the frequency of exposure and receptor(s). This is ranked on a four-point scale (low, medium, high, very high) (Table 4.3 in the IAQ guidance); and

d) A risk assessment using the highest score obtained from (a) and (b) in combination with (c) to obtain an overall risk category on a four-point scale (negligible, low, medium, high).

The outcome of (d) determines what action to take next: negligible and low risks do not require a Stage 2B: detailed assessment, but the higher categories do. There are supplementary accompanying outcomes to distinguish the response to the four categories of risk (see Box 4.2 in the IAQ guidance for more detail).

Stage 2B: detailed assessment. This usually follows on from stage 2A: simple assessment, but the need for a stage 2B: detailed assessment may be determined at stage 1: scoping, and usually requires monitoring and/or modelling, techniques for which are covered in the guidance.

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Stage 3: mitigation/improvement opportunities. This is the final stage of assessment (unless there is negligible risk of harm to a receptor) and aims to identify suitable and effective mitigations and improvements that will reduce the risk to receptors. This is then all written up in **Stage 4: reporting.**

IAQM hope you will find the guidance useful and take the time to test it for us. IAQM are keen to receive feedback on it and will occasionally update the guidance as appropriate. ES

Carl Hawkings worked in the air quality and impact assessment teams at ERM for 15 years and then joined ADM Ltd, where he has worked in many sectors, including oil and gas, cement, incineration, foodstuffs, power and transport infrastructure. Most of his work in the past decade has been managing environmental impact assessments overseas, but he was acting head of the air quality team at ARUP for a while. He has been a Committee Member of IAQM for nearly 3 years and has worked on a variety of IAQM working groups and sub-committees, including the indoor air quality working group.

REFERENCES

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