

VENTILATION FOR HEALTHY BUILDINGS

Reducing the impact of urban air pollution

Vina Kukadia and David Hall



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PREFACE

PURPOSE AND SCOPE OF THIS GUIDANCE

This guidance is intended to assist with the development of ventilation strategies to minimise the ingress of external pollutants into non-domestic urban buildings. It provides a methodology for doing this, together with fundamental information on urban air pollution in relation to buildings, including the following topics.

- Common urban air pollutants which are mostly covered by the Air Quality Strategy for England, Scotland, Wales and Northern Ireland^[1] namely,
 - carbon monoxide (CO)
 - nitrogen dioxide (NO₂)
 - sulfur dioxide (SO₂)
 - ozone (O₃)
 - particles (PM₁₀)
 - benzene (C₆H₆)
 - 1,3-butadiene (C₄H₆)
 - lead (Pb)
 - polycyclic aromatic hydrocarbons (PAHs) (eg benzo[alpha]pyrene (B[alpha]P))
 - nitric oxide (NO)
- Nuisance contaminants such as dust and odour, in brief
- Sources of urban air pollutants
- Contributions of the pollutants from the sources to the exposure of buildings and occupants
- UK Air Quality Strategy and Objectives
- Methods for estimating internal concentrations of external pollutants
- Guidance on ventilation strategies for minimising levels of the external pollutants in indoor air

This guidance concentrates on non-domestic buildings in urban areas since these contain the highest density of buildings and population, and hence usually the highest external pollution loads. However, the same principles can also be applied to domestic buildings and those in more open environments, where conditions are usually less severe but an assessment of the quality and ingress of external air may still be desired. Furthermore, while this guidance has been written primarily with regard to buildings in the UK using relevant UK data sources, it can equally be applied to buildings in other countries by using appropriate data sources.

This guidance does not override the usual requirements of providing adequate ventilation for occupant respiration, diluting occupant-generated carbon

dioxide, removing other internally generated pollutants and controlling humidity. Its concern is with the additional internal pollutant burden that may result from external pollutant sources.

USERS OF THIS GUIDANCE

This guidance is intended for use by:

- the construction sector (architects, developers, building services engineers, planners, facilities managers)
- construction sector clients and building owners, occupiers and managers
- regulatory authorities (eg local authority environmental health, building control and planning officers)

BENEFITS OF FOLLOWING THIS GUIDANCE

In writing this guidance, the aim has been to provide a number of benefits, as follows.

- **Health.** Protection of building occupants against pollutant ingress and hence exposure to potentially harmful pollutants will have important health benefits.
- **Improved productivity.** Productivity of occupants is improved in environments with good air quality.
- **Financial savings.** Substantial savings can be achieved in capital, building maintenance and running costs by:
 - considering air pollution issues early on in the design and planning process
 - optimising a ventilation system by taking account of air quality issues.
- **Reduced energy demand and carbon dioxide emissions.** Solutions for reducing the use of mechanical energy will result in reduced energy consumption. This will help to reduce the CO₂ emissions of a building associated with its energy consumption and assist in compliance with Part L of the Building Regulations^[2].
- **Successful planning applications.** If developments are designed carefully, adverse effects on local air quality can be reduced. However, planning approval may be refused for new developments where external pollution is likely to affect indoor air quality or where the development itself is likely to increase local pollution loads, in particular, in Air Quality Management Areas^[3].

- **Other commercial benefits.** The provision of high quality air, combined with energy-efficient ventilation may have commercial advantages for developers in being able to offer urban buildings with good quality indoor environments.

HOW TO USE THIS GUIDANCE

This guidance deals with the combination of two complex subjects: urban pollution and building ventilation, both of which have their own technical and regulatory aspects.

Depending on the understanding and experience of the user in air pollution and ventilation, or the intended purpose of the user, it may not be necessary to read all of this guidance in detail before proceeding. The following is therefore recommended.

- Those new to this technical area are advised to read through the whole document to ensure a better understanding of urban air pollution issues before using this guidance.
- Those with some understanding of air pollution and building ventilation issues may wish to read only the overview of the methodology given in the *Introduction* before proceeding to use the relevant parts of the detailed guidance as necessary.
- Those wishing to assess pollution concentrations at the building development site, as is often the case with developers, and local authority environmental health and building control officers, may wish to read the *Introduction* and proceed straight to chapter 4, *Assessment of site pollutant concentrations*.
- Those interested in guidance on various ventilation practices to achieve better indoor air quality may wish to read the *Introduction* and proceed straight to chapter 6, *Developing a ventilation strategy to minimise pollutant ingress*.

Users should note that knowledge is still developing in this field and there remain significant gaps in the available data. This guidance is based on the best information available at the time of writing. Users should also bear in mind that some elements of the process presented here require judgement and that in some cases expert advice may be needed.

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Building designers are increasingly being encouraged to consider sustainable or low-energy ventilation as a primary design option for both new-builds and major refurbishment projects. There is thus much debate about how optimum ventilation may be achieved in urban areas where external contaminants can cause the quality of the incoming air to be unacceptable.

This publication provides invaluable practical guidance on developing effective ventilation strategies to minimise the ingress of external pollutants into buildings, while at the same time maintaining adequate ventilation. It takes into account all relevant air pollutant sources (near and far) and assesses their combined impact as a function of several parameters before providing a potential ventilation strategy.

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