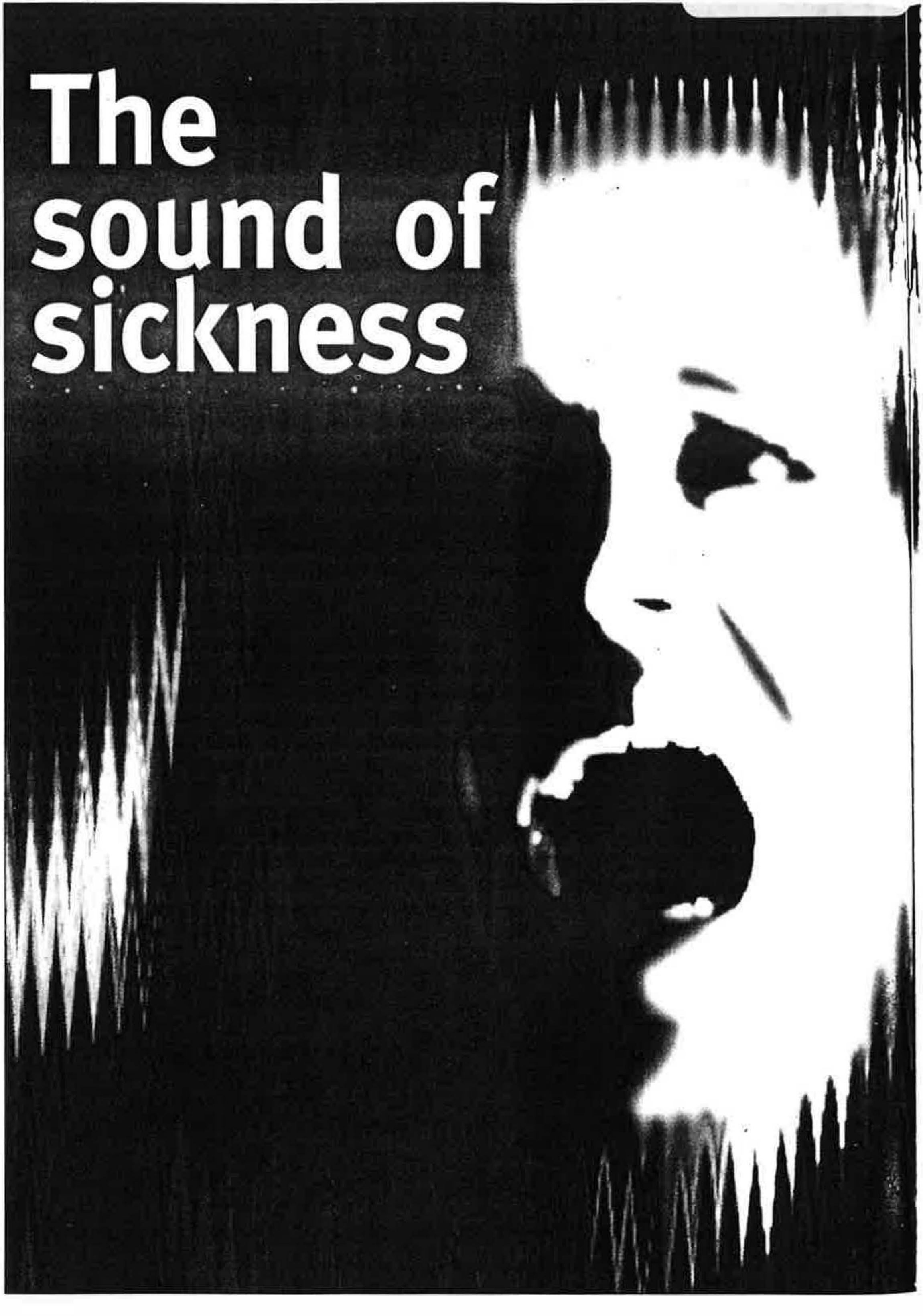
# The sound of sickness

Ventilation system designers may be guilty of professional negligence by working with inaccurate noise data and, even worse, they may be unwittingly causing Sick Building Syndrome. **Ewen Rose** reports.



British building services professionals are working with noise data that is "quite substantially wrong", according to a leading acoustic consultant.

Nicholas Edwards, of Coventry-based Acoustic Dimensions, told a meeting of the CIBSE/ASHRAE Group that it could even be "professionally negligent for an engineer to follow CIBSE guidelines for noise control" because they are out-of-date, he claimed.

Mr Edwards, who has 20 years experience in the design of 'quiet' systems, including the Birmingham Symphony Hall, told the meeting that he refuses to use the guidelines favouring the data supplied by ASHRAE.

As an example, he quoted CIBSE's continued recommendation of NR20 for concert halls, which first appeared over 35 years ago. In contrast, he said that ASHRAE has worked its way through a series of increasingly exacting criteria, each based on the results of the latest research.

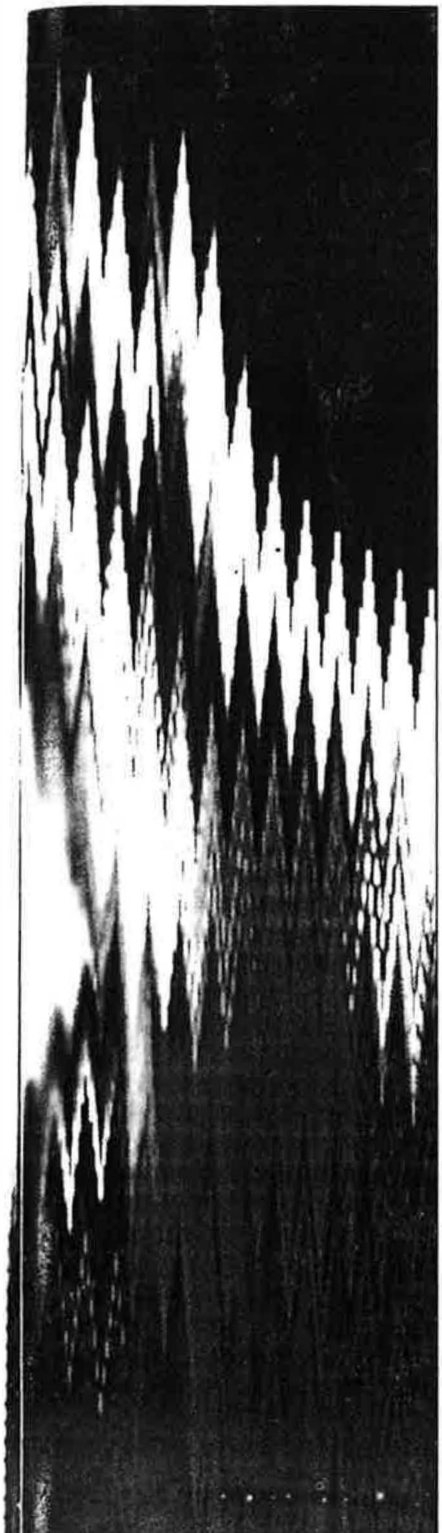
In an acoustically demanding environment, the 63Hz and 125Hz bands are critical. CIBSE data only goes down to 125Hz, whilst ASHRAE includes 63Hz. The CIBSE guidance on attenuation by duct elements is also generally at variance with ASHRAE, said Mr Edwards.

"In assessing the two systems one has to look at their scientific basis. In all cases, ASHRAE gives extensive references to the literature, whilst CIBSE references are either non-existent or sparse . . . . and nearly always old," he added.

Mr Edwards described the "very robust" Noise Committee work within ASHRAE. "There is continuous process of identification of deficiencies in knowledge, sponsored research to fill the gaps and consequent updating of data. ASHRAE has, of course, not reached a final state of perfection, but it is actively progressing whilst, in contrast, CIBSE gives the clear impression of stagnation and lack of interest on noise issues."

Another acoustic design expert, Dr Geoff Leventhall, added that although this is Mr Edwards' personal opinion, "It is one which CIBSE would do well to note."

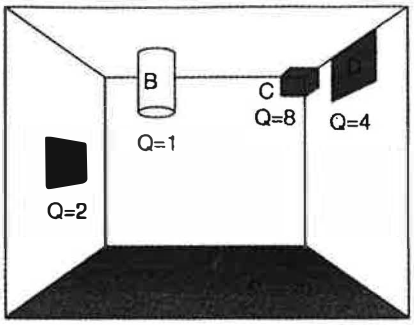
CIBSE told *HAC* that it had noted this opinion and was already acting on it. "Nicholas Edwards' views reinforce CIBSE's own position in this area. The new Guide A is in preparation, and the section covering noise control, which is being updated with the assistance of Dr Leventhall, who is a member of the CIBSE's Internal Environment Panel, addresses the limitations of the current publication," an



official statement said.

"The institution's Publications Policy Committee has already recognised that a more complete publication on acoustic criteria is required as a priority. Work on the proposed publication will seek to take into account current thinking, and we would welcome a contribution from Nicholas Edwards, and indeed other experts in the field, in its development."

# TECHNICAL FILE



A = middle of wall
B = middle of room
C = corner
D = wall end

To estimate sound absorption area the diagram below can be used. (Fig.2)

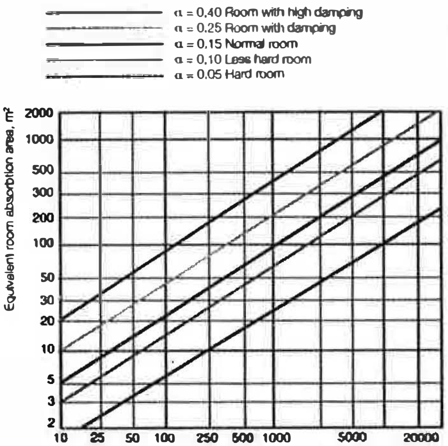


Fig. 2 Equivalent room absorption

Example: Room volyme = 1 000 m³
$\alpha = 0{,}25$
Absorption area = 200 m²

**Calculate sound pressure level**

To calculate the sound pressure level, use this formula or the diagram. (Fig. 3)

$$L_p = L_w + 10\log\left(\frac{Q}{4\cdot\pi\cdot r^2}+\frac{4}{A}\right)$$

$L_p$ = sound pressure level, dB
$L_w$ = sound power level, dB
Q = direction factor
r = distance to sound source, m
a = equivalent room absorption area, m²

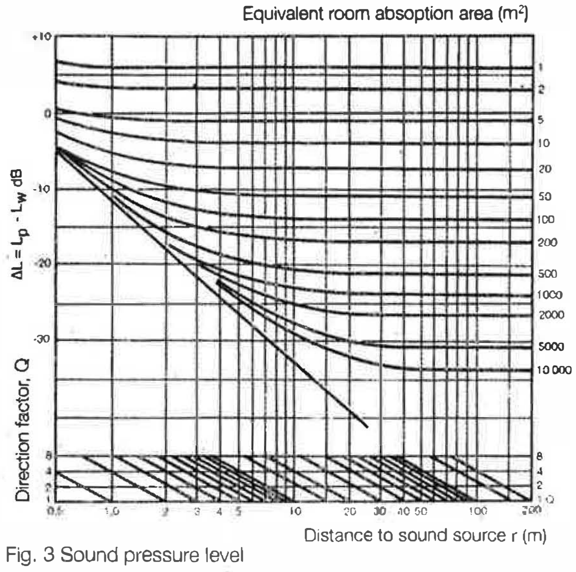


Fig. 3 Sound pressure level

## Calculating sound power and sound pressure:

If the sound source emits a certain sound power level, the following will affect the sound pressure level; the direction factor of the sound, the distance from the sound source and the room's ability to absorb. Direction factor, Q, specifies how the sound is distributed round the sound source. e.g. spherical extension gives Q=1, which can be compared with outlet sound from a high chimney. From a diffuser placed in the middle of a wall is Q=2, half spherical. (Fig.1 left)

**Fig. 1 Direction factors for differently located sound sources.**

Distance from sound source, rr is the measurement's distance from the sound source in metres.
The rooms equivalent absorption area, A
The ability for a surface to absorb sound can be expressed as an absorption factor, which has a value between 0 and 1. The value 1 corresponds to a fully absorbing surface and the value 0 to a fully reflective surface.
The total absorption area of a room is expressed in m². This can be calculated by multiplying the room's surfaces with the surfaces' absorption factor.

Below are normal readings for different premises average absorption factors.
Studio, room 0,30 - 0,45
TV-studio, stores, reading room 0,15 - 0,25
Apartment, office, theatre, conference room 0,10 - 0,15
Classroom, hospital, small church 0,05 - 0,10
Factory, swimming baths, large church 0,03 - 0,05
The room total equivalent absorption area is obtained according to:
= Equivalent room absorption area
= the area's size, m2
= absorption factor
= number of surfaces

To estimate sound absorption area the diagram below can be used. (Fig.2)

**Fig. 2 Equivalent room absorption**

Room volume
= 1,000 m³
= 0,25
Absorption area
= 200 m²

Calculate sound pressure level
To calculate the sound pressure level, use this formula or the diagram. (Fig. 3)
p = sound pressure level, dB
Lw
= sound power level, dB
= direction factor
= distance to sound source, m
= equivalent room absorption area, m²

**Fig. 3 Sound pressure level**

Q = 4
A = 50 m²
Lp-Lw = -10 dB(A)

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## Sick buildings

Dr Leventhall is also leading a research project to investigate the possible link between low frequency noise in systems and Sick Building Syndrome.

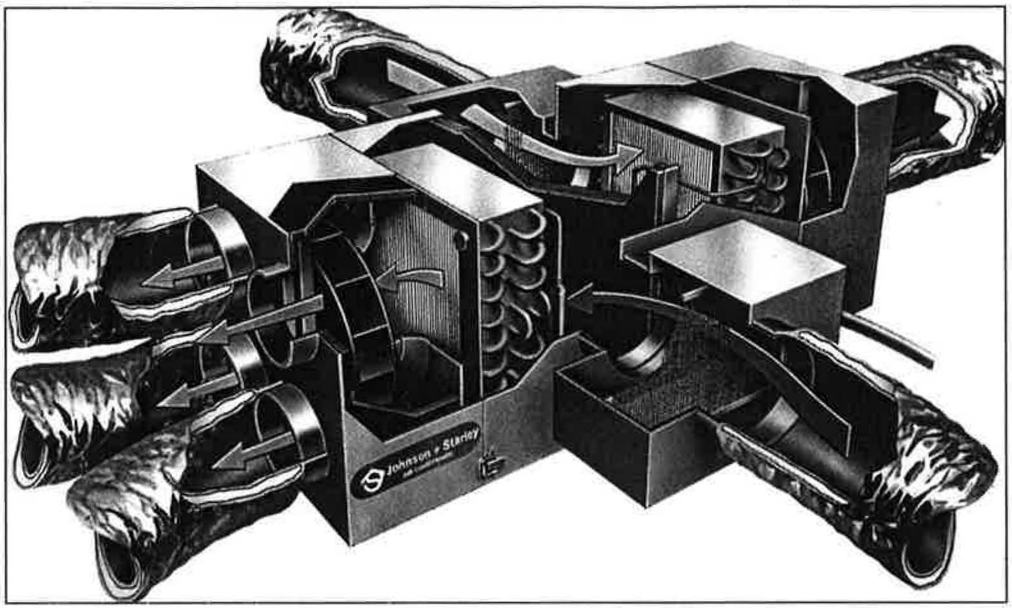
The one-year project, jointly proposed with the North West Lung Centre in Manchester, seeks £45,000 funding from the CIBSE/DETR Partners in Technology scheme.

It would seek to build on research, which has already identified two main risk factors in SBS, namely the presence of small particles and a persistent statistical association in affected buildings with low frequency noise from hvac systems.

Dr Leventhall reports that an investigation of low frequency noise as a potential 'catalyst' to SBS has not been carried out, despite it being widely acknowledged that high levels are an important factor in subjective perception of noise quality in a building.

The project team proposes to carry out an intervention study by controlling the levels of low frequency noise in a building in order to investigate this issue in detail and assess its significance in relation to worker health and comfort, with a possible link to productivity.

The findings would be of benefit to building and hvac designers as well as professional bodies concerned with noise criteria and the built environment.



**Johnson and Starley, the air management and heating manufacturer, is launching the 'Centre Cool' system. The system is installed into roof spaces and provides a flow of cool air into rooms via ceiling diffusers. Enquiry No 205**

# TECHNICAL FILE

## *Testing for Sound*

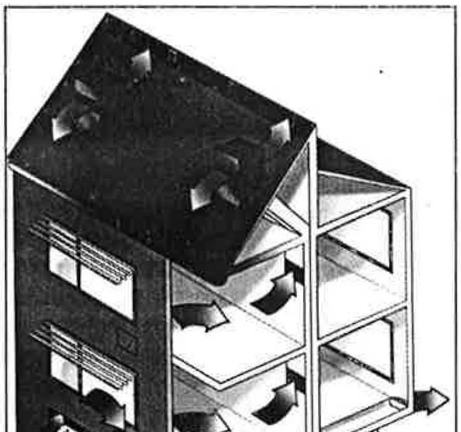
**(refer to graphs and calculations on previous page)**

*Data supplied by Mats Sandor**

In Sweden, the potential problems of low frequency noise have also been noted. The phenomenon known as 'Infra' sound - frequencies below 20 Hz - "can make people feel physically sick," Mr Sandor tells *HAC*.

"It often occurs in ventilation systems and manufacturers need to find ways of avoiding it. Active noise reduction is effective because it uses noise to cancel out other noise.

"To be able to compare different fans, you must know the exact representation of the specified sound value. Sound is an abstract concept and the following are the most important factors:



**The Passivent Commercial system from Willan is designed to supply natural ventilation to commercial buildings on an individual basis through a combination of passive stack, background and night cooling ventilation as well as solar shading. Enquiry No 207**

### Sound pressure

Pressure develops when pressure waves move in the air. Our ears translate the pressure as sound. The sound pressure is measured in Pascal (Pa). The smallest sound pressure that the ear can appreciate is 0,00002 Pa, which is the threshold of hearing. The largest pressure is 20 Pa, the upper threshold of hearing. The large numerical difference in pressure between the threshold of hearing and the upper threshold of hearing, makes it difficult to handle. A logarithmic scale is used to eliminate the large numerical difference, which is based on the difference between actual sound pressure level and the sound pressure at the threshold of hearing. The scale has the unit decibel, dB, where the threshold of hearing is 0 dB and the upper threshold of hearing is 120 dB.

### Sound power

Sound power is the energy per time unit (watt), which the object submits. Sound power is calculated from the sound pressure and is not measured. The logarithmic decibel scale has been developed for sound power in a similar way for sound pressure. Sound power is not dependent on the room's construction, and is therefore easier to compare between different fans.

### Frequency

A sound source's periodical oscillations round a resting position is the sound source's frequency. Frequency is measured in the number of oscillations per second, where one oscillation per second is 1 Herz (Hz). Frequency is the characteristic of the sound's pitch. Many oscillations per second, i.e. higher frequency, give a higher tone.

**N.B! When comparing different fans' sound pressure levels, Lp , the conditions must be similar so that the comparison will be relevant.**

**● Mats Sandor is technical manager of Kanalflakt, the Swedish ventilation equipment manufacturer. Many of the products built in Sweden to these sound criteria are distributed in the UK by Roof Units of Dudley, West Midlands.**

**Enquiry No 206**

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