A testing time for buildings

by Paul Appleby

Paul Appleby examines the need for periodic checks on buildings and describes the actions being considered by CIBSE and the European Commission.

A recent Harris Poll of 1135 office employees in a number of cities in the UK found that 28% had taken between one and five days off each year because of symptoms they blamed on office air quality alone.

For a business employing 400 people this could be costing between £50 000 and £100 000 per annum in lost output.

During its inquiry into indoor pollution (to which CIBSE gave written and verbal evidence), the House of Commons Environment Committee estimated that sick building syndrome could be costing the UK economy between £330 million and £650 million in lost productivity, absenteeism and in addressing the problem of sick building syndrome itself.

In its 1991 report on this issue, the Environment Committee recommended the "establishment of a self-financing inspection system .... where the internal comfort criteria and associated building services plant are checked for compliance with design standards and codes of practice at regular intervals."

How, then, do we define a sick building? A sick building has a number of things wrong with it. Occupants report a wide range of symptoms which they only experience in the building in question. The most common symptoms among office workers are headaches, eye problems, dry mouth and blocked nose. These symptoms can be caused by a number of factors, some relating to display terminal use, some to air quality and some to the indoor climate. In addition, ergonomic and psycho-social factors and work-related stress are prevalent.

An extensive British study found that symptoms were most commonplace in the larger, older, air conditioned buildings, particularly in public sector buildings before privatisation. The worst buildings have been found to be deep-plan city centre offices with sealed windows, and centralised control of temperature and air movement.

Investigators worldwide have found that symptom levels increase with poor maintenance, high airborne chemical and dust concentrations and high winter temperatures. People who spend much of their day working at display terminals are particularly prone to certain symptoms, including eye problems, headaches and musculo-skeletal trouble.

The CIBSE initiative

CIBSE has responded to the Environment Committee's report by establishing a Building Health Checks panel. The panel will begin by producing general guidance on carrying out building health checks. This will be followed by the development of detailed procedures for carrying out each specific check.

The aim of this exercise is to encourage building owners and managers alike to have periodic checks carried out as a preventive measure. This would also monitor the effectiveness of the maintenance regimes and the effect of changes in layout or use.

In parallel with the CIBSE initiative, the European Commission Directorate-General XII for Science, Research and Development has launched a research programme under the Joule II banner.

This ambitious programme was developed as a result of a workshop on indoor air quality (iaq) management held in Lausanne in May 1991, attended researchers from across Europe. research needs identified at the works which overlap with the aims of a build health check include:

☐ the further assessment and survey symptoms in a wider range of buildi according to a common test procedure;

☐ the study of sickness absences and p ductivity related to symptoms;

☐ the assessment of ventilation rate the existing building stock;

☐ the identification and quantificatio pollution sources in buildings;

☐ performance studies of ventilation tems, including filtering of the outdoor and maintenance requirements.

There were many other topics ide fied at the workshop, falling into the ar of sick building syndrome, iaq measu ment, iaq and energy, sources and sou control, ventilation, ventilation syste and regulations.

A pan-European consortium of rese chers is co-ordinating the research pr ramme, which is likely to involve a la number of workers throughout Europe.

Building health checks

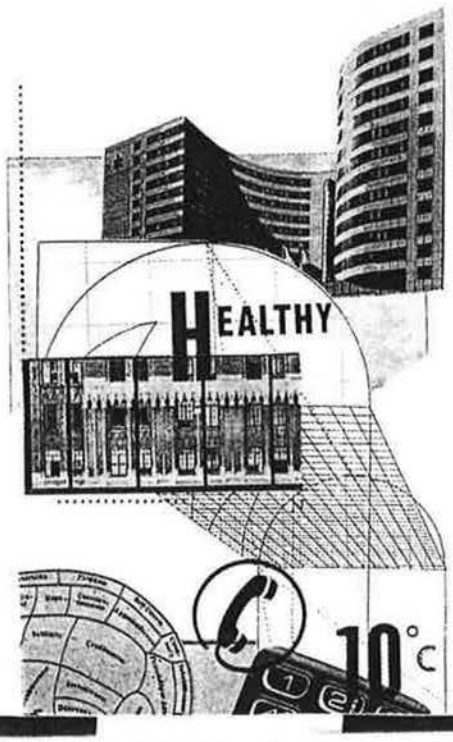
Some of the factors which can contribute building-related sickness may be appar to the experienced eye; others may more subtle and thus require probing tective work to uncover. For this reason 'stepwise' approach to building hea checks is recommended, requiring a mul disciplinary team of surveyors.

The first step involves inspection of t engineering drawings and maintenan documentation etc. This is then follow by a walk round the building, identificati of indoor and outdoor pollutant sourc and discussions with key individuals volved in using, operating and maintai ing the building. If at this stage maj faults are identified, a report should prepared outlining remedial measures.

The next step in the survey would taken once occupants had acclimatised the effects of these measures. This involv conducting a questionnaire survey, whi is used to determine occupant perceptio and to help target surveys of physical par meters. The questionnaire poses que tions which:

☐ elicit information about occupant perceptions which cannot be measur physically;

☐ provide information which can be co



Build tight – ventilate right

by Earle Perera and Lynn Parkins

pared against measured parameters and the investigators' subjective assessments;
- ☐ provide an indication of the effect that working in the building is having on the health of regular users;
- ☐ identify clusters of complaints and symptoms;
- ☐ provide comparative information between floors and areas;
- ☐ help target physical surveys.

There would be certain parameters which would be measured as part of a core survey for every building. Normally these would include:
- ☐ measurement of key parameters, such as outdoor air supply rate, carbon dioxide concentrations, air movement, temperature, humidity and lighting levels;
- ☐ an appraisal of the design, operation, maintenance and control of air conditioning, ventilation and heating systems;
- ☐ an assessment of the display terminal installation and compliance with European Community Directive *90/270/EEC* and corresponding UK guidance in the form of an *Approved Code of Practice* (currently out for consultation) defining the *Health & Safety at Work etc Act 1974*.

Other surveys may be required, depending upon the results of both the walk-round and questionnaire surveys. For example, if concern is expressed about noise levels, a noise survey may be required, or if specific pollution sources are identified, concentrations of a key pollutant may need to be measured.

The report should compare measurements with current standards and guidelines, identify problem areas and prioritise remedial action.

Once a building has had an initial check-up and the major weaknesses have been remedied, a follow-up survey should then be carried out six months after the remedial work has finished, and then annually as part of an auditing regime to monitor the effectiveness of maintenance and the impact of changes of use, refurbishment etc.

A modern office building is a complex and sophisticated entity which, if neglected, can quickly become run-down and unpleasant to live in. It is anticipated that regular check-ups will help maintain a healthy and productive workforce and enhance industrial relations.

Paul Appleby is managing director of London-based Building Health Consultants, and is chairman of the CIBSE Building Health Checks panel.

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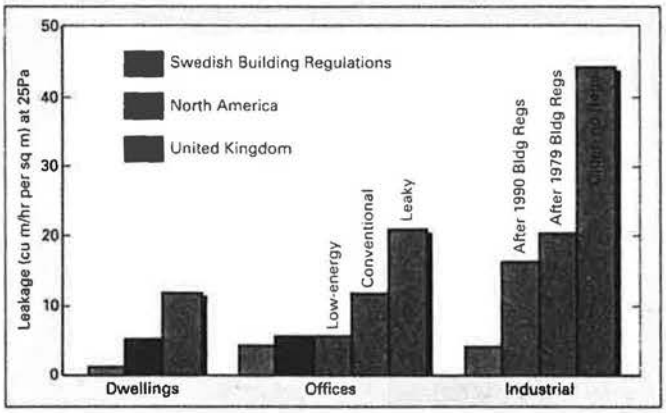

Figure 1: Fabric leakage of different building types in different countries.

Adequate ventilation is essential for the health, safety and comfort of building occupants, but excessive ventilation leads to energy waste and sometimes to discomfort. A building needs to be ventilated by design (eg openable windows). Air leakage (infiltration) through cracks and gaps in the building fabric tends not to be designed for, and may therefore be considered as an overhead or penalty.

It should be the basis of good design to make the building envelope airtight and then to provide controlled ventilation, ie the concept of 'build tight - ventilate right'. This approach reflects and addresses current concerns regarding indoor air quality (eg sick building syndrome), energy conservation and associated environmental issues such as carbon dioxide emissions (arising from space heating and cooling) and use of cfcs. It needs to be emphasised that a building cannot be too tight – but it can be underventilated.

Build tight

The airtightness of a building envelope can be measured by using a 'fan pressurisation' method[1]. This involves sealing a portable fan into an outside doorway and measuring the air flow rates required to maintain a series of pressure differentials across the building envelope.

BREFAN is a new pressurisation system built by the Building Research Establishment (BRE) and designed for use with large buildings. The airtightness of buildings with different forms and volumes can be compared using a leakage index, Q25/S, where Q25 is the flow rate at a pressure difference of 25 Pa and S is the total permeable envelope area.

Figure 1 shows the measured leakage index of different building types in the UK compared with North American and Swedish buildings. The average UK dwelling is twice as leaky as the average North American building and four times more leaky than the average Swedish building. In the office sector, however, the purpose-built BRE low-energy office is as tight as a representative North American building and almost tight enough to conform with the present Swedish *Building Regulations* requirement for non-domestic buildings. By contrast, a typical conventional office building is twice as leaky, while a problem building (where staff dissatisfaction had been expressed) is four times as leaky.

Some of the leakiest UK buildings are single-celled industrial constructions. Even the tightest UK industrial building (satisfying current *Building Regulations*) is five times more leaky than a similar Swedish building, while the older building is 10 times more leaky.

Figure 1 shows that there is considerable scope for making UK buildings tighter. A study[2] has shown that just sealing an