benchmarks for better buildings airtightness campaign

The case for the Q value

Clients, designers and institutions are all calling for more airtight buildings. Do we need mandatory pressure tests backed up by compliance procedures in *Part L*, or simply the publication of good practice guidelines? A recent CIBSE workshop delivered some answers.

BY RODERIC BUNN

Uncontrolled air infiltration in buildings is a growing problem. With the move away from traditional masonry construction to prefabrication techniques such as curtain walling, for example, there are far more interfaces between components and therefore greater opportunity for unplanned gaps.

The problem is made even worse by complex building geometries and subcontract packages which increase the potential for ill-fitting components. It's therefore no surprise that the BSRIA and the BRE both report that the variability of air leakage can be anything up to 40:1.

Services engineers have largely compensated for this by oversizing heating and air conditioning systems. While this is understandable given the lack of control that can be exerted over the architect or building contractor, the reaction neither aids energy efficiency nor provides for a productive and healthy internal environment. In the worst cases, hvac services will be fighting a losing battle.

As a consequence, the CIBSE is lobbying for improved standards, guidance and regulations on building airtightness. In March, CIBSE President Geoffrey Brundrett convened a special workshop to discuss possible solutions to the air leakage problem. Delegates included architects, engineers and air leakage experts.

The retail sector was strongly represented by ASDA, Tesco, Safeway and the John Lewis Partnership. This was significant, given that the superstore operators have been pioneers in the field of building airtightness, regularly achieving the good practice standard of 3 $m^3/h/m^2$ of envelope.

Delegates were asked to debate whether the industry needed improved guidance on airtightness procedures and sealants, or whether a more drastic response was justified, such as mandatory pressure testing in the *Building Regulations*. They were also polled on the potential for remedial measures, and whether it was possible to get building owners and clients interested in incorporating airtightness measures during refurbishment.

To a man, the retail representatives at the seminar expressed puzzlement that air leakage was still a major problem for other sectors of the building industry. Even discounting the energy issue, Safeway Stores had long since recognised the important link between customer satisfaction and a well controlled internal environment. "The key motivation for us is to make store customers comfortable rather than to improve store energy efficiency," said Safeway Stores' Andy Francis.

Airtightness testing in practice

Airtightness testing involves the measurement of an airflow rate, Q, in m^3/h. While the BRE tests at a reference pressure of 25 Pa (Q_{25}), the BSRIA tests to a reference pressure of 50 Pa (Q_{50}).

In either case, the pressure is low enough not to cause any damage to the building, but high enough to overcome the detrimental effects of moderate wind speeds.

To relate the measured airflow rate to an airtightness standard, the flow rate is normalised by the envelope area of the building, S. This is usually defined as the inner area of the walls and roof. The normalised flow rate is also useful for assessing the suitability of cladding, the airtightness of which is usually expressed per unit area.

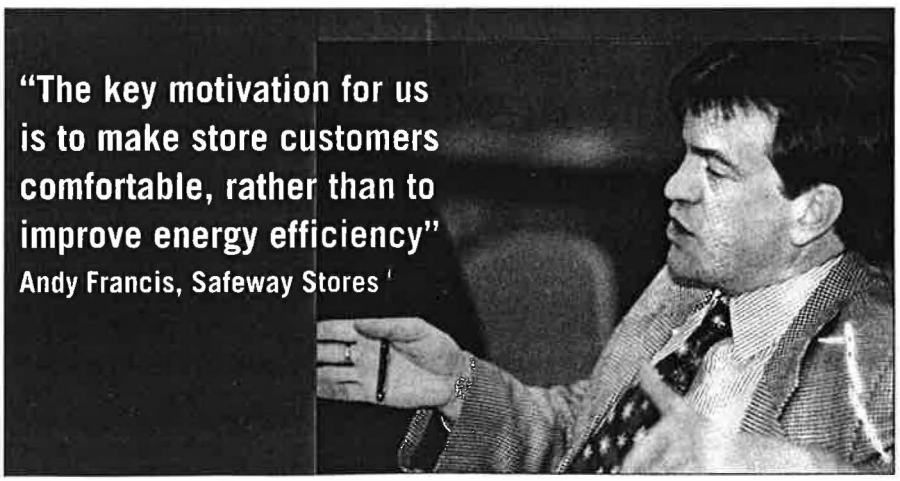
The BSRIA's airtightness recommendations for new buildings are contained in a new guidance note, *Specification 10/98: Airtightness specifications* (see box "Airtightness guidelines").

The role of regulations

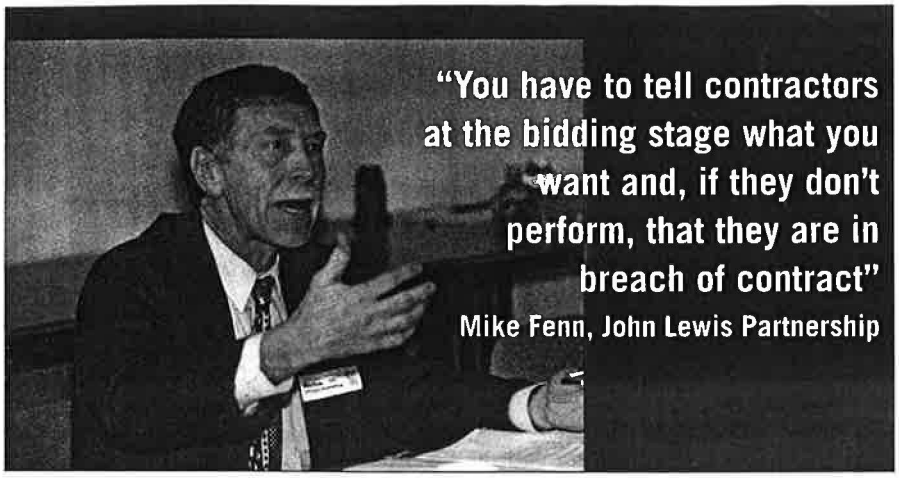
For a variety of reasons there was remarkable unanimity among designers and client representatives that airtightness should be included in the forthcoming revision to the *Building Regulations*.

One delegate voiced the opinion that a compliance clause in the *Building Regulations* would be the only way that local authority building inspectors would be able to enforce airtightness. Another regarded legislation as "more important than ever, now that the cost of fuel is falling".

Architect Robin Marsden of Shepherd Design argued that airtightness needs to be made explicit in the *Building Regulations* "if



PHOTOGRAPHS: RODERIC BUNN



only to raise awareness in the project's initial stages. Introducing airtightness issues halfway through a contract is not the way forward," he added.

Delegates recognised that regulatory compliance would not be the "universal glue to hold buildings together". Regulation needs to go hand in hand with product performance testing, they said, which should range from a leakage index for structural components, like masonry blocks, through to modular components such as windows. Some delegates thought this could be achieved through Agrément certification.

Getting the message across

Concern was expressed by delegates that building contractors are largely ignorant of airtightness detailing, and frightened by the suggestion of pressure testing.

The counter to this was the importance of a clear specification at the outset. "At the end of the day you have to tell contractors at the bidding stage what you want," said Mike Fenn of the John Lewis Partnership. "If they don't perform, then clearly they haven't met the requirements of the contract."

"It's vital that the tender documents are very specific on what the air barriers are required to do," added Doug Lawson of Building Sciences. "Air barriers must be impermeable, continuous around the envelope, have suitable mechanical strength, be neatly installed, durable and accessible for maintenance."

Contract documentation should be just as specific on the performance of sealants, added Lawson. They must be air impervious, capable of adhering to various substrates which may not be clean or dust free, have a long life and be capable of accommodating movements between components.

The case for the Q-value

The majority of delegates agreed that the science of pressure testing was currently too arcane. Even the retailers, who require no persuasion of the benefit of pressure testing, expressed irritation at the lack of a single agreed value to express airtightness.

While it is possible to reconcile results from the two different reference pressures of Q_{50} and Q_{25} used by the BSRIA and the BRE, the differences were not only giving the wrong impression, said delegates, but the derived values are not being presented in an easily digestible form.

"Pressure testing figures need to be turned into figures we can understand," said Tesco Stores' Riaz Malik, "a simple air pressure index that we can all aim for."

A suggestion was made that airtightness should be promoted in a simple form, such as a Q-value, corrected for site, building height and prevailing weather conditions.

ASDA's Kevin Harrison pleaded for some simple literature to be written for lay clients. "There has to be some simple guidelines," he said. "The literature is still in design-speak, and therefore not intelligible to brickies. The vast majority of clients haven't got a clue."

The same view was expressed by Doug Lawson and Mark Skelly of the Centre for Window and Cladding Technology at the University of Bath. Both explained the crucial difference between seals and the acting of sealing. "Contractors often use totally inappropriate sealants to plug gaps in the building," said Skelly. "It is vital that seals and sealants are used which will not degrade under prevailing environmental conditions."

"It's down to the design detailing, as the problem of sealing the building has to be achieved before the testing stage. Designers need diagrams and pictures on it should be done," said ACDP's Colin Goodge.

Improving existing buildings

So what about buildings which, for reasons of age, size or geometry, cannot be pressure tested? If a portion of the building cannot be isolated for the test, then clients may have to rely on infra-red photography, both during and after the construction phase.

Existing buildings pose a more difficult dilemma, in that the success of remedial sealing is largely dependent on getting access to the air gaps. Andy Francis reported that Safeway has begun to look at the state of 500 existing stores, ranking them on the severity of the air leakage problem and the scope for making cost-effective improvements.

Francis explained that Safeway has created a specific audit procedure and a matrix for assessing its building stock at a glance. This appealed to delegates, who suggested that this could form the basis of a generic, self-assessment toolkit for property owners – something which a body like the CIBSE could undertake to develop.

Rounding up, workshop chairman Dr Geoff Brundrett identified the problem of translating airtightness values into something meaningful in business terms. "I am delighted that we got a unanimous 'yes' that airtightness should be in the *Building Regulations*," said Brundrett. "But some kind of simple airtightness label which everyone can understand is obviously needed first of all."

Brundrett closed the workshop with a stark warning: "Once we begin to get airtight buildings...mechanical designers will have a real responsibility to ensure that their services will be able to perform."

AIRTIGHTNESS GUIDELINES

The legislative driving force for building airtightness currently resides within *Approved Document Part L: Conservation of fuel and power* of the *Building Regulations*.

Part L states that: "Space heating demand is significantly affected by the infiltration of cold outside air through leakage paths in the envelope. It is therefore desirable to limit air leakage by reducing unintentional air paths as far as is practicable."

Part L then lists five areas in the building envelope that require special attention.

The latest guidance document has just been published by the BSRIA. ***Specification 10/98: Airtightness specifications*** explains the problems posed by high air leakage rates, and explains the method used to test for it. Performance guidelines are given at test pressures of 25 Pa and 50 Pa for the main building types, plus data for ductwork and builders' shafts.

BRE Report ***BR 265: Minimising air infiltration in office buildings*** was published in 1994 to cover air infiltration in non-domestic buildings. The report highlights common air infiltration paths that can occur in office buildings, such as at the junctions between main structural elements and services penetrations.

Help on designing a tight envelope is given for different types of construction, along with guidance on methods of sealing junctions between building elements and components.

Other guidance includes CIBSE's ***Applications manual AM10 (1997): Natural ventilation in non-domestic buildings*** which outlines the reasons for reducing background air leakage in buildings, the AIVC's ***Guide to energy efficient ventilation (1996)***, which highlights the uncontrolled energy loss in buildings with excessive air infiltration, the BSRIA's ***TN8/95: Air leakage of office buildings***, and the BRE's Information Paper ***IP 6/89: Use of BREFAN to measure the airtightness of non-domestic buildings***.

Finally, ***Building Envelope News*** is an occasional newsletter funded and published by Building Sciences Ltd. The aim of the newsletter is to increase awareness that the building envelope is one of the most critical components within the entire building system.