

School des

Conventional wisdom says that schools are quite capable of being naturally ventilated. Official design guidance has long promoted this belief while frowning heavily on mechanical ventilation, which is assumed to cost more and be less energy efficient.

The tide may be about to turn. Researchers are finding that indoor air quality can be very poor in schools where the windows stay shut. Designers, too, are questioning guidance that asks for schoolchildren to receive less fresh air than an office worker. Add to this vastly improved mechanical heat recovery techniques, and the argument for rewriting the rulebook is becoming difficult to ignore.

In this nine-page feature we weigh up the evidence. To begin, we examine the future of the school design bible: *Building Bulletin 87*.

Lessons in ventilation

Schools are arguably our most important public buildings. They are not only the country's premier places of learning, but also where society stakes its moral, ethical and scientific future. They are not places where we should skim and save.

It is easy to forget that the school building programmes of the 1950s and 1960s operated under severe financial strictures. Modular forms of construction typified by CLASP were very much a response to the need for fast construction and ease of assembly. They may have been draughty and expensive to heat, but at least the pupils got the fresh air they needed, even if it wasn't always in controllable quantities.

In the 1980s, the focus shifted to more tightly insulated school buildings, and on low energy technologies like passive solar design, trickle ventilation, and trombe walls. While these technologies were reported to improve energy efficiency, worrying signs began to emerge that indoor air quality was being sacrificed in the process.

In 1988, researchers reported that Looe

School, a seminal passive solar development in Cornwall, was suffering carbon dioxide (CO₂) concentrations in classrooms in excess of 1200 ppm, with peaks of 3000 ppm. This was attributed to low ventilation rates caused by over-emphasis on low heating energy¹. Other monitoring work has also demonstrated that modern schools are increasingly under-ventilated, with values of 1000 ppm of CO₂ often being reached².

Research evidence suggests that the performance of occupants deteriorates at ventilation rates of less than 8-10 l/s/p. But the CO₂ concentrations observed above imply that schoolchildren are suffering fresh air ventilation rates of just 1 l/s/p or even less. Clearly a wholesale revision of school ventilation design guidance is well overdue.

Where do we go from here?

The current ventilation requirements of schools are laid down by the Department of Education and Employment (DfEE), notably in *Building Bulletin 87 (BB87)*. This is enforced by *The Education (School Premises) Regulations 1999*.

BB87 currently lays down two rates for ventilation: 3 l/s/p for background ventilation and 8 l/s/p for occupied areas. Despite the rate for occupied areas, the guidance expresses a preference for natural ventilation over mechanical ventilation.

This guidance is currently out of step with the ventilation rates laid down for other types of buildings. For example, CIBSE's *Guide A* recommends a fresh air supply rate of 12 l/s/person for offices, residences – and schools.

To its credit, the DfEE is well aware of these discrepancies and is seeking to amend *BB87* to improve compliance not only with other engineering guidance, but also with the *Building Regulations* (a process that will be aided by removal of Crown exemption – see box).

The DfEE's Richard Daniels says that while every section of *BB87* will be reconsidered, it is too early to say which clauses will be updated or removed. Speaking at a recent CIBSE ventilation seminar, Daniels hinted that the background rate of 3 l/s/p may be dropped in favour of a single ventilation rate.

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Section A on acoustics will also be thoroughly overhauled to make it more suitable as a compliance document, says Daniels. The Building Research Establishment is currently working up *Building Bulletin 93* on the acoustic design of schools, and a chapter of that document will be aimed at Building Control officers. Of course *BB87* will also need to be in step with the forthcoming revision to *Approved Document E: Acoustics* in the *Building Regulations*, due out for consultation in the spring.

How will these changes affect planning and design? Possibly not very much. Plans will now be checked by Building Control whereas before they were not (unless the local education authority submitted them voluntarily). For the most part the construction standards already quote *Building Regulations Approved Documents*, but of course *BB87* is still the primary source of environmental design data.

The other big choice DfEE faces, particularly in the light of revisions to *Part L* of the *Building Regulations*, is which parts of *BB87* will remain enforceable and which will remain as design advice, such as the 4-5% daylight factor.

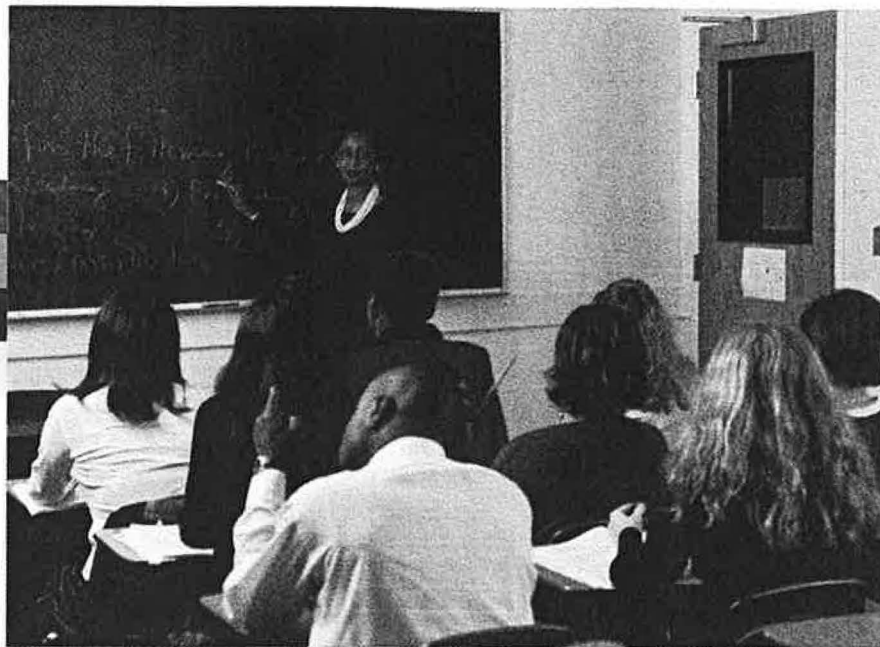
"The energy targets in *BB87* may also have to be revised, but this will require further analysis of the energy consumption of existing schools" suggested the DfEE's Richard Daniels. "The energy calculation method also needs some attention, and there is also a plan to bring the Schools Environmental Assessment Method (SEAM) into *BB87* as a separate section."

The DfEE is planning to issue a draft revision of *BB87* on the web. "This will help us to revise it further during the first year of Crown exemption in the light of feedback from building control officers and designers" said Daniels.

The argument for mechanical ventilation

So what about mechanical ventilation? Given *BB87*'s preference for natural ventilation, only few mechanically ventilated schools have been built in recent years, despite the evidence that a mechanically ventilated system with high heat recovery can consume less energy than an equivalent naturally ventilated building³.

There is plenty of evidence to show that energy consumption of gas-fired heating (at, say, 100 kWh/m²/y) can easily be 10 times than of the transport energy for fans, which might typically



be around 4-8 kWh/m²/y.

Given that air handling systems are available that can recover over 90% of waste heat from the extract air, the need for expensive heat raising systems can, given a highly insulated and airtight fabric, be almost totally avoided⁴.

Irrespective of the ventilation system and efficiency, there still remains a serious issue to be faced: airborne particulates. While it is quite possible to reduce CO₂ concentration through dilution, the presence of unhealthy particulates – such as products of combustion, pollen and man-made fibres – can be harmful to health.

"There is a definite need for the Government to instigate standards relating to specific pollutants to get a truer picture of indoor air quality" says Plymouth University's air quality researcher, George Richardson.

"We have been concerned for some time about the ambiguities in *BB87*", says Mukund Patel, DfEE's head of the Architects and Building Branch. "We need to devise new standards that reflect the needs of a comfortable learning environment for both new and existing schools. With the ending of Crown exemption, we have an opportunity to put things right."

This article is based on the papers and discussion from the CIBSE seminar: Ventilation and Indoor Air Quality in Schools, held in December 2000.

References

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- ²Anon, 'Monitoring Looe School', *Building Services Journal*, 9/89.
- ³PROBE 9: energy & engineering, *Building Services Journal*, 4/97 (Also see the PROBE report on the Elizabeth Fry Building at www.usablebuildings.co.uk/Probe/ProbeIndex.html).
- ⁴Field J, 'Top of the Class' *Building Services Journal*, 2/01.

Further reading

- Natural ventilation in non-domestic buildings*, CIBSE Applications Manual AM10, CIBSE 1997.
- IAQ Update 'School woes continue, despite \$400 000 and two investigations' *Indoor Air Quality Update*, December 1996.
- Limb M J, 'Ventilation in schools', *BIB 6*, Air Infiltration and Ventilation Centre, 1997.

Goodbye to Crown exemption

In 2000, the Department for Education and Employment (DfEE) issued a consultation paper on proposals to end the exemption of building work at maintained schools from the *Building Regulations*. 202 replies were received in response to the consultation paper, including 47 local education authorities and 16 dioceses.

An overwhelming majority of respondents (87%) agreed that the best way to ensure compliance with national standards for building work was to subject schools to the normal building control system. Moreover, 97% agreed that checks for compliance with national standards should be made by a qualified or "competent" party.

As a result of the consultation, DfEE ministers have decided to end Crown exemption for maintained schools.

Section 4 of the *Building Act 1984* empowers the DETR Secretary of State to exempt school buildings from the *Building Regulations*. However, this will require primary legislation, and Parliamentary time has yet to be allotted for that. As a consequence, the DfEE is to effectively end exemption by revoking *Regulation 8 of The Education (Schools and Further and Higher Education) Regulations 1989*.

The DfEE and DETR is aiming for exemption to end on 1 April 2001. All building projects at schools from that date would then be required to comply with the *Building Regulations*.