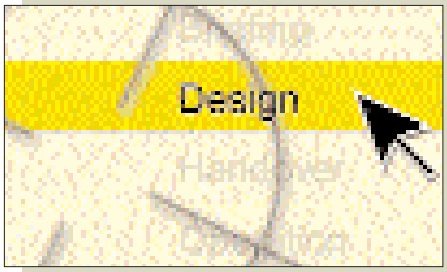
The study illustrates the virtue of carrying out post occupancy audits of existing schools

A useful discussion on the virtues of manual lighting control and absence detection systems.

The quality of the windows and their mechanisms holds the key to successful natural ventilation

PHOTOGRAPH: RODERIC BUNN



Birchensale School 2

In the second of three articles, the PROBE Team report on the detailed design of Birchensale Middle School, and how the design team has incorporated PROBE lessons into the specification.

BY PAUL RUYSSEVELT AND RODERIC BUNN

Birchensale Middle School in Redditch is about as typical as one can get: it's over 30 years old, naturally ventilated and lightweight in construction. However, Worcester County Council is rationalising its teaching accommodation and has earmarked Birchensale School as one of six to inherit pupils from other schools that are being closed. For these reasons Birchensale School is being refurbished and extended.

The PROBE Team has maintained a watching brief with the designers of the extension building – ECD Architects and m&e engineers Whitby Bird. The PROBE Team's role has been to help fine-tune the design based on the findings from PROBE post-occupancy studies. This has ranged from proffering advice on a wide range of issues, from lighting controls and acoustics, to the amount and location of storage spaces.

In this context the researchers have been acting purely as passive commentators and information providers rather than formal consultants. The Team has identified potential pressure points, related instances of problems in similar buildings studied in the PROBE project, and monitored the usefulness of those lessons to the Birchensale design team.

The first article in this series of three was published in the June 2000 issue of *Building Services Journal*. Readers should read that article for full details of the project. What follows is an analysis of the building prior to the tendering process which began on 19 February. Start on site is scheduled for 16 April 2001.

Matters arising

The extension building will double the school's accommodation, from 300 to 600. The budget is £1.5 million, which equates to £740-750 m^2. It will house classrooms, an IT room, laboratories, communal spaces and circulation corridors.

The building's brief was well advanced by the time the PROBE Team became involved, so it was only possible to suggest modifications to the extension rather than have a major influence on its structure, form and internal layout.

After the first round of PROBE Team discussions (June 2000), the Council put the project on hold to deal with more immediate needs. Work began again in September 2000., but in the interim the original m&e engineer on the project had moved on to other duties, and the architectural team had also changed with Peter Stokes at ECD picking up the reins.

These changes highlight a problem faced by professional teams everywhere, namely how

Readers should refer to the June 2000 issue of *Building Services Journal* for the first article in this PROBE study.

Each PROBE intervention study will be reported in three articles over the next 18 months. The series will use a numbering system separate from the standard PROBE building studies so readers can keep track.

"ECD Architects is investigating simple passive CO_2 detectors that darken when CO_2 levels are high"

"intelligence" gained during the gestation of a project can survive changes in personnel. While physical records – drawings, specifications and the results of modelling – can easily be archived and retrieved, the thought process that drove development is more difficult to preserve.

The PROBE Team considered, *en passant*, that this could seed problems that arise later in a project or even during handover when it is too late to make changes. For example, a contractor might not appreciate the importance attached to a detail – the quality of opening window mechanisms for example – or a user might find that the storage space requested for a specific location has been moved somewhere else.

Here, the design team's principal point of contact has been the school headmaster. ECD Architects has also presented its scheme to the school governors, and two governors have had involvement in the scheme development (one governor is a teacher, and another is the school manager). This helped them decide optimal location for those elements most crucial to the users of the building, such as teachers' white boards. Worcester County Council has also employed a consultant, Graham Parker, to advise on the layout of laboratories, and these have also been discussed extensively with the head of science at the school.

Design issues

The extension of Birchensale School was one of a number of projects on the County Council's books. Given the strong environmental agenda local authorities are required to follow, the Council considered how its purchasing power might help it procure low energy products and materials more cost effectively.

Unfortunately the volumes involved – roofing materials for example – were not large enough to obtain significant price reductions. The same was true of the designers' preference for Velfac windows. Other project tenders have come in high, with structure being one factor and the other being prelims (especially the health and safety costs associated with working on a live site with children).

ECD Architects has tried to lighten structure and feel that the approach they have taken to containing the extension works during construction should mean they won't suffer to the same extent on high prelim costs. Clearly it is helpful to have intellegence on other tenders in for similar building works in the locality.

The budget for the Birchensale School extension is quite tight at £740-750 m^2, and the design team had to consider reducing structural costs and programming the works to keep costs down. Primarily this involved keeping the extension separate from the existing school building, and only connecting the two late in the project along a designated circulation route.

Ventilation and acoustics

Given the tight budget, mechanical ventilation was out of the question, save for a landlocked information technology classroom. The perimeter classrooms will therefore be naturally ventilated with cross-ventilation via openable fanlights above the classroom doors.

ECD Architects opted for a three-element window system, all of which will be manually openable. The proposed window opening configuration, with low, middle and high level vents, is considered good practice, but will not necessarily be enough to ensure adequate ventilation.

This is because the key to good natural ventilation is not just one of free area, but more to do with the usability and accessibility of the windows and the ability of the hinges to keep the window open at all stages in its travel, particularly in breezy conditions. Velfac windows should provide this functionality, but the PROBE Team thought it important to word the specification in such a way that the contractor is forced to preserve the functionality of the windows irrespective of who supplies them.

The fan lights over the classroom doors are also very important for cross ventilation. The teachers need to recognise that the fan lights should normally be open, along with an appropriate percentage of the perimeter windows. The question is: how can that be addressed in the specification?

The PROBE Team pointed out the lack of robust guidance on default-to-open windows. ECD thought that clear and robust signs, located either by the windows themselves or within the classrooms generally, would help maintain understanding among the teachers and pupils as to the appropriate default settings. There is also the need to ensure that classrooms are "purged" between classes to reduce CO_2 levels.

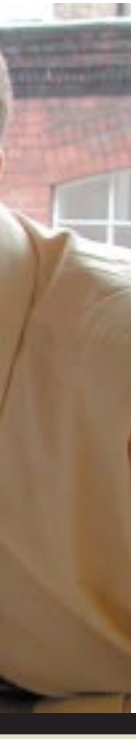
While ECD's architects felt, not unreasonably, that users will have to learn to use and control their spaces more effectively, the PROBE Team thought it would be optimistic to expect teachers to manage the classroom environment at the same time as educating pupils. Teachers may also not perceive the classrooms to be stuffy until levels of CO_2 are quite high[1].

It was agreed that there were three important issues that needed to be addressed in the specification of the ventilation:

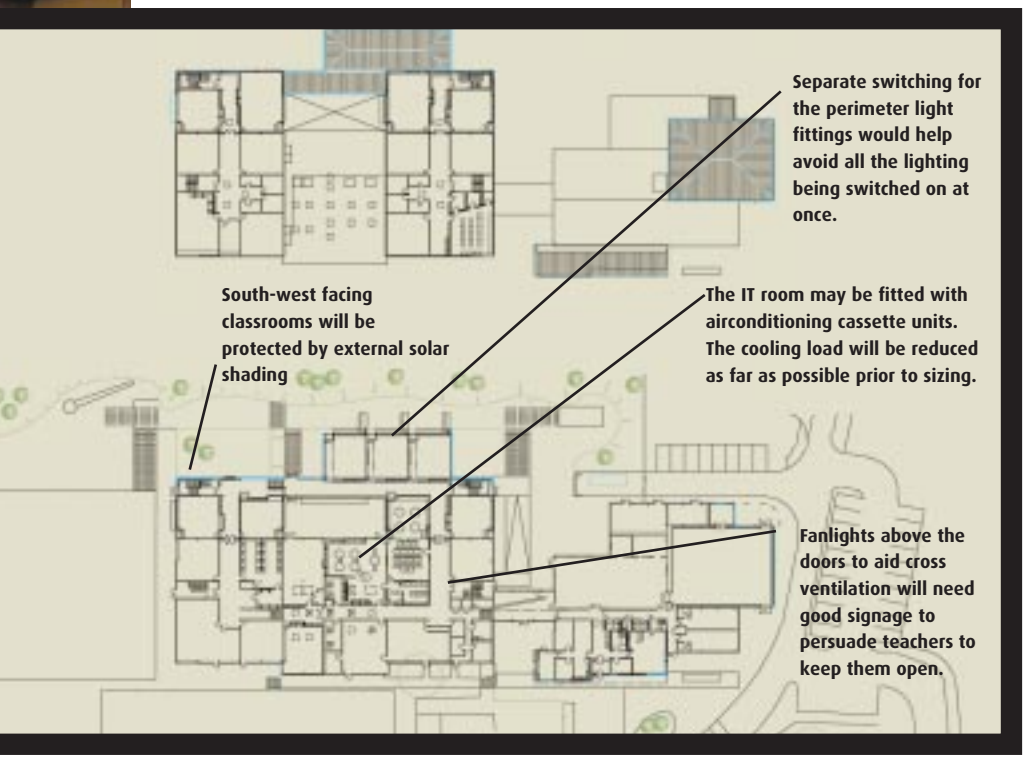
- ☐ the importance of positive-friction window mechanisms to ensure windows stay open at different degrees of travel
- ☐ signage near the fanlights above the doors that reinforce the need for the vents to be normally open
- ☐ passive CO_2 detectors which can show when ventilation is necessary.

For the latter, ECD is investigating simple passive CO_2 detectors that darken when CO_2 levels are high. These should be located where they provide a fair representation of CO_2 levels in the classrooms (ie not subject to draught dilution), while being both tamperproof and accessible. The PROBE Team felt that, together, these measures could go a long way to ensuring that ventilation effectiveness is maintained.

To address the potential problem of noise break-in from corridors into classroom via the fanlights, ECD opted to design them as bottom-hinged units that open out into the corridor,



LEFT: ECD Architects' associate director Brendan O'Neill discusses the finer points of the school's design with PROBE's Paul Ruyssevelt.



thus reflecting noise back down. While this was thought worthwhile, the PROBE Team was not sure how effective this would be, as the degree of noise intrusion is a function of other variables, such as the proximity of the teaching areas to the source of the noise and the reverberation qualities of the circulation spaces.

For the internal IT room, the designers are considering either making the room's clerestory windows openable or putting in some cassette air conditioning units. The m&e engineers are keen to use the cassettes, first because they will work, and second because they will introduce some cooling into the space. Experience shows that gains in IT space are often higher than anticipated and there is a problem with dissipating the heat, particularly by the often less-than-optimal location of cassette devices.

While low-energy flat-screen monitors are expensive, they may be a worthwhile investment by the school and will serve to reduce the cooling load. The school should be informed about the use of energy-saving screensavers and the need to switch off computers out of hours.

Birchensale Middle School
Client: Worcester County Council
Andrew Jarvis, Graham Parker (consultant)
Architect: ECD Architects: Brendan O'Neill, Peter Stokes
Services consulting engineer: Whitby Bird & Partners: Andrew Keelin, Duncan Price

PROBE Team advisors
Adrian Leaman, Paul Ruyssevelt

PROBE articles directly relevant to this study
Readers should refer to the June 2000 issue of *Building Services Journal* for the first article in this PROBE intervention study.

PROBE 11: John Cabot City Technology College, *Building Services Journal*, 10/97.
'Lifting the lid', Building Services Journal, 2/01. (Based on research carried out by Dr Bill Batty at Cranfield University).

For downloadable pdf files of these and earlier PROBE reports, visit the PROBE web site at www.usablebuildings.co.uk./Probe/ProbeIndex.html

In any case, the controls for the cassettes will need to be easily understood, and this should be made explicit in the specification.

Lighting and solar shading

The design team is keen to reduce reliance on electrical lighting by maximising daylight and reducing glare. The architects have introduced a fixed, galvanised external louvre on the south-west elevation which is designed to protect the top third of the three-element window. While internal blinds are not part of the designers' brief, the architects have ensured that enough space exists within the window reveal for a blind to be fitted.

The PROBE Team pointed out that external shading can protect against solar gain but still leave the potential for glare. Even if internal blinds are not provided, the occupants will find other ways of obscuring the glass, particularly with classwork, which means the lights may tend to stay on.

To reduce the risk of windows doubling up as postboards, the architects have nominated specific roles for the classroom walls. For example one wall is a traditional teaching wall, another houses storage space while the third will be kept clear for display purposes. "This gives a simple but reasonably clear and understandable structure for the use of the classrooms", said Brendan O'Neill.

The PROBE Team believe that the teaching wall design should work very well and is only likely to be subject to glare in two of the classrooms that face South West, and this is where the internal blinds are likely to be needed most.

The designers have been investigating the use of automatic lighting controls to reduce lighting energy consumption. The lighting will comprise a mixture of compact fluorescent lamps in circular downlighters and standard linear fluorescent fittings.

The engineer, Whitby Bird, is favouring an absence detection system for the lighting rather than presence detection. With absence detection systems, the lights are switched on manually but go off automatically. This has proved a very robust method of operation.

With presence detection, lighting comes on when human movement is detected, and stays on for a programmed period after people have left the space. The problem with presence detection is that the programmed period can be very long, and all the lights can come on even if occupation is momentary.

The architect is concerned about the cost of any form of automatic lighting control, and favours display panels by the light switches which rely on weather symbols – such as sunny, partly sunny and overcast – to tell the users when lighting should be switched on and off.

The PROBE Team was open-minded about the usefulness of such panels, but believe that the effectiveness of any lighting control is bound up with the quality of any glare control methods added post-contract, such as Venetian blinds. If these were left down they would negate the

WHAT THIS STUDY MEANS FOR YOU

Reduce cooling loads

Information technology is increasingly being introduced into schools, straining natural ventilation strategies and (particularly for landlocked classrooms) raising the need for comfort cooling. Here, the engineers are considering ac cassette units, but the client could also consider low energy lcd screens rather than conventional crts.

Window design is vital

Questions are begining to be asked about the effectiveness of natural ventilation strategies for schools. Windows need to be well specified to ensure they can be stay open at all positions in their travel, and this must be made explicit in the specification. Visual CO_2 sensors may also be a worthwhile and cost effective investment.

Consider "absence" lighting control

ECD Architects wisely considered absence control for the lighting (which is more energy efficient than than presence detection) but the budget will probably preclude it. The alternative is to fit display panels in the classrooms with sun and cloud symbols hinting when lighting is needed. Such panels need to be robust and intuitive.

Undertake energy audits

The *CIBSE TM22 Energy assessment and reporting method* can be used to improve the precision of design energy estimation and to provide a closer link between predicted and monitored consumption, as part of a cradle-to-grave benchmarking exercise.

Promote post-occupancy reviews

Birchensale School is one of a series of schools being refurbished in the Worcester area. Post occupancy studies of those schools would help Worcester Council learn lessons from these developments. Energy meters are also a cheap and effective means of identifying the true energy demands of school extensions compared to the existing buildings.

value of the iconic display panel as the lighting would then stay on.

The PROBE Team think it beneficial for manually controlled lighting to be controlled in rows parallel to the windows, with the light switches arranged in separate panels next to the icons on the display panel. This could help prevent "sweep of the hand" light switching.

Metering and energy management

The design team is aiming to monitor the energy consumption of the new extension, and this led to a discussion on energy monitoring and targeting methods, and the appropriate number and location of energy meters.

Sub-metering on this project will be needed, mainly because some of the primary services, like the boilers, will be shared between the existing building and the extension.

For the electricity consumption, monitoring will be easier as sub-circuits (lighting and small power) in the new extension can be monitored separately, with meters on the main lv panel monitoring the site's total electricity consumption. By logging the energy consumption on spreadsheets contained in the Energy Analysis Reporting Method of *CIBSE TM22*, the loads can be easily broken down and analysed.

The |PROBE Team suggested that the energy metering will need to be expressed in the specification in such a way to survive any cost-cutting. But even if they do survive the cost-cutting, they will need to be installed in such a way that they are useful on a regular basis. This would also be useful to the client in specifying future school projects.

"With all the effort that has gone into designing the windows, the lighting and control systems," said Paul Ruyssevelt, "it would be interesting to compare the electrical demand on this site to an existing demand on another site. If someone could be persuaded to read a couple of the meters on a weekly or monthly basis, then that could be quite useful.

"It is also important that the meters are not tucked away so that no one can read them. Provide too many, and they won't get read."

ECD Architects suggested that this project would benefit from a post-occupancy review. The PROBE Team agreed that it would also be useful for Worcester Council to carry out reviews of existing school premises to help them learn lessons for future developments.

The PROBE Team will return to the Birchensale School project later in the year.