Making older and historic buildings energy efficient

SB sits in on a workshop given by Oxley Historic Buildings Consultancy at the AECB Annual Conference

Oxley Historic Buildings Consultancy said: “Traditional buildings are more energy efficient then many people think, and those that are not efficient can be improved.

However they warn that a lot of damage can be caused by ‘well intentioned’ repairs.

An informed approach needs to be adopted – but you have to UNDERSTAND THE BUILDING.”

According to Oxley Conservation, most traditional buildings are built with stone, soft bricks, timber and earth using earth or lime-based mortars and renders. These materials allow moisture to be absorbed and then to readily evaporate, allowing the building to ‘breathe’. The levels of dampness are ‘controlled’ by the ready evaporation of moisture.

Externally, the porous materials are dried out by the wind and sun. Internally, air movement – through the roof covering, windows and openings help the evaporation of moisture from the internal porous surfaces. Where moisture can evaporate freely and the traditional ‘breathing’ performance is not impaired, the walls of traditional buildings will remain relatively dry.

Modern building materials (hard dense bricks, cement-based mortars and renders, modern masonry paints and external sealants) are generally impermeable and rely on providing physical impervious barriers (cavity walls and cement renders) to the elements to keep out driving rain and physical damp-proof courses to prevent rising dampness. These modern materials and methods work well together in modern buildings designed to exclude the elements.

If impervious modern materials are used on a traditional building there is a risk that the balance between water entering the fabric and water evaporating from it will be disturbed. When the balance is disturbed the traditional performance will be adversely affected and problems will occur.

The application of cement renders, masonry paints or sealants to the wall of an historic building will significantly reduce the amount of evaporation that can take place. As the moisture content of the wall increases, the likelihood of decay increases. Timbers and weaker materials, such as soft external masonry where hard cement pointing has been used, are particularly at risk.

Also modern cement-based renders, mortars and plasters are hard, inflexible and impervious. If they are bonded to softer, more flexible traditional materials these modern materials are susceptible to cracking.

It is estimated that two thirds of the 2050 building stock exists today. About 20% of the dwelling stock in 2001 was built before 1918. Of pre-1918 stock about 25% is listed or within conservation areas. Improvements to 20.8% of the dwelling stock can make a significant contribution. The is aim to make it a long-term contribution. Oxley stresses that older buildings are different due to design and materials, performance, cultural value and legal protection.

You have to understand the history of construction, modification and use, cultural significance and protected status. And you have to get to grips with the performance, intended performance and changes in intended performance along with performance in use.

A deeper understanding can be gained by data logging, looking at fuel bills, conducting fan pressurisation tests, thermal imaging, dampness testing and not forgetting occupant feedback.

Air-tightness Historic and traditional buildings need ventilation to preserve the fabric, to maximise evaporation of moisture and maintain an acceptable equilibrium.

The provision of excessive or poorly thought-out draught proofing to achieve an arbitrary level of air-tightness could lead to: mould growth; associated health problems for the occupants and the conditions for fungal decay and insect attack.

What is the appropriate level of ventilation? The general removal of odour and moisture 8 litres/second/ person, or 0.4 achr at normal domestic occupancies is an appropriate level. Modern airtight homes can reach 0.4 achr.

A Victorian house with leaky timber ground floor is often 1.6 achr. A possible target for traditional dwellings is 0.8 achr which allows the same amount of air for the building as the occupants.

Oxley sounds a word of caution on targets – beware of trying to achieve the unachievable; base targets on an understanding of the building; do not rely on common misconceptions and go for bespoke solutions – avoiding standard ones.

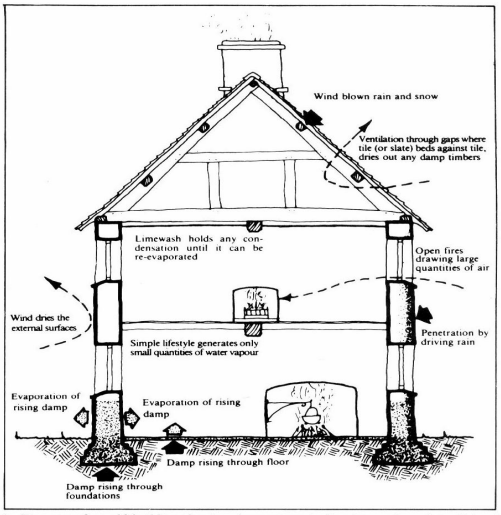
The performance of the existing building stock is underestimated. How often are old buildings described as being draughty? This is not always the case.

Two Victorian terraced buildings were assessed using air pressure tests to measure their air permeability before and after the introduction of draught-proofing to the sash windows. The results revealed that before improvement they had an air permeability of about 0.6 achr at average real pressure differences. These rates showed room for improvement, but are within the limits for new building in the 2002 Building Regulations and are on a par with the average standard of new-built homes in post construction tests.

The draught-proofing of existing sash windows resulted in these two buildings showing a significant improvement in air tightness with air permeability falling by 21%, and 27%. Since reducing leakiness becomes gradually harder as draughtiness decreases, both of these are creditable results.

The background ventilation rates in both buildings should be sufficient for comfort, but the rate of ventilation is now down to levels where the occupants may need to open windows for freshness.

Both cases illustrate that traditional terraced buildings are not necessarily as draughty as presumed.



1. Diagram of an old building showing the movement of moisture through traditional materials

Berg Cottage The Berg Cottage is a good example of a historic building and its energy problems. The Grade II listed cottage was constructed in 1687 and given to the National Trust in the 1930s. It is not open to the public. The current tenants have lived there for 15 years.

It has a thatched roof, timber frame – partially rendered, partially weather-boarded. There are some surviving daub infill panels. The heating is from open fires and electric storage heaters. The tenants were living in conditions of discomfort. The electric night storage heaters were highly ineffective and inefficient and were so expensive to run that they were hardly ever used.

The tenant had installed glass fibre insulation between the timber studwork. Oxley Conservation prepared a *"Quinquennial" Inspection Report* on the condition which also assessed the issues of energy conservation.

An Energy report produced by Peter Warm said that Berg Cottage was losing most of its heat through excessive air movement and identified several potential areas of excessive heat loss. A fan depressurisation test was recommended to measure the building's performance and identify the where leakage was taking place.

Fan test results The building had a theoretical achr of 24.2 @ L(50) and an average real air change of around 1.3 achr. The air movement was greatest through the general structure - particularly the weather-boarded areas and the tiled slopes.

The repairs undertaken were a new boiler (before main works)

- Conservation of the surviving historic render
- Removal of impervious finishes
- Repair of the exposed timber frame
- Repairs to the brickwork plinths
- Re-rendering and lime-washing
- Re-thatching

Fan tests were carried out halfway through the project to re-evaluate effectiveness. The air changes measured had actually gone up!

Ongoing tests, working closely with the contractor revealed problem areas that had not been attended to. This enabled the workforce to appreciate what they were trying to achieve. It also enabled immediate feedback on the success of repairs. Compartment tests were used to find areas of greatest leakage.

Following rendered elevations, ventilation and secondary glazing:

- The SAP rating increased from 49 to 81
- CO_2 emissions reduced from 11.1 to 5.3 tonnes per annum
- Gas cost reduced from £1,076 to £536 (2002)
- The air change reduced to 16 achr @ (L50) – down from 24 achr before works commenced (the target of 14 achr was missed).

As a result, there was a noticeable decrease in the draughtiness, overall there were increased comfort levels and warmer winter temperatures.

Refurbishment of existing buildings Oxley say the most commonly suggested means to improve the energy efficiency of existing buildings are:

- Roof Insulation
- Windows and doors
- Draught-proofing
- Wall insulation (internal or external)
- Heating and boilers
- Energy efficient lighting
- Renewables (solar, photovoltaics)

They advise, based on an understanding of the building to make the following improvements:

- Upgrade boilers
- Install better heating controls
- Restore shutters
- Flue dampers
- Basic draughtproofing
- Install Low energy lighting

On wall insulation (internal or external), the exposure/aspect, type of construction, surface area to volume ratio, dryness – effective dpc, salt contamination, appearance and detailing around openings (including architectural features) need to be taken into consideration.

Oxley concluded by saying refits/refurbs to older buildings have risks. Changes can interfere with a buildings breathing performance. It can mean loss of character and a spoiling of appearance and or loss of historic fabric.

There is only one chance for improvement The blighting of traditional buildings as a justification for demolition should be avoided.

There is also a danger of creating longterm health problems for the building, the occupants and the environment.

However, traditional buildings can make a contribution. If building conservation principles are adopted and improvements are compatible with the existing building – intended performance can be maintained over time and the retention of the existing fabric can be maintained. What-is-more, future options are not prejudiced.

In conclusion, they quote *A R Powys – Repair of Ancient Buildings*: “I have found that it is not wise to lay down dogmatic rules, for when they are made one is apt to be confronted with a case where they do not work.”