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Energy Efficiency

the product of

innovation

Jay Thomson looks at what the supply side of the industry is doing to assist the relentless drive towards greater energy efficiency.

In this, the era of the energy trade off, the building industry's main thermally advantaged products are blocks, mineral wools and timber frames. And while purists may regard trade offs as cop outs, the arrival of the NHER energy target shows a glint of steely hand beneath the velvet.

And the prognosis? If the NHER takes off and the public really bites down hard on this important aspect of the greening of Britain, energy conservation will become a key selling point. So – thicker masonry walls and more timber frame, supported by the development – not too rushed, preferably – of even more refined structural and insulation products.

In practice only those materials on the room side of thermal insulation have any significant effect on the thermal 'capacity' of a construction; and, in general, the higher the mass of these inner materials the better the overall thermal capacity.

However, thermal response time must also be taken into any genuine energy efficiency equation – thermal response being the time it takes for insulating material to heat up enough to improve room temperature.

Thus, external insulation fixed to a solid 200mm wall of dense concrete provides an eventually high thermal mass, but takes a long time to heat. A typical timber frame wall section has low mass internal insulation, but allows rapid heating and good internal heat retention.

To achieve a reasonable degree of energy efficiency the level of thermal capacity and the 'response time' factor needs to be looked at in conjunction with the heating system, building form and orientation and internal room layout.

Material	Density (kg/m³)	Volumetric specific heat (Wh/m³K)	Temperature rise (C) from applications of 1kW to 1m³ for 1hr
Concrete	2 100	490	2.0
Brickwork	1 700	380	2.6
Lightweight concrete	1 000	280	3.6
Plasterboard	950	220	4.5
Softwood timber	600	200	5.0
Plywood	530	200	5.0
Fibreboard	300	80	12.5
Mineral wool	12-40	10	100

Note: Thermal capacity = specific heat x volume.

The new super quality insulation wool by Gyproc Insulation.

As a start point, here's a general guide to the volumetric specific heat of common building materials:

Apart from timber frame, which is inherently more energy efficient than other common construction methods, there are two main materials to consider in devising a housing specification that will meet Building Regulation energy requirements: modern concrete blocks, and various forms of mineral wool or styrofoam-type layers.

It's worth noting that quite standard timber frame will hit at least eight on the best-of-ten NHER target; better specifications can reach ten without, as the NHBC has put it, 'difficulty.'

However, other wall types can contribute to 10-ratings though, predictably, the producers of blocks and mineral wools have been at loggerheads. Unless timber frame starts pick up, mineral wool manufacturers will continue to face relatively constrained markets relating to wall construction. And with the current stockpiles of cheap blocks, it's hard to see how timber frame can make major inroads south of the border, except among enlightened contractors such as Laing Homes, and the growing host of housing associations.

Blockmakers have faced a challenge since the government first gave serious credence to energy conservation in 1975 – though only through the 'poor cousin' route: the primary purpose of improved standards – walls required to have U values of 0·6 – was in fact to cut down on internal condensation.

There were further refinements to 1978 and 1982 regulations, the latter posing what Marley's technical services director Mike Robinson described

as 'a real challenge to the industry, to the builders and specifiers, and the manufacturers.' In effect, it was difficult to meet thermal performance with traditional brick and block walls, without adding various forms of interleaf batts, foams or pellets. Typical early-80s blocks needed 25mm of extra insulation – which would lead to greater wall thicknesses. But lighter weight aerated blocks could be used for both leaves and, with external render and internal plasterboards, meet requirements.

Blockmakers went further by producing two sizes of ultra lightweight block which could be used on the inner leaf to 'beat the numbers.' Even so, thicker walls (with various forms of insulating batt) may well become the norm with the move towards walls with 0·45 U values to boost NHER ratings.

Two hoary questions remain: can the relatively new breed of blocks ensure long term structural performance? And do they actually perform to stated U values?

There is no British-demonstrated answer to the first question as far as the long term is concerned. However, there is evidence from mainland Europe which suggests problems with ultra lightweight blocks may not be significant: in much European brick and block construction, the blocks used for some years are significantly less dense than the current 480kg/m³ blocks typically used here.

On the other hand, this may be because site skills allow this on the continent: is the British brickie up to it? It's interesting to note that Bovis Homes, in a report for the now shelved Energy Council, noted that in fixing cavity insulation batts to blockwork in a high thermal efficiency site great care was needed to avoid block spalling.

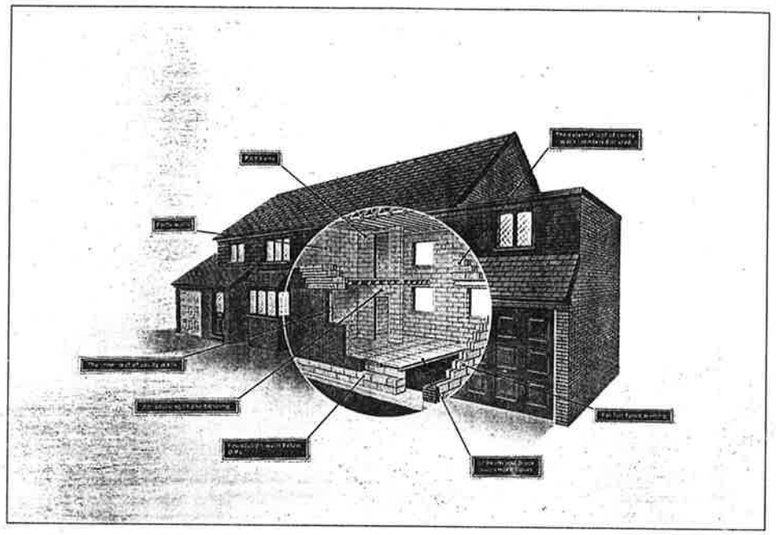
It is also interesting to note that at least one major block manufacturer has confirmed the 'technical risks' involved with the move towards better insulated buildings by emphasising the potential hazard of interstitial condensation – though properly manufactured blocks are of constant density, and therefore produce steady temperature take-ups, with dew points 'rarely reached' according to Thermalite.

Leading blockmakers offer lightweight products which meet BS5268's severe exposure requirements, though workmanship is again a key factor, and puts modern block manufacturers into the same 'great, but where's the proof?' bag into which timber frame was so neatly stitched up in the early 80s.

The remaining question is this: assuming blocks are well laid, do they live up to their 0·6 ratings? The UK Mineral Wool Association (Eurisol) not only says nay, but reports that Yarsley tests on a well-known ultra lightweight block indicates that 0·9 is more like it – and that the bulk of the increase can't be put down to excessive heat loss through mortar joints. It's a claim that blockmakers have not risen to.

In any case, until site practice improves enough to allow the manufacture and use of even lighter blocks with confidence, leading batt suppliers can probably expect to see more of their products used in cavity applications; and on iffy sites, exposure-wise, the NHBC's admitted nervousness about carelessly installed cavity fill will militate towards this.

Whether these potential developments and speculations are worth a hill of beans remains to be seen. The industry would, no doubt, like to build a few more houses before pushing towards the boundaries of the kind of energy efficient construction that would make even cosy trade-offs unnecessary.



Energy efficiency of windows

With a continuing emphasis on energy trade-offs, the use of double glazed windows will undoubtedly increase in newbuild domestic properties. And the significant trend towards more sealed buildings also means that specifiers must pay attention to certain details.

Single glazing, as far as energy conservation is concerned, can be consigned to the out tray. The U value for single glazing in a timber frame is 4·5W/m²K; and that compares with the U rating of a modern timber frame wall of 0·3 – a 15-fold increase in heat waste.

More well known is the fact that, in most situations, the internal surface temperature of single glazing is much lower than that of other surfaces. This means that building occupants radiate body heat to the glass, which also creates down draughts. The visible result of this syndrome is, of course, condensation.

The Timber Research and Development Association recommends that double glazing with an air space of between 12mm and 25mm be used, thus cutting U value to around 2·5.

But this is seen as a minimum requirement: in habitable rooms, triple glazing can reduce U values to 2·0, as can double glazing with low emissivity (low E) glass. Those dealing with very stiff thermal specifications may also consider using special insulating curtains or shutters, which can reduce heat loss of window openings to 0·6.

The choice of frame material is important. Timber is an inherently better insulator than newer materials such as plastic and metal; wood frames also reduce the chance of condensation on the inner face of the frame.

It is safe to predict that wood windows – already used in four out of five newbuild homes – will continue to dominate this market: the combin-

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ation of appearance, thermal performance, predominant use of softwoods and cost is hard to ignore, as are continuing improvements in the quality of both design details and raw material, which are giving longer life.

However, wood windows come off second best in the replacement sector because the joinery industry's marketing approach lacks effective commitment to the High Street and some public sectors. And this is generally down to their being tied to the commercial imperatives of the timber trade where – despite recent developments in sourcing – the key word is 'history'. Which is something the plastic window manufacturers, for example, do not have to bow to in cultivating that 'maintenance free' image that has so riled English Heritage.

A guide to specifying thermally effective windows should in most cases consider the following.

- Double glazed wood windows, using low E double glazing.
- Winter ventilation is needed for condensation control and to encourage a movement of fresh air. Normal opening light windows cannot be considered adequate for winter ventilation because there is no 'fine control'. In practice, this means either that rooms are too fuggy, or that they become draughty and lose excessive heat. Therefore, specifications should always include a fine control slot ventilator on the top rail.
- There should be draught sealing to opening lights, with the seal fixed to the frame where the opening light meets in on closure. The wall/window junction must also be effectively sealed.

Products round up

Heating plays a pivotal role in energy conservation, and there are a number of new products on the market which may go some way towards achieving the 75% market share that combis have on the continent.

Shell Oil, meanwhile, reports that the price gap between mains gas and oil is widening in oil's favour. Oil is said to be 23% cheaper than gas in a three bedroomed semi, and 33% cheaper than Economy 7 electricity.

Saunier Duval have bucked the general trend by taking the 'small is beautiful' route: its SD623 is said to be the smallest combi boiler available, and its fan assisted flue can handle output of up to 80 000Btu/hr, delivering more than 2 gallons of water per minute at 35C.

And from Worcester Heat Systems, a price cut for its latest 350 and 240RSF combis. The company's 9·24 range is said to be the UK's best seller and available with three flueing options.

There are other heating options, including those based on 'air conditioning,' Daikin, a Japanese company with a Belgian base, claim that its air conditioners provide 'an efficient source of heating, helping to reduce winter fuel bills.' It works on the refrigerator principle, reversing the process to use ambient warmth to best effect. Daikin say its system uses up to three times more heat for each unit of electricity consumed, compared to conventional gas or electricity heaters.

2S Airchanger's P17 is a patented multi-pass heat recovery system designed by an ex-Rolls Royce senior design engineer, and it's said to recover up to 85% of heat from stale air. The P17 can be used instead of both trickle vent and extractor fan vent systems. The two fans used – they are the only moving parts – are Scandinavian made and have been used successfully for more than 15 years.

Acma's Four Seasons heat pump-air conditioning console has been designed to deal with external temperatures of minus 20°C at 'good energy efficiency.'

And from Valor Heating the Heartbeat 'living flame' gas fire gives a top heat output of 3·4kW at a claimed efficiency of 60%. The radiant fire market – at which the competitively priced model is aimed – is significant: there are thought to be 11m radiant gas fires in UK homes.

Ventilation is another key issue in increasingly tightly built homes, and Rega Metal Products produce an alternative to trickle or 'pressure' ventilation. Its Rega Ductex HRV is used in homes built to Medallion 2000 specification, and is said to reduce air change heat loss by 50%. The Ductex is designed specifically for well-sealed properties and produces a constant flow of heat-recovered air.

Timber windows are intrinsically energy saving and Swedish-made Espe windows are among those setting an important new trend in site practice: the 'system' includes a former which is used to build brickwork around: the factory-finished window is then installed into a precise opening, which ensures a better thermal envelope, and means the window will last longer and require less significant maintenance. Espe's installation format ensures that frames are set back from the brickwork to minimise the effect of sun and rain on both the frame and double glazing bottom edge seals.

Heat loss through thermally inefficient flooring is common and can account for 15% of the total and Caberboard's Caberwarm floor insulation – tested by TRADA – is said to 'comfortably exceed' NHBC requirements. Caberboard offer moisture resistant chipboard in 18 or 22mm thicknesses, with insulated backing in various thicknesses and two densities.

Onduline's Ondutile undersheeting is designed to form a weatherproof 'under roof' and can be highly suitable for low pitches in potentially stormy areas. However, the rigid corrugated material is also said to cut energy loss by about 5%, compared to standard roof constructions.

Site practice and energy

The building industry has pressed for government intervention in construction, and not least in thermal improvements of existing housing stocks. But are builders up to it? Evidence from the BRE makes uncomfortable reading.

Its latest findings reveal that even when 'rehabilitating' older properties, there's a fair chance poor specification or site practice will ensure that as many new faults are built in as are eradicated – thus confirming a trend originally noted by BRE nearly ten years ago.

BRE inspectors discovered some 2 500 construction faults on 15 projects, mainly in the public sector, which were down to 'lack of care.'

Nearly half the faults were such that, once built in, they could not be corrected because of prohibitive cost.

And it is significant, concerning energy efficiency, that inspectors found condensation in recently improved housing which had not been present before work started.