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Cladding

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REGULATING ENERGY

Richard Twinch looks at the new regulations on energy consumption.

APRIL 1 has special significance this year for building designers since it is the day when the new Building Regulations come into play.

The aim is to reduce energy consumption in new buildings. The major changes involve Part L1 *Conservation of Fuel and Power*, though there are significant changes and adjustments in other areas, notably Part F *(Ventilation & Condensation)*, Part G *(Hygiene)*, Part H *(Drainage and Waste Disposal)* and Park J *(Heat Producing Appliances)*.

This is the thirteenth amendment since 1965. There has been a gradual reduction in wall U-values from 1.5 to the current 0.45W sq m degC. There is still some way to go to reach parity with Scandinavia, but it is likely that once the effects of the current round are assimilated there will be further scope for bigger reduction in four or five years as European standards begin to dominate.

The formulation of the new regulations merely requires that "reasonable provision shall be made for the conservation of fuel and power in buildings", which applies to all dwellings and any other building "whose floor area exceeds 30sq m". The interpretation of this is left to the Approved Document, which itself refers to British Standards and is accompanied by an excellent BRE report *Thermal Insulation; Avoiding the Risks*. This offers guidance on detailed design for walls, roof, floors and windows to overcome increased risks of building failure due to inappropriate use of insulation materials — notably condensation, but also fire and movement problems. This is not itself an approved document though it is essential for reference.

The purpose of the regulations is to reduce the energy losses from new buildings by at least 20 per cent, while offering designers a choice of strategies to achieve this goal. These are threefold:

(1) The Elemental Approach which requires that minimum areas of glazing for walls and roofs are adhered to, and that walls, roof and, for the first time floors, achieve U-values which for non-domestic buildings are 0.45W sq m degC overall.

(2) Calculation Procedure 1 (trade-off) which allows choice to reduce insulation in some areas while increasing in others. This choice comes in the form of trade-offs where, for instance, double glazing can offset extra insulation in the roof, or additional insulation in the walls can offset floor insulation.

For dwellings these trade-offs are simple swops which do not need any calculation. However, for non-domestic dwellings (and if window areas are greater than 15 per cent of floor area) you must do calculations to compare simple heat loss of a notional building against the proposed building. In this calculation the notional heat loss changes as the building changes, particularly when the fenestration is varied.

The new part L1 stipulates that if you have fewer windows in your proposed building than the maximum allowable percentage in your notional building, then you must use the proposed window area to determine the heat loss of the notional building. This is to prevent the designer trading-off rooflight losses, when there are no rooflights.

(3) Calculation Procedure 2 (energy targets) which establishes a target heat loss for the notional building which must not be exceeded by the proposed building. In principle this is the same requirement as Procedure 1 except that in Procedure 2 orientation, solar gain and internal gains are taken into account. There are two calculation procedures for this:

- For dwellings the BREDEM Worksheet (BREDEM 9.2) used in collaboration with the BRE Report BR 150: 1989 *Building Regulations: Conservation of fuel and power — the energy target method of compliance for dwellings* by BR Anderson. This is a simplified version of the method developed for energy-targeting and used to assess schemes in the Milton Keynes Energy Park. Again a notional building with westward/eastward facing windows is compared with the proposed building where windows are placed orientated as designed. The use of this procedure will further encourage the use of south facing windows and allow increased window areas — though in practice, I suspect, most houses which are designed in an energy-conscious fashion will not skimp on insulation elsewhere. A limitation of the procedure is that it does not account for summer over-heating (cooling in the US accounts for as much energy as heating). More sophisticated thermal models are required to predict this with accuracy.
- For buildings other than dwellings, the calculation is in accordance with the space and water heating requirements of CIBSE Energy Code 1981, part 2a. No surprises here, though its implementation falls outside the scope of fabric design into h and v engineering or the specialist energy consultancies envisaged in the Approved Document, which will eventually have the ability to certify projects. This is the way things have gone in much of the rest of Europe and in the US — in the meantime building control remain the arbiters of the new Part L1.

What, then, are the implications of the new regulations for cladding? First, insulation levels are going to increase — though initially these may be traded off against double glazing, the long-term effect will be to standardise U-values at 0.45. Pressure for this will come from component and insulation manufacturers who have re-detailed their products to meet these targets, as well as from building users — particularly if energy costs (which have been low for years) increase rapidly.

Where is this insulation going to be placed? There are three alternatives: within the frame, on the inside of the structure, and outside the frame.

In making a decision on how to upgrade, other factors must must also be taken into account. These are: condensation, cold bridging and fire protection — particularly in the cavity.

Until now most insulation has tended to be placed within the structure, protected by some interior vapour check to reduce moisture penetration to the outer leaf. As insulation levels increase so does condensation risk on the outer skin. Such increased risk is small, yet tangible.

The major design problem, however, is overcoming the new maximum 1.2 U-value requirement for structural elements including lintels, sills and jambs. In a timber-framed building the wood acts as a good insulator and achieves this level. However, with concrete or steel framing, cold-bridging must be designed out — and it is no longer enough simply to fill voids with insulation, it is the line of least resistance that must have the stipulated 1.2 U-value and not just the orthogonal section. Heat is no respecter of straight lines.

Insulation is thus required either on the inside or the outside of the frame and detailed in such a way as to reduce local cold-bridging (insulation may be placed within the frame as well). A recent paper by David Coates of British Alcan British Products in *Roofing* showed an *increase* in U-value of between 26 per cent and 52 per cent depending on the spacing of galvanised spacers in a metal roof (or wall) when using Swedish Standard SS 02 42 30 to calculate the overall U-value. Even with the inclusion of 12mm rockwool spacers under the roofing sheets, the increased U-value was still 15 per cent up on design values due to losses through the fixings.

Insulating on the inside of the frame avoids cold-bridging, but does require a high level of vapour sealing to avoid the increased condensation potential from moist air hitting the cold frame. The frame itself is subject to increased thermal movement if it is neither being kept at a near constant temperature from within nor protected from the vagaries of climate without.

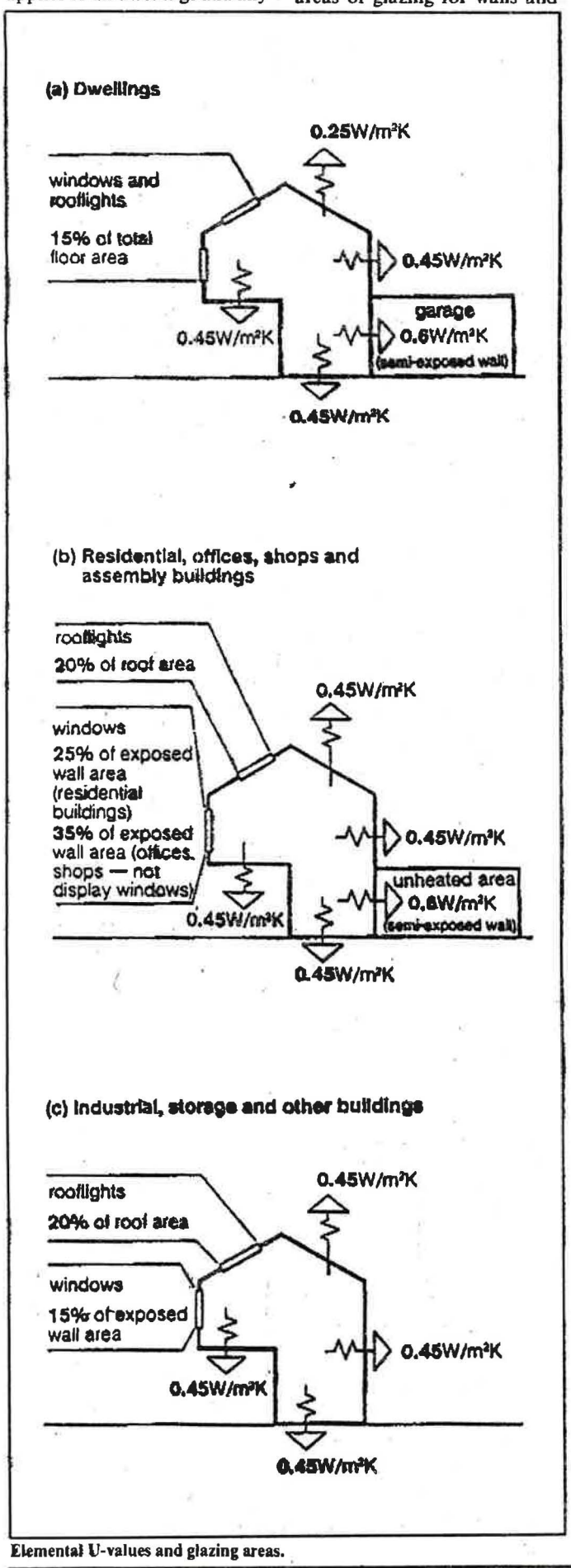
Insulating outside the frame and ventilating the void between the insulation and the cladding (so-called thermal sheathing) not only keeps the frame warm and thus avoids condensation, but also has the benefit of further reducing condensation potential as the insulation increases in thickness. One point to beware of is the requirement for fire stops in the cavity — unless non-combustible insulation is used. The need to fire-stop also conflicts to a degree with the need to ventilate outside the insulation. Thermal sheathing also maintains the structure at constant temperature.

Another potential problem (wherever insulation is placed) is that as insulation levels increase the cladding material suffers from increased thermal cycling. No longer kept warm from the building, and being subject to extremes of heat and cold, the cladding and fixings must tolerate even greater stress.

In saving energy there is a price to pay and that lies not so much in the capital cost (insulation is relatively cheap) but investment in design to achieve a harmonious balance of physical and chemical interactions which are mutually complementary rather than in opposition. Each design has its own balance, and there is less scope for individual whim. Manufacturers are increasingly responsible for coming up with tried and tested methods. Unfortunately the UK's reticence to increase energy efficiency in line with the rest of Europe has meant that when it comes to low-energy solutions other countries are way ahead. Hopefully the new standards in the regulations will promote competitive UK products as well as energy saving and good design, which in any case are synonymous.

References
(1) Approve Document L, L1 Conservation of fuel and power. Department of Environment and Welsh Office. HMSO 1989, £4.
(2) Building Regulations conservation of fuel and power — the energy target method of compliance for dwellings, BR Anderson BRE 1989, £10.
(3) CIBSE energy Code 1981, Part 2a. CIBSE, £22.
(4) Thermal Insulation; avoiding the risks. BRE, 1989, £10.

Richard Twinch has specialised in technical software to do with energy-related areas for 10 years, and has recently completed a program called TRADE-OFF which runs on the IBM PC and Compatibles. TRADE-OFF complies with Calculation Procedure 1 (mentioned above) which is applicable to all types of building as from April 1. This allows U-values, areas of insulation and glazing to be varied to meet the regulations' notional buiding requirement and, if you want, will tell you the cost of each alternative option. Further details: Richard Twinch Design, tel: (0473) 210001, fax: (0473) 254605.



Elemental U-values and glazing areas.