Concrete is worth its weight in cold

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Thermal mass is a term that describes the ability of a material to store heat – something many construction materials can do to a greater or lesser extent. But, to be useful in the built environment, they must also be able to absorb and release heat at a rate roughly in step with a building's daily heating and cooling cycle. Concrete and masonry products do this well and, being dense materials, can also store a lot of heat.

Members of the Precast Flooring Federation (PFF) recognized this many decades ago and this 'fabric first' philosophy led to the development of concrete beam-and-block flooring with expanded white polystyrene (EPS) sheeting. Such systems attained U-values up to 0.25W/m^2K, levels that seemed fine 25 years ago. However, the need to achieve better thermal performance has since resulted in a second generation of higher specification Neopor (silver) EPS panel with U-values up to 0.08W/m^2K. This compares with the Government's anticipated zero carbon level of 0.15W/m^2K for floors with enhanced details and good Psi values (used for rapid calculation of the thermal heat bridge "correction" factors).

At a time of increasing energy prices, fuel poverty and dependency on overseas foreign fuel resources, not forgetting global warming and growing CO_2 emissions, there are compelling reasons to optimize the thermal performance of dwellings. It is vital that new homes remain both energy-efficient and comfortable throughout their lifespan. Indeed, the Government's latest mandatory targets – to build homes that achieve Code level 3, 4, 5, 6 and zero carbon – come into force in 2016.

The initial development of beam-and-block for upper floors in place of traditional timber joists has been universally accepted in 'high end' builds. This has happened for two main reasons. First, there is the so-called 'Waltons syndrome' where the density of occupation keeps increasing as succeeding generations of the extended family live together under the same roof. Second is the 'family use scenario' in that we no longer live our lives as we did in the 1950/60s: today we seldom watch tv or eat together in a standard nine-to-five work day, so greater segregation and privacy is required within the dwelling.

Beam-and-block floors contribute hugely to the internal thermal mass of a dwelling – the heating demand in winter and cooling demand in summer are less, so reducing CO_2 emissions. And the saving is free.

The operating principle is simple. In the winter, heating is switched on during the day and the heat is absorbed into the mass of the concrete/masonry within the highly insulated dwelling. Then at night with the heating switched off, the absorbed heat is released back into the dwelling. During the summer, the reverse applies, so the thermal mass gives reciprocal benefits of summer warmth and winter coolth. Lighter forms of construction have less thermal mass and hence higher heating demand in the winter and overheated homes (or energy input for air conditioning) during the summer.

All this has been known and understood for the last 40 years or more: indeed articles were published in the late 1970s by the Federation of Concrete Specialists identifying these benefits. What is more, the system was shown to work in the late 1970s by Salford City Council in a trial that went largely unknown for more than 30 years. A pair of semi-detached homes and a prototype terrace of six mixed dwellings were built and extensively monitored to the Council's specification. The Salford design recognized from the outset that the thermal storage capacity of a building is largely determined by its internal mass, making

emphasis on the structure and thermal capacity with internal walls of dense concrete blocks and beam-and-block floors, wet-plastered walls and ceilings and sand-cement screeded floors, all encapsulated by a nominal 200mm of insulation.

After the initial trial, 200 houses were built by the Council for socially rented housing and 50 were built by a local developer for the private sector. In short, we have an accumulated experience of 8000+ house years and the results showed substantial energy savings and occupant satisfaction.

The passive design, which incorporates a high thermal capacity from the internal structure protected by a highly insulated, well-sealed envelope, provides a high level of continuous thermal comfort at low cost while being robust, resistant to fire, rot, damp, and mould. Thirty years on, the Salford design has less than 60% of the energy demand of 2010 UK Building regulations and meets 2016 Zero Carbon.

The Salford house is truly an inspirational project that was well ahead of its time. We need to extol the benefit universally so that the next generation of home owners never have to make the choice of heat or eat.

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