Insulation	Published Date: 09/04/2009

The Building Regulations require that all buildings have a minimum specified level of insulation. The usual requirement is for a 'global' insulation value for the whole structure, or at least large areas of it. There are well defined ways of calculating the insulation values of both a complete building, and individual elements of construction. The Architect or a specialist consultant normally carries out the overall designs. Depending on the proportion of windows etc, he will then arrive at a requirement for cladding to satisfy the overall 'average' requirements. It is this 'local' requirement that has to be satisfied, usually by the provision of insulation.

Heat loss through a material depends on its thermal conductivity and thickness. Thermal conductivity can be regarded as the reciprocal of thermal resistance. The units of the various properties are

Thermal conductivity = λ = W/mK (watts/metre degree Kelvin)

Thermal resistance = R = l / λ = m2K/W (l = thickness of element in m)

Thermal transmittance = U = 1/SR = W/m2K

In non-technical terms, λ is the amount of energy lost per m2 for every degree temperature difference. The lower the value, the better the insulation is. Thermal conductivity values are published for most materials including concrete and insulation. From this, and the thicknesses, it is a simple matter to calculate the thermal resistance for each element. These are all added together, including the resistances of surfaces and cavities, and the total is reciprocated to give the 'U' value of the construction. It is this 'U' value which appears in specifications, and which has to be met. Typical specifications call for a 'U' value of 0.35, although tighter environmental requirements mean that values of 0.3 and even 0.2 are becoming more common. To achieve 0.35 on its own, concrete cladding would need to be over 3m thick since it is not a very efficient insulator. Thermally efficient insulation is therefore used to maintain sensible thicknesses.

Heat is transferred in three ways, radiation, conduction and convection. Air is a poor conductor, therefore by trapping air in the right place such as in foam or a mineral wool mat, a layer of poor conductivity is provided. This is because radiation is minimised by the fact that only small spaces exist, conduction can only occur in a solid, of which there is very little, and convection is limited since the air cannot move about.

Commercially available insulations either trap air within a mat of fibres, or trap air/gas in rigid foam. The percentage of trapped air or gas is the main factor in determining the thermal properties.

The usual place to put a layer of insulation is established by default. It cannot go on the outside of the cladding since it would be subject to the weather, as well as being unacceptable visually. It cannot go on the inside face of the wall since it would be visually unacceptable. This means it must go in the space/cavity between the cladding and the inner lining.

It is not critical where in the cavity it goes. However there is an argument that if it is on the outer face of the cavity, then the air in the cavity is on the 'warm side' and less prone to condensation. It is easy to fix foam insulation to the inner face of cladding, either in the factory or on site. Mineral wool insulation is generally incorporated into the inner skin and site fixed by others in case of damage during transport.

An exception to the above is on a shear wall where insulation is fixed to the wall to the wall before cladding. In this case a weather resistant insulation is required. A further exception is a sandwich panel, where the insulation actually forms part of the precast element.