



By Tim Pullen

## Insulation



*The purpose of insulation is to slow down the rate at which heat escapes. The effectiveness of the insulation is stated as a "U-value", being a measurement in Watts (of energy) per square metre of material per degree temperature difference, expressed as  $W/m^2K$ . Therefore the lower the U-value the better the insulation.*

The [Building Regulations](#) set out minimum requirements for all the elements of new buildings. The U-value currently required for a new-build external wall is 0.3. As a comparison, the U-value of a straw-bale wall is 0.13, and of a solid 225mm (9") brick wall, 2.0.



It's worth noting that the Building Regulations currently require a U-value for glazing of 1.8. So when a double-glazing salesman tells you how fantastic double glazing is, suggest a comparison with a solid brick wall, which is never considered to be well insulated!

The U-value of a 9" solid brick wall can be reduce to a quarter (from 2.0 to 0.5) by lining the wall with 40mm (1.5") of insulated plasterboard.

## Materials

There are fundamentally 2 kinds of insulation:

- *Natural*
- *Synthetic*

They are equally effective as insulators (properly used) and the pros and cons are:

<i>Type</i>	<i>Pros</i>	<i>Cons</i>
Natural	Sustainable Non-irritating No "gassing-off" No protective clothing needed No special tools Easily recycled	Relatively expensive
Synthetic	Cheap Readily available	Some are irritants Need protective clothing Non-sustainable High embodied energy Difficult to recycle Gasses-off



Cellulose (left) and wood fibre (right) being installed

What you install is a matter of personal choice. Economically synthetics cannot be beaten – natural insulation is still relatively a cottage industry. Practically, a mix of natural and synthetic can give the best result. Natural materials in the loft, for instance, where you might be a regular visitor and skin irritation may be an issue. Synthetic under floor slab where gassing-off will not be an issue and there is no benefit in the extra expense of natural material (other than saving the world).

## Walls

35% of the heat lost from a building will be through the walls. The Building Regulations call for a maximum U-value of 0.3W/m<sup>2</sup>K in walls. This can be achieved with 90mm of high density foam insulation.

By comparison a Passivhaus wall will achieve a U-value of 0.1 with, typically, 350mm of low density natural insulation – hemp and wood fibre would be common.

## Floor

15% of the heat lost from the building will be through the ground floor.

## Solid Floors

Building Regs call for a U-value of 0.16, which is typically achieved with 100mm of polystyrene insulation. Increasing this to 150mm reduces the U-value to 0.12W/m<sup>2</sup>

## Suspended Floors

Usually insulation is installed between the floor joist, ensuring that the underside of the joist is left exposed. A 200mm mineral (or sheep's) wool will achieve the required U-value.

If you are installing underfloor heating the insulation needs to be on top of the floor slab to prevent the heating system heating the concrete first. With other heating systems the insulation needs to be under the floor slab, to allow the concrete to be used as a thermal mass.

## Roof

25% of the heat lost from the home is through the roof. Building regs call for a maximum U-value of 0.16W/m<sup>2</sup> for pitched roofs which is generally achieved with 270mm of mineral wool (Rockwool, etc.) insulation. The same thickness of sheep's wool, hemp or cellulose would achieve the same U-value.



Stepping up to 450mm would reduce the U-value to 0.08W/m<sup>2</sup> reducing the overall energy consumption (and fuel bill) by 12.5%. If space is an issue then rigid foam insulation (Kingspan, Celotex or similar) will work as well. Around half the thickness will achieve the same U-value, so 225mm will achieve 0.08W/m<sup>2</sup>.

## Multi-foil insulation



Multifoil insulation has been in the news a bit, with all sorts of claims being made as to its efficiency. We can only suggest that these products are approached with caution. The Building Control organisation have determined that they can only be used in conjunction with other materials, and the National Physical Laboratories (who test all building insulation materials) suggest that their U-value is equivalent to around 50mm of mineral wool – not the 200mm claimed by some manufacturers.

## Windows & Doors

Just 10% of the heat lost from the house is via the windows and doors, assuming they have a U-value of 1.8W/m<sup>2</sup>. And yet we will spend more on them than on any other area of the envelope. Remember that standard insulation to a wall will have a U-value of 0.3 and the roof 0.16 so 1.8 is pretty poor in comparison.

A single-glazed window will have a U-value of 5.0W/m<sup>2</sup> and needs dealing with. Replacement double-glazed windows will cost upwards of £10,000 while secondary

double-glazing to single-glazed windows in good repair will cost less than a tenth of that and get a U-value of perhaps  $2.5\text{W/m}^2$ . The renovator's automatic move to replace all those old-fashioned single-glazed windows may not be the smartest move.

### Triple-glazing

Triple-glazing will cost 15% to 20% more than double-glazing and reduce the heat loss by around 5%. It is useful in a super-insulated house where it is the last piece of the jigsaw needed to get the energy consumption below the  $15\text{kW/m}^2$  p.a. mark. Otherwise it is best to leave it alone.