Thermal Conductivity

Thermal Conductivity or 'k' values of typical building materials. The lower the k vlaue the better the material is at resisting heat energy transfer.

Material

k value W/m/K

Relative to foam insulation performance assuming still air and dry conditions

Polyurethane Foam

0.020 100%

Mineral Wool

0.045 44%

Timber

0.15

13%

Plasterboard

0.25

0.08%

Block

0.60

0.03%

Brick

0.80

0.025%

Mortar

0.90

0.022%

Glass

0.90

0.022%

Concrete

1.0

0.020%

Steel

36

0.0006%

The Building Regulations provide minimum standards of thermal insulation, typically expressed as a U value.

A U value of a material can be calculated as U = k/d where k is the thermal conductivity of a material, d the materials depth, the units of U are W/(K•m^2). A U value is simply a guide to the amount of energy lost in Watts per square metre of material for a given temperature difference of 1 degree C or Kelvin from one side of the material to the other.

An R value is the reciprocal of the U value, i.e. R = 1/U with units K•m^2/W in SI units. Also, it should be seen that an R value can be calculated as the depth of a material divided by its thermal conductance, i.e. R = d/k. R values are referred to as the thermal resistance of a material.

Some countries (e.g. United States) use the units of R value as 1 ft^2•°F•h/Btu. 1 R value US is equivalent to 0.1761 R value SI units, or 1 R value SI is equivalent to 5.67446 R value US.

Because of the relative low performance of timber as an insulator, the Building Regulations now regard timber not as a thermal insulator and timber cold bridges need to be taken account of when designing a thermal insulation system. Timber cold bridges need to minimised in the building design and steps taken to insulate the buildings air from potential timber cold bridges that will suck the heat away from the inside of the building.

It should be noted that the comparison between sprayed in place polyurethane foam and mineral wool insulation assumes still and dry air conditions and this assumption favours the performance of mineral wool. Given real world conditions of air movement and moist air, polyurethane foam is largely unaffected in its insulation properties whilst there will be a big negative impact on the performance of mineral wool. Wet mineral wool has no thermal insulation qualities as the material assumes the conductivity of water. High wind conditions and low and high pressure stack effects on a pitched roof with thermal eddies around the pitch do not affect the performance of spray in place rigid polyurethane foam but dramatically reduces the performance of mineral wool. As a rule of thumb, under real world conditions, polyurethane foam is at least 5 times more effective as an insulator than mineral wool. R and U values alone do not adequately reflect this real world rather than laboratory difference.