

Thermal Conductivity

Thermal conductivity is a material property that quantifies the rate of heat transfer through a unit thickness of a material when there is a temperature difference of one degree between its sides. Specifically, it is defined as the amount of heat (in watts) that flows through one square metre of a material that is one metre thick, with a temperature difference of one degree Kelvin (K) or one degree Celsius (°C). It is typically expressed in units of $\text{W m}^{-1} \text{K}^{-1}$.

In the context of building construction and retrofitting, thermal conductivity plays a crucial role in determining the energy efficiency of a building. Materials with low thermal conductivity, such as insulation materials, are essential for reducing heat loss in buildings, thereby improving energy efficiency and comfort.

For instance, in the UK, the use of high-performance insulation materials in loft conversions can significantly reduce heat loss through the roof. A material like expanded polystyrene (EPS) has a thermal conductivity of around $0.035 \text{ W m}^{-1} \text{K}^{-1}$, making it an effective insulator compared to traditional materials like concrete, which may have a thermal conductivity of about $1.5 \text{ W m}^{-1} \text{K}^{-1}$. By choosing materials with lower thermal conductivity for insulation, builders can ensure that the heat generated within homes is retained, leading to lower heating costs and enhanced comfort for occupants.

When retrofitting older properties in the UK, such as Victorian terraced houses, builders often install external wall insulation (EWI) with a low thermal conductivity rating to improve the home's energy efficiency. This not only helps in maintaining a consistent indoor temperature but also contributes to meeting the UK's energy performance standards, such as those outlined in the Energy Efficiency (Private Rented Property) (England and Wales) Regulations.