Insulation

The most efficient strategy of energy saving in buildings is optimisation of heat insulation. Thermal insulation reduces the heat losses due to transmission and is therefore the condition for a low heating energy demand.

The extra insulation can be added from the outside or the inside. Both will have different consequences, e.g. insulation on the outside will change the appearance of the building facade, and insulation on the inside will decrease the living area. In addition, with internal insulation, care must be taken to avoid the risk of condensation in the outer building envelope.

Insulating the roof is a very important measure, which should be given special attention in every building. As warm air goes up, the temperature in the upper air layers of heated rooms is always a bit higher. That is the reason why a lot of heat can be lost through the roof.

The insulation of a steep roof can be implemented in two ways: by insulating the ceiling of the top floor if the attic is not heated and by insulating the roof construction itself in case of a heated attic. If the last mentioned kind of insulating the roof is applied, five constructional principles have to be differentiated: insulation between the rafters, over the rafters, between and over the rafters, between and under the rafters and an insulation lying outside.

It is also important to insulate the cellar. The insulating material can be implemented either on the ceiling of the cellar or under the ceiling of the cellar. In most cases an additional insulation is used to reduce the sound propagation due to subsonic noise. Another aspect to be aware of when isolating is avoiding cold bridges and airtight constructions in order to avoid draught and unnecessary heat losses.

A measure for a material to transmit heat is the heat conductivity (λ), a value that is characteristic for a specific material, independent of the thickness and the integration of the component. The unit of the heat conductivity is therefore W/mK, i. e. it indicates how much heat (W) passes a component of 1 m² with a thickness of 1 m and a temperature difference of 1 Kelvin (K). The lower the heat conductivity of a material is, the better is its efficiency of insulation.
The quantitative heat losses through a component are measured by the coefficient of thermal transfer, the U-value. Similar to the heat conductivity λ it describes the amount of heat that goes through a component of 1 m², when the temperature difference between the inside and the outside is 1 K. Its unit is W/m²K.
Insulating materials are such materials that a characterised by a heat conductivity below 0,1 W/mK. The best available insulating materials have λ-Values of 0,025. However, the materials that are mostly used have λ-values of 0,04 or 0,035. They are fixed as a thermal envelope around the area that should be kept warm. Materials that are on the market have very different consistencies. Only few products are completely made of a single raw material. In general, insulating materials can be differentiated in inorganic and organic raw materials, whereas those can again be partitioned in synthetic and natural materials.

Based on the λ-value, the U-value or heat loss coefficient can be calculated as:

U- value (W/m²c°) = λ- value (W/m c°) / Insulation thickness (m)

Technology	Relevant Indicators	Performance Requirements			Check Systems and standards
		2006 (Present situation)	Goal for next EPBD in 2011	BAT (Best Available Technology)	
Insulation	U-value [W/m²K] External Wall:	I: 0,2-0,6 II: 0,25-0,45 III: 0,15-0,7	I: 0,1-0,6 II: 0,11-0,4 III: 0,1 GR: N/A	I: 0,1-0,2 II: 0,1-0,3 III: 0,1-0,35	EnEV Passivhaus-Institut SAP RATING Building Regs
	Roof:	I: 0,13-0,6 II: 0,2-0,25 III: 0,1-0,5	I: 0,08-0,6 II: 0,11-0,2 III: 0,08-0,1 GR: N/A	I: 0,1-0,12 II:0,1-0,2 III: 0,1-0,4	STYROFOAM NBE-CT 79; UNE 92115/97 for XPS (extruded)
	Floor (ground/ unheated rooms):	I: 0,12-0,6 II: 0,35-0,45 III: 0,2-2 GR: 0,7-3.0	I: 0,09-0,6 II: 0,15-0,4 III: 0,1 GR: N/A	I: 0,12-0,18 II: 0,1-0,3 III: 0,12-1,2	Stamp INCE-AENOR (www.dow.com)