Principle of thermal performance

General

A building that is thermally efficient reduces the amount of energy required to maintain a comfortable living/working environment. Any building with an internal temperature lower than external temperature will gain heat and vice versa. Thermal insulation reduces heat gain/loss and therefore conserves energy. The term thermal insulation can refer either to materials used to reduce the rate of heat transfer, or the methods and processes used to reduce heat transfer. Thermal insulation can keep an enclosed area, such as a building, cool/warm. Optimum level of thermal insulation can be achieved by using cavity construction using gypsum wall and the right insulation. It helps in maintaining an effective ambient temperature.

Key figures

Thermal conductivity (often denoted *k, λ*)
This is a measure of a material's ability to conduct heat, and is expressed as heat flow in watts per metre thickness of material for a temperature gradient of one degree Kelvin (K). It is expressed as W/m.K, materials of high thermal conductivity are widely used in heat sink applications and materials of low thermal conductivity are used as thermal insulation. Generally, dense materials have high thermal conductivity, and are inefficient thermal insulate. Lightweight materials have low conductivity, and can be efficient thermal insulate. The lower the value of a material, the better insulating efficiency it is.

Thermal resistance (R)
Thermal resistance is the ability of a material to resist the flow of heat. This is the measure of the resistance to the passage of heat offered by the thickness of a material and is expressed as $m^2.K/W$. The thermal resistance of a material is obtained by the following calculation:

$$R=\frac{t}{\lambda}$$

t = thickness (m)
λ= thermal conductivity (W/m.K)

Thermal transmittance (U-value)
A third term, thermal transmittance, quantifies the thermal conductance of a structure along with heat transfer due to convection and radiation. It is measured in the same units as thermal conductance, and is sometimes known as the composite thermal conductance. The term U-value is often used. This is a property of whole construction, including air spaces, and is a measure of its ability to transmit heat under steady state conditions. It is calculated by taking the reciprocal of the sum of all the individual thermal resistances, taking into consideration any thermal bridging, and is expressed as $W/m^2.K$. The lower U-value of the element the better thermal insulation it is.

Design standards

QCVN 09:2013/BXD – National Technical Regulation on Energy Efficiency Buildings. All exterior walls (opaque parts of the walls) shall maintain a maximum overall heat transfer value ($U_{o.max}$) no greater, or a minimum overall heat transfer value ($R_{o.min}$) no smaller than the values specified in Table 3.

Table 3 - Thermal performance requirements for exterior walls

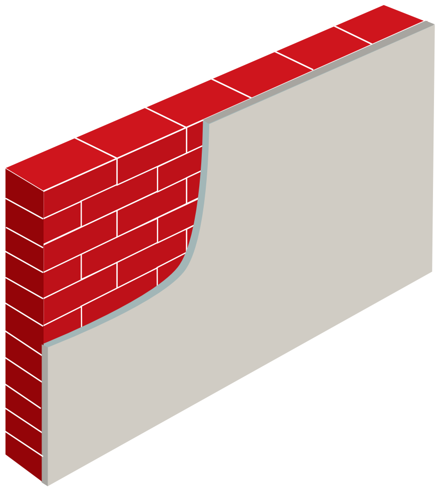
Areas	Wall orientation	$U_{o.max}$ W/m^2.K	$R_{o.min}$, m^2.K/W
All areas	All orientations	1.80	0.56

Source: QCVN 09:2013/BXD

Thermal

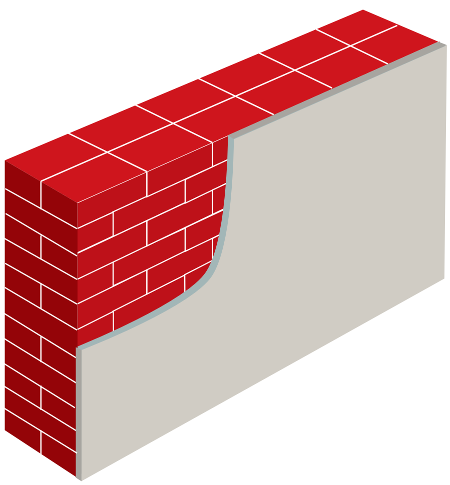
Principle of thermal performance

Thermal performance of typical exterior wall constructions



Brick wall (110mm)
R = 0.32 (m^2.K/W)
U = 3.13 (W/m^2.K)

not meet QCVN 09: 2013/BXD
($U_{o.max}$ 1.8 W/m^2.K)



Brick wall (220mm)
R = 0.474 (m^2.K/W)
U = 2.15 (W/m^2.K)

not meet QCVN 09: 2013/BXD
($U_{o.max}$ 1.8 W/m^2.K)

Brick wall (110mm)+
GypLyner (Gyproc Classic 12.5mm)
R = 0.94(m^2.K/W)
U = 1.06 (W/m^2.K)

meet QCVN 09: 2013/BXD