U values

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U Values

The building envelope is the interface between the interior of the building and the outdoor environment. In most buildings, the envelope, along with the outdoor weather, is the primary determinant of the amount of energy used to heat, cool and ventilate the building.

A U-value (or thermal transmittance) is a measure of the rate at which heat is lost through a wall, roof, floor, door or window. As it is a measure of heat loss then the lower the U-value the better. U-values are measured in Watts / (meter2 * Kelvin) or as is more commonly written W/m2K.

It is the norm for literature relating to construction materials to quote the thermal conductivity (λ – value) of the material. Thermal conductivity is a measure of the rate at which heat passes through a material, and is expressed in units of W/mK.

The Thermal Resistance (R) of a layer of material of a given thickness can be found by dividing the thickness of the layer by the thermal conductivity (λ – value) of the material. Thermal resistance is measured in units of m2K/W

R layer = Thickness / λ

To calculate the U-value of a building element (wall or roof etc.) the thermal resistance of each component is calculated and these thermal resistances, together with surface resistances as appropriate, are then summed to yield the total thermal resistance of the building element. The U-value is then the reciprocal of the total thermal resistance.

U-value = 1 / ΣRlayer

When calculating the U-value of an element it is also necessary to take account of thermal bridging. Thermal bridging occurs when the principal material of the layer is penetrated by another material of different thermal conductivity. This is considered to have created a “thermal bridge” or “short-circuit” through the material.

Part L of the Building Regulations sets minimum standards for U-values both for dwellings and for buildings other than dwellings. The methodology and standards used in both cases are almost identical.

There are a number of methods for calculating the U-value of an element (Roof, walls, floors, doors and windows) namely;

- Manual calculation
- Software programs
- Estimation from tables (provided in an appendix to Part L of the regulations or in the case of existing buildings, default values are given in the DEAP software)

Compliance with Part L of the building regulations must be achieved by two methods;

- Elemental Area Weighted Average U value: The building is assessed element by element and each element must have a U-value within defined limits. These values are the average U values for each element. The main elements are listed here

- Pitched Roof (insulation at ceiling) - 0.16 W/m2K
- Pitched Roof (Insulation on slope) - 0.20 W/m2K
- Flat roof - 0.22 W/m2K
- Walls 0.27 W/m2K
- Ground Floor - 0.25 W/m2K
- Doors, windows, Roof-lights - 2.00 W/m2K

- Average Elemental U Value : In addition to the above no element or section of element should exceed the following U values:

- Roofs - 0.3 W/m2K
- Walls - 0.6 W/m2K
- Ground Floors - 0.6 W/m2K
- External doors, windows & roof lights - 2.6 W/m2K

- The U Value of the windows, doors and roof lights can vary according to the percentage floor area, see the table below to determine if the U values are in compliance with the regulations.

Table 2 **Permitted variation in combined areas (A_{ope}) and average U-values (U_{ope}) of external doors, windows and rooflights**

Average U-value of windows, doors and rooflights (Uope) (W/m^2 K)	Maximum combined area of external doors, windows and rooflights (A_{ope}), expressed as % of floor area (A_f)
1.0	59.2
1.2	46.5
1.4	38.3
1.6	32.5
1.7	30.2
1.8	28.3
1.9	26.5
2.0	**25.0**
2.1	22.4
2.2	22.4
2.3	21.3
2.4	20.3
2.6	18.6

NOTE : Intermediate values of "combined areas" or of "U-values" may be estimated by interpolation in the above Table. Alternatively the following expression may be used to calculate the appropriate value:

$Aope/A_f = 0.4325/(U_{ope} - 0.27)$.

This expression may also be used to calculate appropriate values outside the range covered by the Table.

The DEAP methodology uses U-values to determine the "Heat Loss Parameter" (HLP) for the dwelling. The HLP is in turn used to calculate the Building Energy Rating (BER) for the dwelling.

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