Part 6.C U-values of ground floors and basements

part

6.C

U-values of ground floors and basements

6.C.0 Introduction

Insulation not necessary

For new *buildings* a ground floor should not have a *U-value* exceeding 0.25 W/m^{2}K, This may only be achieved without the need for insulation if the perimeter to area ratio is less than 0.12 m/m^2 for solid ground floors or less than 0.09 m/m^2 for suspended floors. However, some ground floor insulation will be needed for the majority of *buildings*. For basement floors the *U-value* should also not exceed 0.25 W/m^{2}K and for basement walls it is 0.25 W/m ^{2}K for domestic/0.30 W/m^{2}K for non-domestic. For upper exposed floors and for floors over unheated spaces the reader is referred to Part 6.B.

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Full details about how to calculate the *U-value* of a ground floor, a basement floor or a basement wall are given in BS EN ISO 13370 and in CIBSE Guide A Section 3 (2006 edition). This Part gives a summary of how to determine the *U-value* which will suffice for most common *constructions*.

Soil type

For ground floors and basements the *U-value* depends upon the type of soil beneath the *building*. Where the soil type is unknown, clay soil should be assumed as this is the most typical soil type in the UK. The tables which follow refer to this soil type. Where the soil is not clay or silt, the *U-value* should be calculated using the procedure in BS EN ISO 13370.

Calculation of areas

Extensions

Floor dimensions should be measured in accordance with clause 6.0.11. In the case of semi-detached or terraced premises, for example blocks of *flats,* a row of industrial units' and similar, the floor dimensions can either be taken as those of the *buildings* themselves, or of the whole *building*. When considering extensions to existing *buildings* the floor dimensions may be taken as those of the complete *building* including the extension.

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Care should be taken to avoid thermal bridging at the floor edge. See BRE Report BR262 "Thermal insulation: avoiding risks" and 'Accredited Construction Details (Scotland)'.

Areas outwith the *insulation envelope*

Unheated spaces outside the insulated fabric, such as attached garages or porches, should be excluded when determining the perimeter and area but the length of the wall between the heated *building* and the unheated space should be included when determining the perimeter.

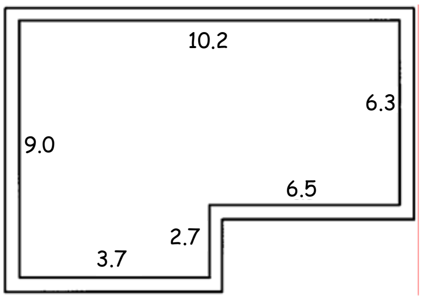
Interpolation

The following tables have been derived from BS EN ISO 13370. For the purposes of Section 6 it will be sufficient to derive the *U-values* from the tables using linear interpolation where appropriate.

6.C.1 Example of how to obtain *U-values* from the tables

The following example shows how to use Table 1 for a solid ground floor and serves as an illustration of how to use the tables supplied in this Part, interpolating between appropriate rows or columns.

A proposed *building* has a perimeter of 38.4 m and a ground floor area of 74.25 m^2. The floor *construction* consists of a 150 mm concrete slab, 80 mm of rigid insulation (thermal conductivity 0.025 W/mK) and a 65 mm screed. Only the insulation layer is included in the calculation of the thermal resistance.



The perimeter to area ratio is equal to 38.4 ÷ 74.25 = 0.517 m/m^2. Table 1 gives values for perimeter/area ratios of 0.50 and 0.55 but not for any values between 0.50 and 0.55. In this case, the *U-value* corresponding to a perimeter to area ratio of 0.50 should be used since 0.517 is closer to 0.50 than to 0.55.

The thermal resistance of the insulation is obtained by dividing the thickness (in metres) by the conductivity. The resistance is then 0.080 ÷ 0.025 = 3.2 m^2K/W.

Extract from the relevant part of Table 1 is shown below:

	Thermal resistance (m^2K/W)	
Perimeter/Area	**3.0**	**3.5**
0.50	0.22	0.19

The *U-value* corresponding to a thermal resistance of 3.2 m^2K/W is obtained by linear interpolation as below:

$$U = 0.22 \times \frac{3.5 - 3.2}{3.5 - 3.0} + 0.19 \times \frac{3.2 - 3.0}{3.5 - 3.0}$$

$$= 0.22 \times 0.6 + 0.19 \times 0.4$$

$$= 0.208 W / m^2 K$$

In the example for Table 1 the appropriate row was chosen and interpolation was carried out between the appropriate columns. For all of the other tables, however, the appropriate column in the table should be selected and interpolation should be carried out between the appropriate rows.

Ground floors with all-over insulation or no insulation

6.C.2 Solid ground floors

Solid ground floors are taken to mean ground floors in which there is no significant air layer separating the *building* from the ground. Listed in the table below are *U-values* for solid ground floors. *U-values* are given in the following table for various perimeter-to-area (P/A) ratios for a range of insulation levels. Where the floor is uninsulated the column corresponding to a thermal resistance of 0 should be used.

Table 1: *U-values* for solid ground floors (W/m²K)

	Thermal resistance of all-over insulation (m²K/W)								
Perimeter/Area	**0.0**	**0.5**	**1.0**	**1.5**	**2.0**	**2.5**	**3.0**	**3.5**	**4.0**
0.05	0.13	0.11	0.10	0.09	0.08	0.08	0.07	0.07	0.07
0.10	0.22	0.18	0.16	0.14	0.13	0.12	0.11	0.11	0.10
0.15	0.30	0.24	0.21	0.18	0.17	0.15	0.14	0.13	0.12
0.20	0.37	0.29	0.25	0.22	0.19	0.18	0.16	0.15	0.14
0.25	0.44	0.34	0.28	0.24	0.22	0.19	0.18	0.16	0.15
0.30	0.49	0.38	0.31	0.27	0.23	0.21	0.19	0.17	0.16
0.35	0.55	0.41	0.34	0.29	0.25	0.22	0.20	0.18	0.16
0.40	0.60	0.44	0.36	0.30	0.26	0.23	0.20	0.18	0.17
0.45	0.65	0.47	0.38	0.32	0.27	0.23	0.21	0.19	0.17
0.50	0.70	0.50	0.40	0.33	0.28	0.24	0.22	0.19	0.18
0.55	N/A	0.52	0.41	0.34	0.28	0.25	0.22	0.20	0.18
0.60	N/A	0.55	0.43	0.35	0.29	0.25	0.23	0.20	0.18
0.65	N/A	0.57	0.44	0.35	0.30	0.26	0.23	0.21	0.19
0.70	N/A	0.59	0.45	0.36	0.30	0.26	0.23	0.21	0.19
0.75	N/A	0.61	0.46	0.37	0.31	0.27	0.24	0.21	0.19
0.80	N/A	0.62	0.47	0.37	0.32	0.27	0.24	0.21	0.19
0.85	N/A	0.64	0.47	0.38	0.32	0.28	0.24	0.22	0.20
0.90	N/A	0.65	0.48	0.39	0.32	0.28	0.24	0.22	0.20
0.95	N/A	0.66	0.49	0.39	0.33	0.28	0.25	0.22	0.20
1.00	N/A	0.68	0.50	0.40	0.33	0.28	0.25	0.22	0.20

Note:

As an alternative to the above table, the methods described in BS EN ISO 13370 may be used.

Ground floors with edge insulation

Where horizontal or vertical edge insulation is used instead of all-over floor insulation, the *U-value* of the uninsulated floor (obtained from the column corresponding to thermal resistance of 0 in Table 1) is adjusted by adding $\Psi \times P/A$ to account for the effects of edge insulation, where P/A is the perimeter (m) to area (m^2) ratio and Ψ is the edge insulation factor obtained from either Table 2 or 3 below. As $\Psi \times P/A$ is negative, the effect of this addition will be a reduction in the *U-value*.

Table 2: Edge insulation factor (Ψ) for horizontal edge insulation

Insulation width (m)	Thermal resistance of insulation (m^2K/W) **0.5**	**1.0**	**1.5**	**2.0**	**2.5**	**3.0**
0.5	-0.13	-0.18	-0.21	-0.22	-0.23	-0.24
1.0	-0.20	-0.27	-0.32	-0.34	-0.36	-0.37
1.5	-0.23	-0.33	-0.39	-0.42	-0.45	-0.46

Table 3: Edge insulation factor (Ψ) for vertical edge insulation

Insulation depth (m)	Thermal resistance of insulation (m^2K/W) **0.5**	**1.0**	**1.5**	**2.0**	**2.5**	**3.0**
0.25	-0.13	-0.18	-0.21	-0.22	-0.23	-0.24
0.50	-0.20	-0.27	-0.32	-0.34	-0.36	-0.37
0.75	-0.23	-0.33	-0.39	-0.42	-0.45	-0.46
1.00	-0.26	-0.37	-0.43	-0.48	-0.51	-0.53

Note:
When floors incorporate both all-over and edge insulation, the procedure in BS EN ISO 13370 may be used.

6.C.3 Suspended ground floors

Ground floors with no insulation

The following table gives *U-values* of uninsulated suspended floors for various perimeter to area ratios and for two levels of ventilation (expressed in m^2/m) below the floor deck. The data applies to a floor deck at a height of not more than 0.5 m above the external ground level where the wall surrounding the underfloor space is uninsulated.

Table 4: *U-values* of uninsulated suspended floors

Perimeter to area ratio	Ventilation opening area per unit perimeter of underfloor space (m^2/m)	
	0.0015 m^2/m	**0.0030 m^2/m**
0.05	0.15	0.15
0.10	0.25	0.26
0.15	0.33	0.35
0.20	0.40	0.42
0.25	0.46	0.48
0.30	0.51	0.53
0.35	0.55	0.58
0.40	0.59	0.62
0.45	0.63	0.66
0.50	0.66	0.70
0.55	0.69	0.73
0.60	0.72	0.76
0.65	0.75	0.79
0.70	0.77	0.81
0.75	0.80	0.84
0.80	0.82	0.86
0.85	0.84	0.88
0.90	0.86	0.90
0.95	0.88	0.92
1.00	0.89	0.93

Note: As an alternative to the above table, the methods described in BS EN ISO 13370 may be used.

Suspended floors with insulation

The *U-value* of an insulated suspended floor can be calculated using:

$$U = 1 / [(1/U_0) - 0.2 + R_f]$$

where U_0 is the *U-value* of an uninsulated suspended floor obtained from Table 4, above or another approved method. R_f, the thermal resistance of the floor deck, is determined from U_f, the *U-value* of the floor deck, where:

$$R_f = \frac{1}{U_f} - 0.17 - 0.17$$

and where U_f is calculated using the Combined Method, as described in BS EN ISO 6946, assuming thermal resistances of 0.17 m^2K/W for both the upper and lower surfaces of the floor deck.

6.C.4 Basement floors

Basement floors with no insulation

The *U-value* of an uninsulated basement floor should be calculated by using Table 5 below, or the methods described in BS EN ISO 13370.

Table 5: *U-values* of uninsulated basement floors

Perimeter to area ratio	Basement depth (m)				
	0.5	**1**	**1.5**	**2**	**2.5**
0.1	0.20	0.19	0.18	0.17	0.16
0.2	0.34	0.31	0.29	0.27	0.26
0.3	0.44	0.41	0.38	0.35	0.33
0.4	0.53	0.48	0.44	0.41	0.38
0.5	0.61	0.55	0.50	0.46	0.43
0.6	0.68	0.61	0.55	0.50	0.46
0.7	0.74	0.65	0.59	0.53	0.49
0.8	0.79	0.70	0.62	0.56	0.51
0.9	0.84	0.73	0.65	0.58	0.53
1.0	0.89	0.77	0.68	0.60	0.54

Basement floors with insulation

Determine the *U-value* of an insulated basement floor from:

$U = 1 / [(1/U_0) + R_{ins}]$

where U_0 is the *U-value* determined from Table 5 (or other approved method) for uninsulated basements and R_{ins} is the thermal resistance of the insulation in m^2K/W. The value of R_{ins} may be calculated from the thickness of the insulation (in metres) divided by its conductivity (in W/m·K).

6.C.5 Basement walls

Table 6 below gives the *U-value* of a basement wall for a given basement depth and basement wall resistance.

Table 6: *U-values* of basement walls

Basement wall resistance (m^2K/W)	Basement depth (m)				
	0.5	**1**	**1.5**	**2**	**2.5**
0.2	1.55	1.16	0.95	0.81	0.71
0.5	0.98	0.78	0.66	0.58	0.52
1.0	0.61	0.51	0.45	0.40	0.37
2.0	0.35	0.30	0.27	0.25	0.24
2.5	0.28	0.25	0.23	0.21	0.20