Part
6.A Tables of U-values and thermal conductivity

Part

6.A

Tables of U-values and thermal conductivity

6.A.0 Introduction

The *U-value* tables in this Part give a “ready reckoner” approach to establishing the *U-values* of *construction* elements. It applies to all building types. If the designer considers that a more accurate calculation is appropriate for the design of the *building* then, for roofs, walls and floors, the procedures in Parts 6.B and 6.C can be used. When using the *U-value* tables, the following should be borne in mind:

a. the values in these tables have been derived using the Combined Method, taking into account the effects of thermal bridging where appropriate;

b. intermediate values can be obtained from the tables by linear interpolation.

The last table of this Part gives thermal conductivities of some common *building* materials. If however certified test values are available, these should be used in preference to those given in the table.

Windows, rooflights and doors

Full details about calculating the *U-value* of a window or door are given in BS EN ISO 10077-1. This Part provides indicative *U-values* for windows, rooflights and doors. Table 6.A.1 applies to windows (and rooflights) with wood or plastic frames. Table 6.A.2 applies to windows with metal frames, for which the adjustments (for thermal breaks and/or rooflights) in Table 6.A.3 should be applied.

Low-E coatings

The *U-value* of a window or rooflight containing low-E *glazing* is influenced by the emissivity, ε_n, of the low-E coating. Low-E coatings are of two principal types, known as 'hard' and 'soft'. Hard coatings generally have emissivities in the range 0.15 to 0.2, and the data for ε_n = 0.2 should be used for hard coatings, if the emissivity is not specified or if the *glazing* is stated to be low-E but the type of coating is not specified. Soft coatings generally have emissivities in the range 0.05 to 0.1. The data for ε_n = 0.1 should be used for a soft coating if the emissivity is not specified.

When available, manufacturers' *U-values*, certified by a *notified body*, for windows, or rooflights or doors should be used in preference to the data given in these tables.

Table 6.A.1: Indicative *U-values* (W/m²K) for windows, rooflights, doors with wood or plastic frames [1]

	Gap between panes			Adjustment for rooflights [Note 5]
	6 mm	12 mm	16 mm or more	
Double-glazing (air filled)	3.1	2.8	2.7	
Double-glazing (low-E, ε_n = 0.2, air filled) [Note 2]	2.7	2.3	2.1	
Double-glazing (low-E, ε_n = 0.15, air filled)	2.7	2.2	2.0	
Double-glazing (low-E, ε_n = 0.1, air filled)	2.6	2.1	1.9	
Double-glazing (low-E, ε_n = 0.05, air filled)	2.6	2.0	1.8	
Double-glazing (argon filled) [Note 3]	2.9	2.7	2.6	
Double-glazing (low-E, ε_n = 0.2, argon filled)	2.5	2.1	2.0	
Double-glazing (low-E, ε_n = 0.15, argon filled)	2.4	2.0	1.9	
Double-glazing (low-E, ε_n = 0.1, argon filled)	2.3	1.9	1.8	
Double-glazing (low-E, ε_n = 0.05, argon filled)	2.3	1.8	1.7	
Triple-glazing (air filled)	2.4	2.1	2.0	
Triple-glazing (low-E, ε_n = 0.2, air filled)	2.1	1.7	1.6	
Triple-glazing (low-E, ε_n = 0.15, air filled)	2.1	1.7	1.6	
Triple-glazing (low-E, ε_n = 0.1, air filled)	2.0	1.6	1.5	
Triple-glazing (low-E, ε_n = 0.05, air filled)	1.9	1.5	1.4	
Triple-glazing (argon filled)	2.2	2.0	1.9	
Triple-glazing (low-E, ε_n = 0.2, argon filled)	1.9	1.6	1.5	
Triple-glazing (low-E, ε_n = 0.15, argon filled)	1.8	1.5	1.4	
Triple-glazing (low-E, ε_n = 0.1, argon filled)	1.8	1.5	1.4	
Triple-glazing (low-E, ε_n = 0.05, argon filled)	1.7	1.4	1.3	
Solid wooden door [Note 4] 3.0				N/A

Notes:

1. The *U-values* in this table are based on the frame comprising 30% of the total window area.
2. The emissivities quoted are normal emissivities. (Corrected emissivity is used in the calculation of *glazing U-values*.) Uncoated glass is assumed to have a normal emissivity of 0.89.
3. The gas mixture is assumed to consist of 90% argon and 10% air.
4. For doors which are half-glazed the *U-value* of the door is the average of the appropriate window *U-value* and that of the non-glazed part of the door (e.g. 3.0 W/m²K for a wooden door).
5. For roof lights refer to table 6A3

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Table 6.A.2: Indicative *U-values* (W/m²K) for windows with metal frames (4 mm thermal break) [Notes 1 and 2]

	gap between panes		
	6 mm	12 mm	16 mm or more
Double-glazing (air filled)	N/A	N/A	3.3
Double-glazing (low-E, ε_n = 0.2)	3.3	2.8	2.6
Double-glazing (low-E, ε_n = 0.15)	3.3	2.7	2.5
Double-glazing (low-E, ε_n = 0.1)	3.2	2.6	2.4
Double-glazing (low-E, ε_n = 0.05)	3.2	2.5	2.3
Double-glazing (argon filled)	3.5	3.3	3.2
Double-glazing (low-E, ε_n = 0.2,argon filled)	3.0	2.6	2.5
Double-glazing (low-E, ε_n = 0.15,argon filled)	3.0	2.5	2.4
Double-glazing (low-E, ε_n = 0.1, argon filled)	2.9	2.4	2.3
Double-glazing (low-E, ε_n = 0.05, argon filled)	2.8	2.2	2.1
Triple-glazing (air filled)	2.9	2.6	2.5
Triple-glazing (low-E, ε_n = 0.2)	2.6	2.1	2.0
Triple-glazing (low-E, ε_n = 0.15)	2.5	2.1	2.0
Triple-glazing (low-E, ε_n = 0.1)	2.5	2.0	1.9
Triple-glazing (low-E, ϵ_n = 0.05)	2.4	1.9	1.8
Triple-glazing (argon-filled)	2.8	2.5	2.4
Triple-glazing (low-E, ε_n = 0.2, argon filled)	2.3	2.0	1.9
Triple-glazing (low-E, ε_n = 0.15, argon filled)	2.3	1.9	1.8
Triple-glazing (low-E, ε_n = 0.1, argon filled)	2.2	1.9	1.8
Triple-glazing (low-E, ε_n = 0.05, argon filled)	2.2	1.8	1.7

Notes:

1. The *U-values* in this table are based on the frame comprising 20% of the total window area.
2. For windows with metal frames incorporating a thermal break or rooflights , the adjustments given in Table 6.A.3 should be made to the *U-values* given in Table 6.A.2.

Table 6.A.3: Adjustments to *U-values* in Table 6.A.2 for frames with thermal breaks

	vertical window	roof window at 45°		horizontal rooflight	
Frame type	**double or triple glazed**	**double glazed**	**triple glazed**	**double glazed**	**triple glazed**
Wood or PVC-U frame	+ 0.0	+ 0.2	+ 0.2	+ 0.5	+ 0.3
Metal, 4 mm thermal break	+ 0.0	+ 0.3	+ 0.2	+ 0.5	+ 0.3
Metal, 8 mm thermal break	- 0.1	+ 0.2	+ 0.1	+ 0.4	+ 0.2
Metal, 12 mm thermal break	- 0.2	+ 0.1	+ 0.0	+ 0.3	+ 0.1
Metal, 16 mm thermal break	- 0.2	+ 0.1	+ 0.0	+ 0.3	+ 0.1
Metal, 20 mm thermal break	- 0.3	+ 0.0	- 0.1	+ 0.2	+ 0.0
Metal, 32 mm thermal break	- 0.4	- 0.1	- 0.2	+ 0.1	- 0.1

Roofs

Table 6.A.4: Base thickness of insulation between ceiling ties/collars or rafters

	Design *U-value* (W/m^2K)	Thermal conductivity of insulant (W/m·K)					
		0.020	**0.025**	**0.030**	**0.035**	**0.040**	**0.045**
		Base thickness of insulating material (mm)					
	A	**B**	**C**	**D**	**E**	**F**	**G**
1	0.15	371	464	557	649	742	835
2	0.20	180	224	269	314	359	404
3	0.25	118	148	178	207	237	266
4	0.30	92	110	132	154	176	198
5	0.35	77	91	105	122	140	157

Table 6.A.5: Base thickness of insulation between and over ceiling ties/collars or rafters

	Design *U-value* (W/m^2K)	Thermal conductivity of insulant (W/m·K)					
		0.020	**0.025**	**0.030**	**0.035**	**0.040**	**0.045**
		Base thickness of insulating material (mm) between and over ties/collars or rafters					
	A	**B**	**C**	**D**	**E**	**F**	**G**
1	0.10	228	272	317	363	410	457
2	0.15	161	188	217	247	277	307
3	0.20	128	147	167	188	210	232
4	0.25	108	122	137	153	170	187
5	0.30	92	105	117	130	143	157
6	0.35	77	91	103	113	124	136

Note:
Tables 6.A.4 and 6.A.5 are derived for roofs with the proportion of timber at 8%, corresponding to 48 mm wide 100mm deep timbers at 600 mm centres, excluding dwangs. For other proportions of timber the *U-value* can be calculated using the procedure in Part 6.B.

Table 6.A.6: Base thickness for continuous insulation

	Design *U-value* (W/m^2K)	Thermal conductivity of insulant (W/m·K)					
		0.020	**0.025**	**0.030**	**0.035**	**0.040**	**0.045**
		Base thickness of insulating material (mm)					
	A	B	C	D	E	F	G
1	0.10	197	247	296	345	394	444
2	0.15	131	163	196	228	261	294
3	0.20	97	122	146	170	194	219
4	0.25	77	97	116	135	154	174
5	0.30	64	80	96	112	128	144
6	0.35	54	68	82	95	109	122

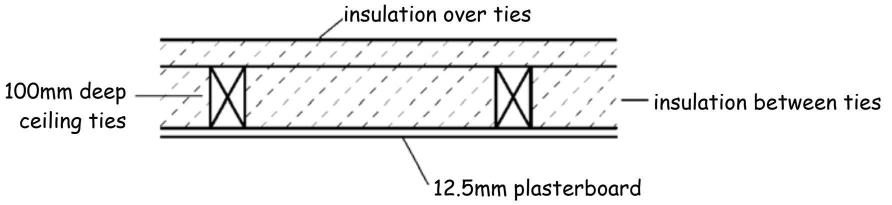
Table 6.A.7: Allowable reductions in thickness for common roof components

	Concrete slab density (kg/m³)	Thermal conductivity of insulant (W/m·K)					
		0.020	0.025	0.030	0.035	0.040	0.045
		Reduction in base thickness of insulating material (mm) for each 100 mm of concrete slab					
	A	B	C	D	E	F	G
1	600	10	13	15	18	20	23
2	800	7	9	11	13	14	16
3	1100	5	6	8	9	10	11
4	1300	4	5	6	7	8	9
5	1700	2	2	3	3	4	4
6	2100	1	2	2	2	3	3
	Other materials and components	**Reduction in base thickness of insulating material (mm)**					
	A	B	C	D	E	F	G
7	9.5 mm plasterboard	1	2	2	2	3	3
8	12.5 mm plasterboard	2	2	2	3	3	4
9	13 mm sarking board	2	2	3	3	4	4
10	12 mm calcium silicate liner board	1	2	2	2	3	3
11	*Roof space* (pitched)	4	5	6	7	8	9
12	*Roof space* (flat)	3	4	5	6	6	7
13	19 mm roof tiles	0	1	1	1	1	1
14	19 mm asphalt (or 3 layers of felt)	1	1	1	1	2	2
15	50 mm screed	2	3	4	4	5	5

Example 1

Pitched roof with insulation between and over ceiling ties/collars

Determine the thickness of the insulation layer above the ceiling ties that will achieve a *U-value* of 0.16 W/m²K for the roof *construction* shown below:



It is proposed to use mineral fibre insulation between and over the ties with a thermal conductivity of 0.040 W/m·K. Using Table 6.A.5:

From **column F, row 2** of the table, the base thickness of insulation layer is **277 mm**.

The base thickness may be reduced by taking account of the other materials as follows:

From Table 6.A.7:

19 mm roof tiles	**column F, row 13**	= 1 mm
Roof space (pitched)	**column F, row 11**	= 8 mm
12.5 mm plasterboard	**column F, row 8**	= 3 mm
Total reduction		= **12 mm**

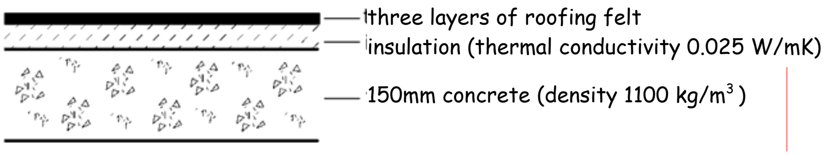
To achieve a *U-value* of 0.16 W/m^{2}K the minimum thickness of the insulation layer over the joists, in addition to the 100 mm insulation between the joists, is therefore:

Base thickness less **total reduction** i.e. 277 - 100 - 12 = **165 mm**.

Example 2

Concrete deck roof

Determine the thickness of the insulation layer that will achieve a *U-value* of 0.20 W/m²K for the roof *construction* shown below.



Using Table 6.A.6:

From **column C, row 3** of the table, the base thickness of the insulation layer is **122 mm**.

The base thickness may be reduced by taking account of the other materials as follows:

From Table 6.A.7:

3 layers of felt	**column C, row 14**	= 1 mm
150 mm concrete deck	**column C, row 3**	
adjusted for 150 mm thickness (1.5 x 6)		= 9mm
Total reduction		= **10 mm**

To achieve a *U-value* of 0.25 W/m^{2}K, the minimum thickness of the insulation layer is therefore:

Base thickness less **total reduction** i.e. 122 - 10= **112 mm**.

Walls

Table 6.A.8: Base thickness of insulation layer

	Design *U-value* (W/m^2K)	Thermal conductivity of insulant (W/m·K)					
		0.020	**0.025**	**0.030**	**0.035**	**0.040**	**0.045**
		Base thickness of insulating material (mm)					
	A	**B**	**C**	**D**	**E**	**F**	**G**
1	0.15	130	162	195	227	260	292
2	0.20	97	121	145	169	193	217
3	0.25	77	96	115	134	153	172
4	0.30	63	79	95	111	127	142
5	0.35	54	67	81	94	107	121
6	0.40	47	58	70	82	93	105
7	0.45	41	51	62	72	82	92

Table 6.A.9: Allowable reductions in base thickness for common components

	Component	Thermal conductivity of insulant (W/m·K)					
		0.020	**0.025**	**0.030**	**0.035**	**0.040**	**0.045**
		Reduction in base thickness of insulating material (mm)					
	A	**B**	**C**	**D**	**E**	**F**	**G**
1	Cavity (25 mm or greater)	4	5	5	6	7	8
2	Outer leaf brick	3	3	4	5	5	6
3	13 mm plaster	1	1	1	1	1	1
4	13 mm lightweight plaster	2	2	2	3	3	4
5	9.5 mm plasterboard	1	2	2	2	3	3
6	12.5 mm plasterboard	2	2	2	3	3	4
7	Air space behind plasterboard dry lining	2	3	4	4	5	5
8	9 mm sheathing ply	1	2	2	2	3	3
9	20 mm cement render	1	1	1	1	2	2
10	13 mm tile hanging	0	0	0	1	1	1

Example 2

Table 6.A.10: Allowable reductions in base thickness for concrete components

	Density (Kg/m³)	Thermal conductivity of insulant (W/m·K)					
		0.020	0.025	0.030	0.035	0.040	0.045
		Reduction in base thickness of insulation (mm) for each 100 mm of concrete					
	A	**B**	**C**	**D**	**E**	**F**	**G**
Concrete inner leaf							
1	600	9	11	13	15	17	20
2	800	7	9	10	12	14	16
3	1000	5	6	8	9	10	11
4	1200	4	5	6	7	8	9
5	1400	3	4	5	6	7	8
6	1600	3	3	4	5	6	6
7	1800	2	2	3	3	4	4
8	2000	2	2	2	3	3	3
9	2400	1	1	2	2	2	2
Concrete outer leaf or single leaf wall							
10	600	8	11	13	15	17	19
11	800	7	9	10	12	14	15
12	1000	5	6	7	8	10	11
13	1200	4	5	6	7	8	9
14	1400	3	4	5	6	6	7
15	1600	3	3	4	5	5	6
16	1800	2	2	3	3	3	4
17	2000	1	2	2	3	3	3
18	2400	1	1	2	2	2	2

Table 6.A.11: Allowable reductions in base thickness for insulated timber framed walls

	Thermal conductivity of insulation within frame (W/m·K)	Thermal conductivity of insulant (W/m·K)					
		0.020	0.025	0.030	0.035	0.040	0.045
		Reduction in base thickness of insulation material (mm) for each 100 mm of frame					
	A	**B**	**C**	**D**	**E**	**F**	**G**
0	0.020	53	66	79	92	105	118
1	0.025	47	59	71	83	95	107
2	0.030	43	54	65	75	86	97
3	0.035	39	49	59	69	79	89
4	0.040	36	45	55	64	73	82

Note:
The table above is derived for walls in which the proportion of timber is 15%, and this corresponds to 38 mm wide studs at 600 mm centres (see BR 443). For other proportions of timber the *U-value* can be calculated using the procedure in Part 6.B.

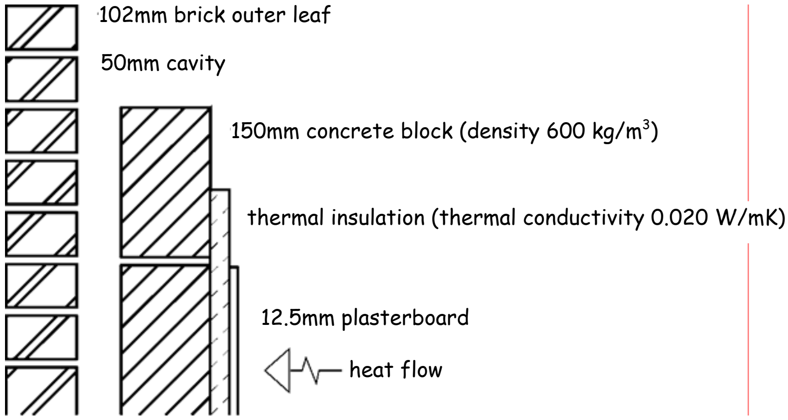
Multiply the values in the table by stud thickness ÷ 100mm

Example 3

Masonry cavity wall with internal insulation

(For *buildings* where sound resisting *separating floors* and *separating walls* are provided, this *construction* may not provide appropriate resistance to flanking sound transmission)

Determine the thickness of the insulation layer that will achieve a *U-value* of 0.25 W/m^{2}K for the wall *construction* shown below.



Using Table 6.A.8:

From **column B row 3** of the table, the base thickness of the insulation layer is **77 mm**.

The base thickness may be reduced by taking account of the other materials as follows:

From Table 6.A.9:

Brick outer leaf	**column B, row 2**	= 3 mm
Cavity	**column B, row 1**	= 4 mm
Plasterboard	**column B, row 6**	= 2 mm

And from table 6.A.10

Concrete block	**column B, row 1**	
adjusted for 150 mm block thickness (1.5 x 9)		= 13.5 mm
Total reduction		= **22.5 mm**

To achieve a *U-value* of 0.25 W/m²K, the minimum thickness of the insulation layer is therefore:

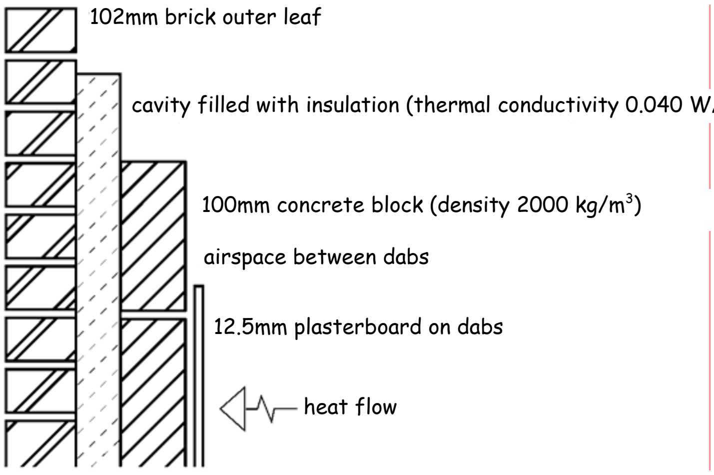
Base thickness less **total reduction** i.e. 77 – 22.5 = **54.5 mm**

Example 3

Example 4

Masonry cavity wall filled with insulation with plasterboard on dabs

Determine the thickness of the insulation layer that will achieve a *U-value* of 0.25 W/m²K for the wall *construction* shown below. (This calculation assumes the effect of wall ties to be negligible).



Using Table 6.A.8:

From **column F, row 3** of the table, the base thickness of the insulation layer is **153 mm**.

The base thickness may be reduced by taking account of the other materials as follows:

From Table 6.A.9:

Brick outer leaf	**column F, row 2**	= 5 mm
Plasterboard	**column F, row 6**	= 3 mm
Air space behind plasterboard	**column F, row 7**	= 5 mm

And from Table 6.A.10:

Concrete block	**column F, row 8**	= 3 mm
Total reduction		= **16 mm**

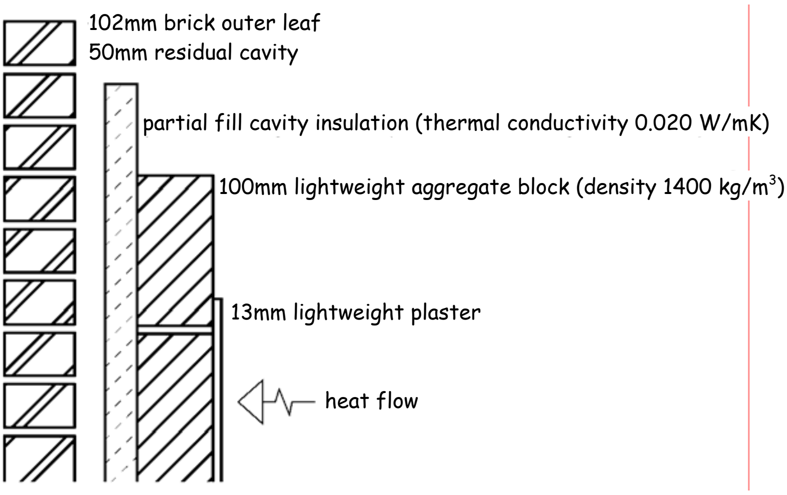
To achieve a *U-value* of 0.25 W/m²K the minimum thickness of the insulation layer is therefore:

Base thickness less **total reduction** i.e. 153 – 16 = **137 mm**

Example 5

Masonry wall with partial cavity-fill

Determine the thickness of the insulation layer that will achieve a *U-value* of 0.25 W/m^{2}K for the wall *construction* shown below.



Using Table 6.A.8:

From **column B row 3** of the table, the base thickness of the insulation layer is **77 mm**.

The base thickness may be reduced by taking account of the other materials as follows:

From Table 6.A.9:

Brick outer leaf	**column B, row 2**	= 3 mm
Cavity	**column B, row 1**	= 4 mm
Lightweight plaster	**column B, row 4**	= 2 mm

And from Table 6.A.10:

Concrete block	**column B, row 5**	= 3 mm
Total reduction		= **12 mm**

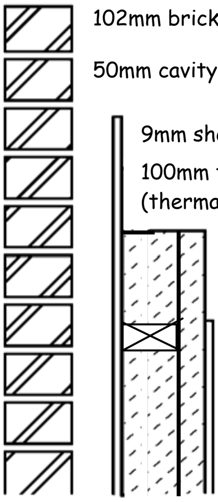
To achieve a *U-value* of 0.25 W/m²K, the minimum thickness of the insulation layer is therefore:

Base thickness less **total reduction** i.e. 77 – 12 = **65 mm**

Example 6a

Timber-frame wall

Determine the thickness of the internal insulation layer that will achieve a *U-value* of 0.25 W/m²K for the wall *construction* shown below. (Note this *construction* may be inappropriate where the wall should have a level of fire resistance.)



Using Table 6.A.8:

From **column C, row 3** of the table, the base thickness of the internal insulation layer is **96 mm**.

The base thickness may be reduced by taking account of the other materials as follows:

From Table 6.A.9:

Brick outer leaf	**column C, row 2**	= 3 mm
Cavity	**column C, row 1**	= 5 mm
Sheathing ply	**column C, row 8**	= 2 mm
Plasterboard	**column C, row 6**	= 2 mm

And from Table 6.A.11:

Timber frame **column C, row 1**
(not necessary to adjust as is 100mm thick frame) =59 mm
Total reduction = **71 mm**

To achieve a *U-value* of 0.25 W/m²K the minimum thickness of the internal insulation layer is therefore:

Base thickness less **total reduction** i.e. 96 – 71 = **25 mm**

Alternative version of example 6:-

Example 6b

Determine the thickness of the cavity (or internal) insulation that will achieve a *U-value* of 0.25 W/m^{2}K for the wall construction shown, with insulation of conductivity 0.025 W/m·K between 89 mm studs and continuous insulation in the cavity of conductivity 0.040 W/m·K.

Using Table 6.A.8:

From **column F, row 3** of the table, the base thickness of the continuous insulation layer is **153 mm**

The base thickness may be reduced by taking account of the other materials as follows:

From Table 6.A.9:

Brick outer leaf	**column C, row 2**	= 3 mm
Cavity	**column C, row 1**	= 5 mm
Sheathing ply	**column C, row 8**	= 2 mm
Plasterboard	**column C, row 6**	= 2 mm

And from Table 6.A.11:

Timber frame	**column F, row 1 (λ = 0.025)**	= 95mm
adjusted for 89 mm thick frame (95 mm x 89 mm / 100 mm)		= 85 mm
Total reduction		= **97 mm**

To achieve a *U-value* of 0.25 W/m²K the minimum thickness of the internal insulation layer is therefore:

Base thickness less **total reduction** i.e. 153 – 97 = **56 mm**

Example 6

Ground floors

Note: In using the tables for floors, the **P/A** ratio should be calculated first, where **P** is the floor perimeter length in metres; and **A** is the floor area in square metres.

Table 6.A.12: Insulation thickness for ground supported solid floors

		Thermal conductivity of insulant (W/m·K)					
	P/A	**0.020**	**0.025**	**0.030**	**0.035**	**0.040**	**0.045**
	A	**B**	**C**	**D**	**E**	**F**	**G**
		Insulation thickness (mm) for *U-value* of 0.15 W/m^2K					
1	1.00	112	140	168	196	224	253
2	0.90	111	138	166	194	222	250
3	0.80	109	136	164	191	218	246
4	0.70	107	134	160	187	214	241
5	0.60	104	130	156	182	208	233
6	0.50	100	125	150	175	200	225
7	0.40	94	117	141	164	188	211
8	0.30	84	105	126	147	168	189
9	0.20	68	85	102	119	136	154
		Insulation thickness (mm) for *U-value* of 0.20 W/m^2K					
10	1.00	81	101	121	142	162	182
11	0.90	80	100	120	140	160	180
12	0.80	78	98	118	137	157	177
13	0.70	77	96	115	134	153	173
14	0.60	74	93	112	130	149	167
15	0.50	71	89	107	125	143	160
16	0.40	67	84	100	117	134	150
17	0.30	60	74	89	104	119	134
18	0.20	46	57	69	80	92	103
		Insulation thickness (mm) for *U-value* of 0.25 W/m^2K					
19	1.00	61	76	91	107	122	137
20	0.90	60	75	90	105	120	135
21	0.80	58	73	88	102	117	132
22	0.70	57	71	85	99	113	128
23	0.60	54	68	82	95	109	122
24	0.50	51	64	77	90	103	115
25	0.40	47	59	70	82	94	105
26	0.30	40	49	59	69	79	89
27	0.20	26	32	39	45	52	58
		Insulation thickness (mm) for *U-value* of 0.30 W/m^2K					
28	1.00	48	60	71	83	95	107
29	0.90	47	58	70	81	93	105
30	0.80	45	56	68	79	90	102
31	0.70	43	54	65	76	87	98
32	0.60	41	51	62	72	82	92
33	0.50	38	47	57	66	76	85
34	0.40	33	42	50	59	67	75
35	0.30	26	33	39	46	53	59
36	0.20	13	16	19	22	25	28

Note: **P/A** is the ratio of floor perimeter (m) to floor area (m^2).

Table 6.A.13: Insulation thickness for suspended timber ground floors

		Thermal conductivity of insulant (W/m·K)					
	P/A	**0.020**	**0.025**	**0.030**	**0.035**	**0.040**	**0.045**
	A	**B**	**C**	**D**	**E**	**F**	**G**
		Insulation thickness (mm) for *U-value* of 0.15 W/m^2K					
1	1.00	178	204	230	257	283	308
2	0.90	177	203	228	254	280	305
3	0.80	175	201	226	252	278	303
4	0.70	172	198	223	249	274	299
5	0.60	169	194	219	245	270	294
6	0.50	165	190	214	239	263	287
7	0.40	159	183	206	230	254	277
8	0.30	150	172	194	216	238	260
9	0.20	131	151	171	191	210	230
		Insulation thickness (mm) for *U-value* of 0.20 W/m^2K					
10	1.00	127	145	164	182	200	218
11	0.90	125	144	162	180	198	216
12	0.80	123	142	160	178	195	213
13	0.70	121	139	157	175	192	209
14	0.60	118	136	153	171	188	204
15	0.50	114	131	148	165	181	198
16	0.40	109	125	141	157	173	188
17	0.30	99	115	129	144	159	173
18	0.20	82	95	107	120	132	144
		Insulation thickness (mm) for *U-value* of 0.25 W/m^2K					
19	1.00	93	107	121	135	149	162
20	0.90	92	106	119	133	146	160
21	0.80	90	104	117	131	144	157
22	0.70	88	101	114	127	140	153
23	0.60	85	98	111	123	136	148
24	0.50	81	93	106	118	130	142
25	0.40	75	87	99	110	121	132
26	0.30	66	77	87	97	107	117
27	0.20	49	57	65	73	81	88
		Insulation thickness (mm) for *U-value* of 0.30 W/m^2K					
28	1.00	71	82	93	104	114	125
29	0.90	70	80	91	102	112	122
30	0.80	68	78	89	99	109	119
31	0.70	66	76	86	96	106	116
32	0.60	63	73	82	92	102	111
33	0.50	59	68	78	87	96	104
34	0.40	53	62	70	79	87	95
35	0.30	45	52	59	66	73	80
36	0.20	28	33	38	42	47	51

Note: **P/A** is the ratio of floor perimeter (m) to floor area (m^2). The table is derived for suspended timber floors for which the proportion of timber is 12%, which corresponds to 48 mm wide timbers at 400 mm centres.

Table 6.A.14: Insulation thickness for suspended concrete beam and block ground floors

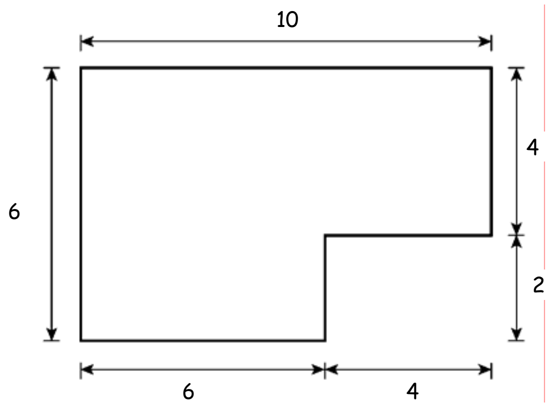
		Thermal conductivity of insulant (W/m²K)					
	P/A	**0.020**	**0.025**	**0.030**	**0.035**	**0.040**	**0.045**
	A	**B**	**C**	**D**	**E**	**F**	**G**
		Insulation thickness (mm) for *U-value* of 0.15 W/m2K					
1	1.00	114	142	171	199	228	256
2	0.90	113	141	170	198	226	254
3	0.80	112	140	168	196	224	252
4	0.70	110	138	166	193	221	249
5	0.60	109	136	164	191	218	245
6	0.50	107	134	160	187	214	241
7	0.40	104	129	155	181	207	233
8	0.30	98	123	148	172	197	222
9	0.20	89	111	133	155	177	199
		Insulation thickness (mm) for *U-value* of 0.20 W/m²K					
10	1.00	82	103	123	144	164	185
11	0.90	81	101	122	142	162	183
12	0.80	80	100	120	140	160	180
13	0.70	79	99	118	138	158	177
14	0.60	77	96	116	135	154	173
15	0.50	75	93	112	131	150	168
16	0.40	71	89	107	125	143	161
17	0.30	66	82	99	115	132	148
18	0.20	56	69	83	97	111	125
		Insulation thickness (mm) for *U-value* of 0.25 W/m²K					
19	1.00	62	78	93	109	124	140
20	0.90	61	76	92	107	122	138
21	0.80	60	75	90	105	120	135
22	0.70	59	74	88	103	118	132
23	0.60	57	71	86	100	114	128
24	0.50	55	68	82	96	110	123
25	0.40	51	64	77	90	103	116
26	0.30	46	57	69	80	92	103
27	0.20	36	45	54	62	71	80
		Insulation thickness (mm) for *U-value* of 0.30 W/m²K					
28	1.00	49	61	73	85	97	110
29	0.90	48	60	72	84	96	108
30	0.80	47	59	70	82	94	105
31	0.70	45	57	68	80	91	102
32	0.60	44	55	66	77	88	98
33	0.50	41	52	62	72	83	93
34	0.40	38	48	57	67	76	86
35	0.30	33	41	49	57	65	73
36	0.20	22	28	33	39	44	50

Note: **P/A** is the ratio of floor perimeter (m) to floor area (m²)

Example 7

Solid floor in contact with the ground

Determine the thickness of the insulation layer that will achieve a *U-value* of 0.20 W/m^2K for the ground floor slab shown below.



It is proposed to use insulation with a thermal conductivity of 0.025 W/m·K.

The overall perimeter length of the slab is: (10 + 4 + 4 + 2 + 6 + 6) = 32 m.

The floor area of the slab is: (6 x 6) + (4 x 4) = 52 m^2.

The ratio: $\frac{\text{perimeter length}}{\text{floor area}} = \frac{32}{52} = 0.6$

Using Table 6.A.12, **column C, row 14** indicates that **93 mm** of insulation is appropriate.

Example 8

Suspended timber floor

If the floor shown above was of suspended timber *construction*, the perimeter length and floor area would be the same, yielding the same ratio of:

$$\frac{\text{perimeter length}}{\text{floor area}} = \frac{32}{52} = 0.6$$

To achieve a *U-value* of 0.20 $W/m^2{\cdot}K$, using insulation with a thermal conductivity of 0.040 W/m·K, Table 6.A.13 **column F, row 14** indicates that the insulation thickness between the joists should be not less than **149 mm**.

Upper floors

Table 6.A.15: Upper floors of timber *construction*

		Thermal conductivity of insulant (W/m·K)					
Design *U-value* (W/m²K)		0.020	0.025	0.030	0.035	0.040	0.045
		Base thickness of insulation between joists to achieve design *U-value*					
	A	B	C	D	E	F	G
1	0.15	370	462	555	647	739	832
2	0.20	167	211	256	298	341	383
3	0.25	109	136	163	193	225	253
4	0.30	80	100	120	140	160	184

Note:
Table 6.A.15 is derived for floors with the proportion of timber at 12% which corresponds to 48 mm wide timbers at 400 mm centres. For other proportions of timber the *U-value* can be calculated using the procedure in Part 6.B.

Table 6.A.16: Upper floors of concrete *construction*

		Thermal conductivity of insulant (W/m·K)					
Design *U-value* (W/m²K)		0.020	0.025	0.030	0.035	0.040	0.045
		Base thickness of insulation to achieve design *U-value*					
	A	B	C	D	E	F	G
1	0.15	129	161	194	226	258	291
2	0.20	95	119	142	166	190	214
3	0.25	75	94	112	131	150	169
4	0.30	62	77	92	108	123	139

Table 6.A.17: Upper floors: allowable reductions in base thickness for common components

		Thermal conductivity of insulant (W/m·K)					
		0.020	0.025	0.030	0.035	0.040	0.045
Component		Reduction in base thickness of insulation material (mm)					
	A	B	C	D	E	F	G
1	9.5 mm plasterboard	1	2	2	2	3	3
2	19 mm timber flooring	3	3	4	5	5	6
3	50 mm screed	2	3	4	4	5	5

Table 6.A.18: Thermal conductivity of some common *construction* materials

		Density (kg/m³)	Conductivity (W/m·K)
Walls	Brickwork (outer leaf)	1700	0.77
	Brickwork (inner leaf)	1700	0.56
	Lightweight aggregate concrete block	1400	0.57
	Autoclaved aerated concrete block	600	0.18
	Concrete (medium density)	1800	1.13
		2000	1.33
		2200	1.59
	Concrete (high density)	2400	1.93
	Reinforced concrete (1% steel)	2300	2.3
	Reinforced concrete (2% steel)	2400	2.5
	Mortar (protected)	1750	0.88
	Mortar (exposed)	1750	0.94
	Gypsum	600	0.18
		900	0.30
		1200	0.43
	Sandstone	2600	2.3
	Limestone (soft)	1800	1.1
	Limestone (hard)	2200	1.7
	Timber framing in prefabricated wall panels	480	0.12
	Timber (softwood, plywood, chipboard)	500	0.13
	Timber (hardwood)	700	0.18
Surface finishes	Plasterboard	700	0.21
	Fibreboard	400	0.1
	Tiles (ceramic)	2300	1.3
	External sand-cement rendering	1300	1.0
	Plaster (dense)	1300	0.57
	Plaster (lightweight)	600	0.18
Roofs	Aerated concrete slab	500	0.16
	Asphalt	2100	0.70
	Felt/bitumen layers	1100	0.23
	Screed	1200	0.41
	Stone chippings	2000	2.0
	Tiles (clay)	2000	1.0
	Tiles (concrete)	2100	1.5
	Wood wool slab	500	0.10

Table 6.A.18 (continued)		Density (kg/m³)	Conductivity (W/m·K)
Floors	Cast concrete	2000	1.35
	Metal tray (steel)	7800	50.0
	Screed	1200	0.41
	Timber (hardwood)	700	0.18
	Timber (softwood, plywood, chipboard)	500	0.13

Note:
If available, certified test values should be used in preference to those in the table.
Information on typical thermal conductivities of common insulation materials is given at www.timsa.org.uk.