ISSUE 1.0

MCS GUIDANCE DOCUMENT

Guidance on U-Values from Domestic Heating Design Guide

The following U-Values are from the Domestic Heating Design Guide, and the complete publication is available for purchase from members of the Domestic Building Services Panel.

5.8 Ground Floor U-Values

The calculation of U-values for ground floors is complex and cannot be achieved in the same way as for other structural components, since the thermal transmission varies according to the shape of the room and the proportion of exposed edge to the total floor area. For regular shaped areas refer to tables 6.9 and 6.14. For irregular shaped areas the following formula can be used:

$$U_0 = 0.05 + (1.65 \times (P/A)) - (0.6 \times ((P/A)^2)),$$

where P is the length of exposed perimeter (m) and

A is the floor area (m^2).

Calculate the numbers inside the brackets first, starting with those inside the innermost brackets, then working outwards.

This formula applies to all types of floor construction including slab-on-ground and suspended floors. Unheated spaces outside the insulated fabric, such as attached garages or porches, should be treated as though they are not present when determining P and A.

5.9 Building Regulations

Building regulations require good standards of insulation and the provision of certain types of heating control for new buildings and buildings undergoing 'material alterations and change of use'. The requirements have undergone successive revisions and offer a range of different methods of achieving compliance. These include area weighted U-values for types building elements, and limiting U-values for individual sections of a type of building element, see Figure 5.2 below, and calculations based on the Standard Assessment Procedure (in the United Kingdom) or the Dwelling Energy Assessment Procedure (in the Republic of Ireland). The reader is referred to the current version of the relevant Building Regulations for a detailed description of the requirements. See also Appendix C.

Slope of roof window	U-value adjustment (W/m^2K) Twin skin or double glazed
70° or more (treat as vertical)	0.0
< 70° and > 60°	+0.2
< 60° and > 40°	+0.3
< 40° and > 20°	+0.4
< 20° (treat as horizontal)	+0.5

TABLE 5.4: U-value adjustments for windows on a slope

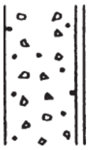
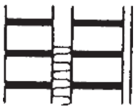
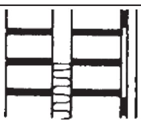
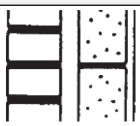
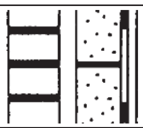
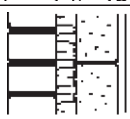
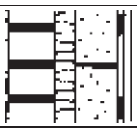
EXTERNAL WALLS		U-value W/m²K	
Solid brick wall, dense plaster			
	Brick 102 mm, plaster	2.97	
	Brick 228 mm, plaster	2.11	
	Brick 343 mm, plaster	1.64	
Solid stone wall, unplastered			
	Stone 305mm (12in)	2.78	
	Stone 457mm (18in)	2.23	
	Stone 610mm (24in)	1.68	
Solid concrete wall, dense plaster			
	Concrete 102mm, plaster	3.51	
	Concrete 152mm, plaster	3.12	
	Concrete 204mm, plaster	2.80	
	Concrete 254 mm, plaster	2.54	
Cavity wall, (Open cavity or mineral wool slab), lightweight plaster		**Open Cavity**	**Mineral Wool Slab 50 mm**
	Brick 102mm, brick 102mm, 13mm plaster	1.37	0.56
	Brick 102mm, brick 102mm, 12.5mm plasterboard on dabs	1.21	0.53
Cavity wall, aerated block inner leaf, lightweight plaster		**Inner leaf thickness**	
		100mm	**125mm**
	Brick 102mm, cavity, standard aerated block (k=0.17), 13mm plaster	0.87	0.77
	Brick 102mm, cavity, standard aerated block (k=0.17), 12.5mm plasterboard on dabs	0.80	0.72
	Brick 102mm, mineral wool slab in cavity 50mm, standard aerated block (k=0.17), 13mm plaster	0.45	0.42
	Brick 102mm, mineral wool slab in cavity 50mm, standard aerated block (k=0.17), 12.5mm plasterboard on dabs	0.43	0.41

TABLE 6.1

6.0 U-VALUE TABLES

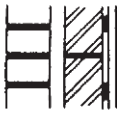
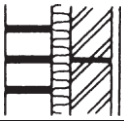
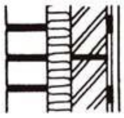
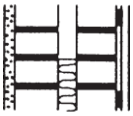
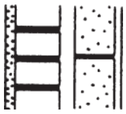
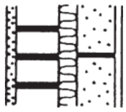
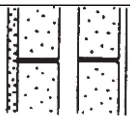
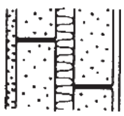
EXTERNAL WALLS		U-value W/m²K	
Cavity wall, aerated block inner leaf, lightweight plaster or plasterboard		**Inner leaf thickness**	
		100mm	**125mm**
	Brick 102mm, cavity, high performance aerated block (k=0.11), 13mm plaster	0.68	0.59
	Brick 102mm, cavity, high performance aerated block (k=0.11), 12.5mm plasterboard on dabs	0.64	0.56
	Brick 102mm, mineral wool slab in cavity 50mm, high performance aerated block (k=0.11), 13mm plaster	0.39	0.36
	Brick 102mm, mineral wool slab in cavity 75mm, high performance aerated block (k=0.11), 12.5mm plasterboard on dabs	0.29	0.27
Rendered Cavity wall, (Open cavity or mineral wool slab), lightweight plaster		**Open Cavity**	**Mineral wool slab**
	Render 19mm, brick 102mm, brick 102mm, 13mm plaster	1.25	0.54
	Render 19mm, brick 102mm, brick 102mm, 12.5mm plasterboard on dabs	1.11	0.51
Rendered cavity wall, aerated block inner leaf, lightweight plaster or plasterboard		**Inner leaf thickness**	
		100mm	**125mm**
	Render 19mm, brick 102mm, cavity, standard aerated block, 13mm plaster	0.82	0.73
	Render 19mm, brick 102.5mm, mineral wool slab in cavity 50mm, standard aerated block, 13mm plaster	0.44	0.41
	Render 19mm, standard aerated block 100mm, cavity, standard aerated block, 13mm plaster	0.61	0.56
Rendered cavity wall, inner aerated block, lightweight plaster		**Inner leaf thickness**	
		100mm	**125mm**
	Render 19mm, standard aerated block 100mm mineral wool slab in cavity 50mm, std. Aerated block, 13mm plaster	0.37	0.35

TABLE 6.2

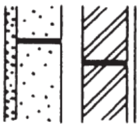
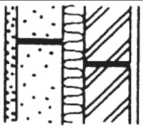
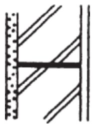
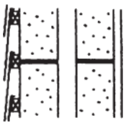
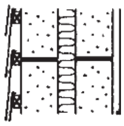
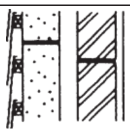
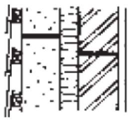
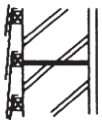
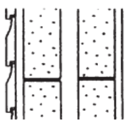
EXTERNAL WALLS		U-value W/m²K	
Rendered cavity wall, inner aerated block, lightweight plaster		Inner leaf thickness	
		100mm	125mm
	Render 19mm, standard aerated block 100mm, cavity, high performance aerated block (k=0.11), 13mm plaster	0.51	0.45
	Render 19mm, standard aerated block 100mm, mineral wool slab in cavity 50mm, high performance aerated block (k=0.11), 13mm plaster	0.33	0.31
Rendered Solid Wall			
	Render 19mm, high performance aerated block (k=0.11) 215mm, 13mm plaster	0.44	
Tile clad cavity wall, (Open cavity or mineral wool slab), lightweight plaster		Inner block thickness	
		100mm	125mm
	Tiles, airspace, standard aerated block, 13mm plaster	0.58	0.53
	Tiles, airspace, standard aerated block 100mm, mineral wool slab in cavity 50mm, standard aerated block, 13mm plaster	0.36	0.34
	Tiles, airspace, standard aerated block 100mm, cavity, high performance aerated block (k=0.11), 13mm plaster	0.49	0.44
Tile clad cavity wall,, (Open cavity or mineral wool slab), lightweight plaster		Inner block thickness	
		100mm	125mm
	Tiles, airspace, standard aerated block 100mm, mineral wool slab in cavity 50mm, high performance aerated block (k=0.11), 13mm plaster	0.32	0.30
Tile Clad Solid Wall			
	Tiles, airspace, high performance aerated block 215mm, 13mm plaster	0.43	
Timber Clad Cavity Wall			
	Shiplap boards, airspace, standard aerated block 100mm, cavity, standard aerated block, 13mm plaster	0.53	0.49

Table 6.3

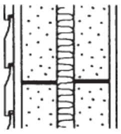
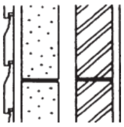
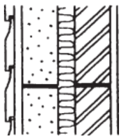
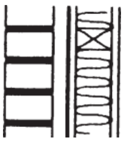
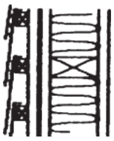
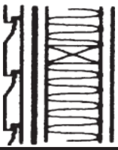
EXTERNAL WALLS			U-value W/m²K	
Timber Clad Cavity Wall				
	Shiplap boards, airspace, standard aerated block 100mm, mineral wool slab in cavity 50mm, standard aerated block, 13mm plaster		0.34	0.32
	Shiplap boards, airspace, standard aerated block. 100mm, cavity, high performance aerated block, 13mm plaster		0.45	0.41
	Shiplap boards, airspace, standard aerated block 100mm, mineral wool slab in cavity 50mm, high performance block, 13mm plaster		0.31	0.29
Timber frame wall with cladding, membrane, plywood, studding, vapour membrane, plasterboard		**Insulation thickness**		
		60mm	**80mm**	**100mm**
	Brick 102.5mm, cavity, membrane, plywood 10mm, studding 100mm, with infill insulation, vapour membrane, plasterboard 12.5mm	0.43	0.36	0.32
	Tiles, airspace, membrane, plywood 10mm. Studding 100mm, with infill insulation, vapour membrane, plasterboard 12.5mm	0.47	0.38	0.34
	Shiplap boards, airspace, membrane, plywood 10mm, studding 100mm with infill insulation	0.44	0.36	0.32

TABLE 6.4

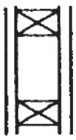
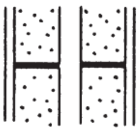
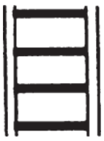
INTERNAL WALLS		U-value W/m²K
	Plasterboard 12.5mm, studding 75mm, plasterboard 12.5mm	1.72
	Plaster 13mm, block 10mm, cavity, block 100mm, plaster 13mm	1.02
	Plaster 13mm, brick 102.5mm, plaster 13mm	1.76

Table 6.5

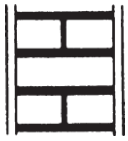
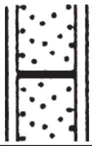
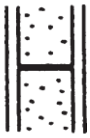
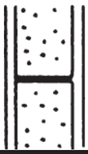
INTERNAL WALLS		U-value W/m² K
	Plaster 13mm, brick 215mm, plaster 13mm	1.33
	Plaster, breeze block 100mm, plaster	1.58
	Plaster 13mm, standard aerated block 100mm, plaster 13mm	1.66
	Plaster 13mm, standard aerated block 125mm, plaster 13mm	1.53

TABLE 6.6

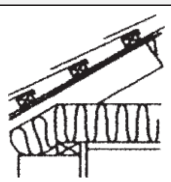
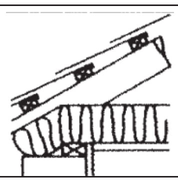
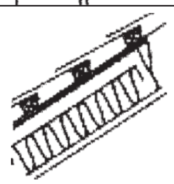
ROOFS		U-value W/m²K				
Flat roof, timber construction, insulation and plasterboard		**Insulation thickness (mm)**				
		Nil	**50**	**100**	**200**	**300**
	Chippings, 3 layers of felt, boarding, air space, insulation, 9.5 mm plasterboard	1.69	0.53	0.32	0.17	0.12
30° Pitched roof with tiles						
	Slates or tiles, sarking felt, ventilated air space, insulation between joists, 9.5 mm plasterboard	2.51	0.60	0.34	0.18	0.12
	Slates or tiles, ventilated air space, insulation between joists, 9.5 mm plasterboard	3.13	0.62	0.35	0.18	0.12
	Slates or tiles, sarking felt, air space, insulation between rafters, 9.5 mm plasterboard	2.51	0.60	0.34	0.18	0.12

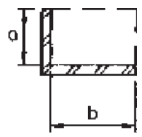
Table 6.7

WINDOWS AND DOORS	
The U-values listed below apply to the whole window including the frame and assume a standard gap between panes of 12mm	
Windows with wood or PVC-U frames	**U-value W/m²K**
Single	4.8
Double	2.8
Double, low-E glass	2.3
Double, low-E glass, argon filled	2.1
Triple	2.1
Triple, low-E glass	1.7
Triple, low-E glass, argon filled	1.6
Windows with metal frames	**U-value W/m²K**
Single	5.7
Double	3.4
Double, low-E glass	2.8
Double, low-E glass, argon filled	2.6
Triple	2.6
Triple, low-E glass	2.1
Triple, low-E glass, argon filled	2.0
Single glazed window with Secondary Glazing Doors	**U-value W/m²K**
Solid wood door to outside	3.0
Solid wood door to unheated corridor	1.4
Triple, low-E glass, argon filled	2.0

TABLE 6.8

SOLID GROUND FLOORS IN CONTACT WITH EARTH

Solid ground floor with TWO ADJACENT EDGES EXPOSED insulation slabs laid below screed with 25mm thick edge insulation. Floor finished with thermoplastic tiles or similar. Thermal conductivity of insulation = 0.04 W/mK

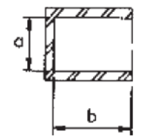


Length of Exposed Wall a+b (m)	U-values, W/m²K for insulation thickness mm:-				
	Nil	**25**	**50**	**75**	**100**
5	1.02	0.58	0.41	0.31	0.26
6	0.90	0.54	0.39	0.30	0.25
7	0.82	0.51	0.37	0.29	0.24
8	0.76	0.49	0.36	0.28	0.23
9 - 10	0.70	0.46	0.34	0.27	0.23
10 - 12	0.60	0.41	0.32	0.26	0.22
12 - 14	0.52	0.38	0.29	0.24	0.21
14 - 17	0.45	0.34	0.27	0.23	0.19
17 - 20	0.39	0.30	0.25	0.21	0.18

Example room size = 6.5 x 5.0m = 11.5m exposed wall. U-value with 50mm insulation = 0.32 W/ m²K

Table 6.9

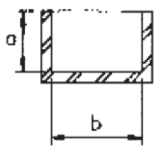
Solid ground floor with THREE EDGES EXPOSED, the shortest being the single exposed edge. (Use this table for square rooms). Insulation slabs laid below screed with 25mm edge insulation. Floor finish as above. Thermal conductivity of insulation = 0.04 W/mK



SHORT Length a(m)	LONG Length b(m)	U-values Wm²K for insulation thickness mm:-				
		Nil	25	50	75	100
3	3 - 4	1.15	0.62	0.43	0.32	0.26
3	4 - 6	1.03	0.58	0.41	0.31	0.26
3	6 - 8	1.00	0.57	0.40	0.31	0.25
3	8 - 10	0.96	0.56	0.40	0.31	0.25
4	4 - 6	0.95	0.56	0.40	0.31	0.25
4	6 - 10	0.85	0.52	0.38	0.29	0.24
5	5 - 7	0.81	0.51	0.37	0.29	0.24
5	7 - 10	0.74	0.48	0.35	0.28	0.23
6	6 - 8	0.71	0.46	0.35	0.28	0.23
6	8 - 10	0.65	0.44	0.33	0.27	0.22

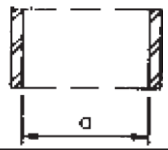
Example: Room = 5.0 x 6.5m U-value with 50mm insulation = 0.37 W/m²K

Solid ground floor with THREE EDGES EXPOSED, the longest being the single exposed edge. Insulation as previously specified



SHORT Length a(m)	LONG Length b(m)	U-values Wm²K for insulation thickness mm:-				
		Nil	25	50	75	100
3	3 - 5	1.05	0.59	0.41	0.32	0.26
3	5 - 7	0.90	0.54	0.39	0.30	0.25
3	7 - 9	0.85	0.52	0.38	0.29	0.24
3	9 - 10	0.77	0.49	0.36	0.28	0.24
4	4 - 6	0.95	0.56	0.40	0.31	0.25
4	6 - 8	0.87	0.53	0.38	0.30	0.24
4	8 - 10	0.76	0.49	0.36	0.28	0.24
5	5 - 7	0.83	0.51	0.37	0.29	0.24
5	7 - 9	0.77	0.49	0.36	0.28	0.24
5	9 - 10	0.68	0.45	0.34	0.27	0.23
6	6 - 8	0.75	0.48	0.36	0.28	0.23
6	6 - 10	0.70	0.46	0.34	0.27	0.23

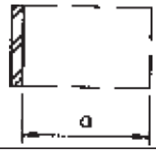
Solid ground floor with TWO OPPOSITE EDGES EXPOSED.
Insulation as previously specified



DISTANCE Between Edges a(m)	U-values Wm²K for insulation thickness mm:-				
	Nil	25	50	75	100
2	1.15	0.62	0.43	0.32	0.26
3	0.90	0.54	0.39	0.30	0.25
4	0.73	0.47	0.35	0.28	0.23
4 - 6	0.62	0.43	0.32	0.26	0.22
6 - 8	0.55	0.39	0.30	0.25	0.21
8 - 10	0.44	0.33	0.27	0.22	0.19

Table 6.10

Solid ground floor with ONE EDGE EXPOSED
Insulation as previously specified

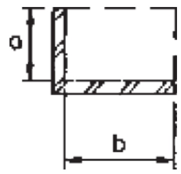


DEPTH of room a(m)	U-values, W/m²K for insulation thickness mm:-				
	Nil	25	50	75	100
1.5	0.90	0.54	0.39	0.30	0.25
2	0.73	0.47	0.35	0.28	0.23
3	0.55	0.39	0.30	0.25	0.21
3-5	0.45	0.34	0.27	0.23	0.19
5-7	0.38	0.30	0.24	0.21	0.18
7-10	0.28	0.23	0.20	0.17	0.15

TABLE 6.11

SUSPENDED GROUND FLOORS

Suspended ground floor with TWO ADJACENT EDGES EXPOSED Insulation slabs laid between joists on polypropylene net and covered with timber boarding. Thermal conductivity of insulation = 0.04 W/mK



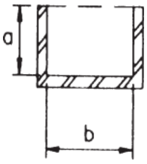
Length of Exposed Wall a + b (m)	U-values W/m²K for insulation thickness mm::-				
	Nil	25	50	75	100
5	1.05	0.59	0.41	0.32	0.26
6	0.93	0.55	0.39	0.30	0.25
7	0.86	0.53	0.38	0.30	0.24
8	0.79	0.50	0.37	0.29	0.24
9 - 10	0.75	0.48	0.36	0.28	0.23
10 - 12	0.65	0.44	0.33	0.27	0.22
12 - 14	0.58	0.41	0.31	0.25	0.21
14 - 17	0.71	0.37	0.29	0.24	0.20
17 - 20	0.43	0.33	0.26	0.22	0.19

Example: Room size = 6.5 x 5.0m = 11.5m exposed wall. U-value with 50mm insulation = 0.33 W/m²K

Table 6.12

SUSPENDED GROUND FLOORS

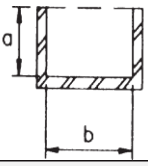
Suspended ground floor with THREE EDGES EXPOSED, the shortest being the single exposed edge. (Use this table for square rooms). Insulation slabs laid between joists on polypropylene net and covered with timber boarding. Thermal conductivity of insulation = 0.04 W/mK



SHORT Length a(m)	LONG Length b(m)	U-values Wm²K for insulation thickness mm:				
		Nil	25	50	75	100
3	3-4	1.15	0.62	0.43	0.32	0.26
3	4-6	1.03	0.58	0.41	0.31	0.26
3	6-8	1.00	0.57	0.40	0.31	0.25
3	8-10	0.99	0.56	0.40	0.31	0.25
4	4-6	0.95	0.56	0.40	0.31	0.25
4	6-10	0.87	0.53	0.38	0.30	0.24
5	5-7	0.83	0.51	0.37	0.29	0.24
5	7-10	0.80	0.50	0.37	0.29	0.24
6	6-8	0.75	0.48	0.36	0.28	0.23
6	8-10	0.72	0.47	0.35	0.28	0.23

Example: Room – 5.0 x 6.5m U-value with 50mm insulation = 0.37 W/m²K

Suspended ground floor with THREE EDGES EXPOSED, the longest being the single exposed edge. (Use this table for square rooms). Insulation as previously specified



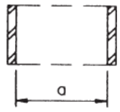
SHORT Length a(m)	LONG Length b(m)	U-values Wm²K for insulation thickness mm:				
		Nil	25	50	75	100
3	3-5	1.00	0.57	0.40	0.31	0.25
3	5-7	0.85	0.52	0.38	0.29	0.24
3	7-9	0.80	0.50	0.37	0.29	0.24
3	9-10	0.77	0.49	0.36	0.28	0.24
4	4-6	0.85	0.52	0.38	0.29	0.24
4	6-8	0.79	0.50	0.37	0.29	0.24
4	8-10	0.73	0.47	0.35	0.28	0.23
5	5-7	0.77	0.49	0.36	0.28	0.24
5	7-9	0.72	0.47	0.35	0.28	0.23
5	9-10	0.66	0.44	0.33	0.27	0.23
6	6-8	0.69	0.46	0.34	0.27	0.23
6	6-10	0.67	0.45	0.34	0.27	0.23

Example: Room – 5.0 x 6.5m U-value with 50mm insulation = 0.37 W/m²K

TABLE 6.13

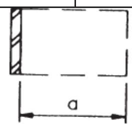
SUSPENDED GROUND FLOORS

Suspended ground floor with TWO OPPOSITE EDGES EXPOSED. Insulation as previously specified.



DISTANCE between edges a(m)	U-values W/m²K for insulation thickness mm:				
	Nil	25	50	75	100
2	1.10	0.61	0.42	0.32	0.26
3	0.95	0.56	0.40	0.31	0.25
4	0.83	0.51	0.37	0.29	0.23
4 - 6	0.74	0.48	0.35	0.26	0.23
6 - 8	0.67	0.45	0.34	0.27	0.23
8 - 10	0.55	0.39	0.30	0.25	0.21

Suspended ground floor with ONE EDGE EXPOSED. Insulation as previously specified.



DEPTH of Room a(m)	U-values W/m²K for insulation thickness mm:-				
	Nil	25	50	75	100
1.5	1.10	0.61	0.42	0.32	0.26
2	0.83	0.51	0.37	0.29	0.24
3	0.67	0.45	0.34	0.27	0.23
3 - 5	0.56	0.40	0.31	0.25	0.21
5 - 7	0.48	0.35	0.28	0.23	0.20
7 - 10	0.38	0.30	0.24	0.21	0.19

TABLE 6.14

INTERNAL FLOORS EXPOSED UNDERSIDE

Timber floor with underside exposed to outside or unheated area. (heat flow-down)		Insulation thickness Nil	100mm	150mm
	Boarding 19mm, airspace between joists, insulation, 6mm sheeting	1.75	0.33	0.23
Concrete slab with underside exposed to outside or unheated area. (heat flow-down)				
	Screed 50mm, concrete slab 150mm, insulation between battens, 6mm sheeting	1.82	0.57	
INTERMEDIATE FLOORS				
Timber boarding 19mm, airspace between joists, 9.5mm plasterboard				
	Heat flow - upwards	1.73	0.32	
	Heat flow – down	1.41	0.31	

TABLE 6.15

Room volume (m^3)	Throat restrictor fitted to flue	Air changes per hour
Up to 40	NO	5
Up to 40	YES	3
Up to 70	NO	4
Up to 70	YES	2

TABLE 8.2 Ventilation arising from chimneys and flues

8.5 Building Exposure

When a building is located in an exposed position, such as on top of a hill, by a riverside, at the coast, or in any extreme open location, allowance should be made for increased heat losses. For a windy location, this can be taken into account by increasing ventilation rates. Increased elevation may be accounted for by reducing the external design temperature by 0.5°C for each 160 metres above sea level.

Alternatively, a general addition to heat losses may be made to allow for an exposed location. A 10% addition is recommended as a rule of thumb but this should be based on local conditions and increased if the location is particularly exposed.

8.6 High Ceilings

Rooms with unusually high ceilings need additional heat to compensate for the stratification of warmer air at the higher level.

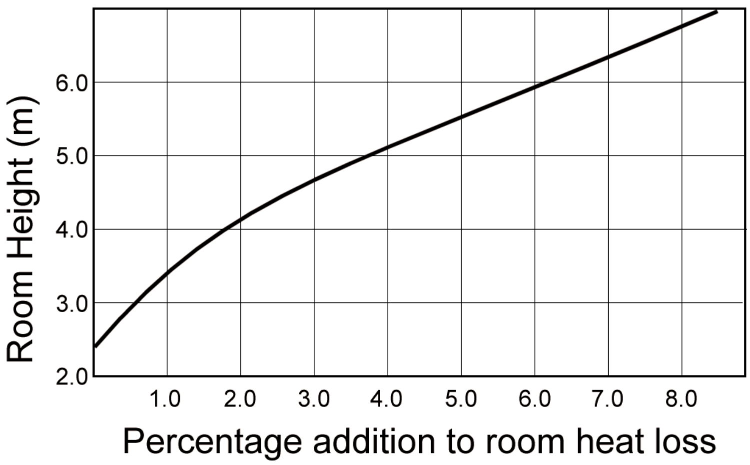


Fig. 8.1 Effect of room height on heat loss