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APPENDIX H – ENERGY EFFICIENCY

H.1 GENERAL

(a) Class 1a buildings, including additions of one or more *habitable rooms,* and attached Class 10a buildings must –

(i) comply with the requirements of Appendix H (**Sections H.3** to **H.8**) or;

(ii) achieve a minimum 6-star house energy rating when assessed with house energy rating software that is compliant with the Australian Buildings Codes Board's (ABCB) Protocol for House Energy Rating Software and comply with:

(A) H.4.1, H.4.2, H.4.3, H.4.4(b), H4.4.4(d), H.4.6(b), H.4.7(a); and

(B) H.6; and

(C) H.8.2, H.8.3, H.8.4 and H.8.5

of this Appendix for the relevant *climate zone* for the *site; or*

(iii) if the building is a transportable building, achieve a minimum 5-star house energy rating when assessed with house energy rating software that is compliant with the Australian Building Codes Board's (ABCB) Protocol for House Energy Rating Software and comply with:

(A) H.4.1, H.4.2, H.4.3, H.4.4(b), H4.4.4(d), H.4.6(b), H.4.7(a); and

(B) H.6; and

(C) H.8.2, H.8.3, H.8.4 and H.8.5

of this Appendix for the relevant *climate zone* for the *site*.

Note: Heaters for swimming pools and spas fall outside the scope of the Housing Code but are still *required* to comply with the *BCA*.

(b) For the purposes of Appendix H, a sunroom, glazed conservatory or the like is deemed to be a Class 10a building and must comply with **clause H.4.8**.

Note: Information about the current version of the ABCB's Protocol for House Energy Rating Software can be obtained from the ABCB's website at www.abcb.gov.au.

H.2 * * * *

This clause has been left deliberately blank.

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H.3 CLIMATE ZONES

The *Climate Zone* for the *site* must be determined from **Table H.1** or the *Climate Zone* map.

Note: The *climate zone* map can be found at the conclusion of the Housing Code Appendices.
The map can also be viewed on the Department of Planning and Local Government, Building Policy web site at http://www.dplg.sa.gov.au/go/building/climate-zones

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Table H.1 *Climate Zones* for *Council* areas and selected towns

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METROPOLITAN ADELAIDE			
***Council* area**	***Climate Zone***	***Council* area**	***Climate Zone***
Adelaide, City of	**5**	**Onkaparinga, City of**	**5**
Burnside, City of		**Playford, City of**	
Campbelltown, City of		**Port Adelaide Enfield, City of**	
Charles Sturt, City of		**Prospect, City of**	
Holdfast Bay, City of		**Salisbury, City of**	
Gawler, Town of		**Tea Tree Gully, City of**	
Marion, City of		**Unley Corporation, City of**	
Mitcham, City of		**Walkerville, Town of**	
Norwood, Payneham & St. Peters, City of		**West Torrens, City of**	

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Table H.1 (Cont) ***Climate Zones* for *Council* areas and selected towns**

OUTER METROPOLITAN AND COUNTRY			
***Council* area**	***Climate Zone***	***Council* area**	***Climate Zone***
Adelaide Hills Council	**5 & 6**	**Mallalla District Council**	**5**
Birdwood	6	**Mid Murray Council**	**5**
Lobethal	6	**Mount Barker D.C.**	**6**
Rostrevor (part)	5	**Mount Gambier City of**	**6**
Stirling	6	**Mount Remarkable D.C.**	**4 & 5**
Teringie (part)	5	Melrose	**5**
Woodforde	5	Port Germein	**4**
Woodside	6	Wilmington	**5**
Alexandrina Council	**6**	**Murray Bridge Rural City**	**6**
Barossa Council	**5 & 6**	**Naracoorte D.C.**	**6**
Lyndoch	5	**Northern Areas Council**	**5 & 6**
Mt Pleasant	6	Jamestown	6
Nuriootpa	6	Laura	5
Tanunda	6	Spalding	6
Williamstown	6	Yacka	5
Barunga West DC	**5**	**Orroroo / Carrieton D.C.**	**5**
Berri Barmera Council	**5**	**Peterborough D.C.**	**6**
Ceduna D.C.	**5**	**Port Augusta, City of**	**4**
Clare and Gilbert Valleys	**6**	**Port Lincoln, City of**	**5**
Cleve D.C.	**5**	**Port Pirie Regional Council**	**4**
Coober Pedy D.C.	**4**	**Renmark Paringa D.C.**	**5**
Coorong D.C.	**6**	**Robe D.C.**	**6**
Copper Coast D.C.	**5**	**Roxby Downs Council**	**4**
Elliston D.C.	**5**	**Southern Mallee D.C.**	**6**
Flinders Ranges Council of	**5**	**Streaky Bay D.C.**	**5**
Franklin Harbour D.C.	**5**	**Tatiara D.C.**	**6**
Goyder Regional Council	**5 & 6**	**Tumby Bay D.C.**	**5**
Brownlow	5	**Victor Harbor City**	**6**
Bower	5	**Wakefield Regional Council**	**5**
Burra	6	**Wattle Range Council**	**6**
Eudunda	6	**Whyalla, City of**	**4**
Frankton	5	**Yankalilla DC**	**6**
Hallett	6	**Yorke Peninsula D.C.**	**5**
Grant D.C.	**6**	**Unincorporated Areas**[1]	
Kangaroo Island Council	**6**	Andamooka	4
Karoonda East Murray D.C.	**6**	Blinman	5
Kimba D.C	**5**	Innamincka	4
Kingston DC	**6**	Leigh Creek	5
Le Hunte D.C.	**5**	Maree	4
Light Regional Council	**6**	Penong	4
Lower Eyre Peninsula D.C.	**5**	Woomera	4
Loxton Waikerie D.C.	**5**	Yunta	5

Note:
[1]Generally the *Climate Zone* for Unincorporated areas in the far North is Zone 4. Land at an altitude of greater than 300 m above the datum level within this area will be *Climate Zone* 5.

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H.4 BUILDING FABRIC

H.4.1 General

Where insulation is used in order to achieve a *required R-Value*, it must comply with AS/NZS 4859.1 and be installed so that it –

(a) abuts or overlaps adjoining insulation other than at supporting members such as columns, studs, noggings, joists, furring channels and the like where the insulation must butt against the member; and

(b) forms a continuous barrier with the elements that inherently contribute to the thermal barrier such as ceilings, walls, bulkheads, floors or the like; and

Explanatory Information:
In a two storey house with the second storey set back, the insulation in the first storey wall, the second storey wall and the roof over the set-back must be continuous. Therefore, if the roof over the set-back has insulation on a horizontal ceiling, then insulation is also needed on the vertical in any ceiling space in order to connect the ceiling insulation to the second storey wall.

(c) does not affect the safe or effective operation of a domestic service or fitting.

H.4.2 Bulk insulation

Where bulk insulation is used to achieve the minimum *required Total R-Value*, it must –

(a) be installed so that it maintains its position and thickness, other than where it crosses roof battens, water pipes, electrical cabling or the like; and

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(b) when installed in a ceiling, where there is no bulk insulation or *reflective insulation* in the *external wall* below, overlap that *external wall* by not less than 50mm.

H.4.3 *Reflective insulation*

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(a) Where *reflective insulation* is used to achieve the minimum *required Total R-value* of a roof, wall, ceiling or floor it must -

(i) be installed with the necessary airspace to achieve the *required R-value* between the reflective side of the *reflective insulation* and the building lining or cladding; and

(ii) be closely fitted against any penetration or door or *window* opening; and

(iii) be adequately supported by framing members; and

(iv) where sheet membrane is used, each adjoining sheet must be overlapped not less than 150mm or taped together for the full length of the join.

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Explanatory Information: Adjoining sheets of roll membrane
Where *reflective insulation* also acts as a damp-proofing membrane or *sarking-type material*, both the minimum overlap and taping may be necessary..

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(b) Where *reflective insulation* is used in a roof, the *R-value* added by the *reflective insulation* must be determined from **Table H.2** The *reflective insulation* must -

(i) be laid directly under the roof cladding and must have a minimum air space of 15mm between the reflective side of the *reflective insulation* and the adjoining building lining or cladding; and

(ii) where an *R-value* for a ventilated roof space is used, the roof space must be ventilated by –

(A) gable vents, ridge vents, eaves vents, roof vents or the like that –

(i) are evenly distributed to allow an unobstructed airflow; and

(ii) are located to ensure, where practicable, there are no dead airspaces; and

(iii) have an aggregate fixed open area of not less than 1.0% of the ceiling area; or

(B) not less than 2 wind driven roof ventilators having an aggregate opening area of not less than 0.14m^2 in conjunction with gable vents, ridge vents, eaves vents, roof vents or the like that have an aggregate fixed open area of not less than 0.2% of the ceiling area.

(c) Where *reflective insulation* is used in a wall the *R-value* added by the *reflective insulation* must be determined from **Table H.3**.

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TABLE H.2 *R-Value* added to roofs by *reflective insulation*

Ceiling	Roof space ventilation	Emittance of added *reflective insulation*	*R-Value* added by *reflective insulation*
Flat, skillion or pitched roof with pitch not greater than 10 degrees			
Horizontal	Non-ventilated	0.2 outer / 0.05 inner	0.68
		0.9 outer / 0.05 inner	0.49
Pitched roof with pitch not less than 10 degrees			
Horizontal	Ventilated[1]	0.2 outer / 0.05 inner	0.59
		0.9 outer / 0.05 inner	0.40
	Non- ventilated	0.2 outer / 0.05 inner	0.75
		0.9 outer / 0.05 inner	0.55
Pitched roof with pitch greater than 10 degrees and up to 22 degrees			
Cathedral	Non-ventilated	0.2 outer / 0.05 inner	0.72
		0.9 outer / 0.05 inner	0.51
Pitched roof with pitch greater than 22 degrees and up to 30 degrees			
Cathedral	Non-ventilated	0.2 outer / 0.05 inner	0.74
		0.9 outer / 0.05 inner	0.52
Pitched roof with pitch greater than 30 degrees and up to 45 degrees			
Cathedral	Non-ventilated	0.2 outer / 0.05 inner	0.77
		0.9 outer / 0.05 inner	0.53

Notes

[1] Ventilated roof space means ventilated in accordance with **Clause H.4.3(b)(ii)**.

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TABLE H.3 *R-Value* added to walls by *reflective insulation*

Reflective air space details	Emittance of added *reflective insulation*	*R-Value* added by *reflective insulation*
Concrete or masonry wall with internal plasterboard on battens	One 20mm reflective airspace located between the *reflective insulation* (of not more than 0.05 emittance inwards) and the plasterboard	0.48
External wall cladding (70mm timber frame with internal lining)	One 70mm reflective airspace located between the *reflective insulation* (of not more than 0.05 emittance inwards) and the plasterboard	0.43
Masonry veneer (70mm timber frame with internal lining)	One 70mm reflective airspace located between the *reflective insulation* and the plasterboard; and one 25mm anti-glare space located between the *reflective insulation* (of not more than 0.2 emittance outwards) and the masonry	0.95
Cavity masonry	No air space between the *reflective insulation* and the inner leaf of masonry; and one 35mm anti-glare air space located between *reflective insulation* (of not more than 0.2 emittance outwards) and the outer leaf of the masonry	0.49

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H.4.4 Roofs / ceilings

(a) A roof, or roof and associated ceiling, must –

(i) achieve the minimum required Total R-Value specified in Table H.4; and

(ii) where a pitched roof has a flat ceiling, have not less than 50% of the added insulation laid on the ceiling.

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(b) In *Climate Zones* 4 and 5, the *Total R-Value* specified in **Table H.4** is reduced by R0.5 where the *required* insulation is laid on the ceiling and the roof space is ventilated by -

(i) gable vents, ridge vents, eave vents, roof vents or the like that –

(A) are evenly distributed to allow an unobstructed flow of air; and

(B) are located to ensure, where practicable, there are no dead airspaces; and

(C) have an aggregate fixed open area of not less than 1.0% of the ceiling area; or

(ii) not less than 2 wind-driven roof ventilators having an aggregate opening area of not less than 0.14m^2 in conjunction with gable vents, ridge vents, eave vents, roof vents or the like having an aggregate fixed open area of not less than 0.2% of the ceiling area.

(c) A roof that –

(i) has metal sheet roofing directly fixed to metal purlins, metal rafters or metal battens and;

(ii) has a ceiling lining fixed directly to those metal purlins, metal rafters or metal battens,

must have a thermal break consisting of a material with an *R-Value* of not less than 0.2, installed between the metal sheet roofing and its supporting metal purlins, metal rafters, or metal battens.

(d) A thermal break may be provided by materials such as timber of not less than 20mm thickness, expanded polystyrene strips of not less than 12mm thickness, or plastic strips that achieve the required R-Value.

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(e) A roof or roof and associated ceiling is deemed to achieve the *Total R-Value* in Table H.5(a).

(f) Where for operational or safety reasons associated with exhaust fans, flues or recessed downlights, the area of *required* ceiling insultation is reduced, the loss of insulation must be compensated for by increasing the *R-Value* of insulation in the remainder of the ceiling in accordance with **Table H.5(b)**.

TABLE H.4 Minimum *required Total R-Values* for a roof or roof and associated ceiling

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Construction element	Minimum *Total R-Value*		
	Climate Zone		
	4	5	6
Direction of heat flow	Upwards		
Minimum *Total R-Value* for a roof with an upper surface solar absorptance value of not more than 0.4	4.1	4.1	4.1
Minimum *Total R-Value* for a roof with an upper surface solar absorptance value of more than 0.4 but not more than 0.6	4.6	4.6	4.6
Minimum *Total R-Value* for a roof or ceiling with a roof upper surface solar absorptance value of more than 0.6	5.1	5.1	5.1

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TABLE H.4a Typical absorptance values

Colour	Value
Slate (dark grey)	0.90
Red, green	0.75
Yellow, buff	0.60
Zinc aluminium - dull	0.55
Galvanised steel - dull	0.55
Light grey	0.45
Off white	0.35
Light cream	0.30

TABLE H.5(a) *Total R-Value* for typical roof and ceiling construction

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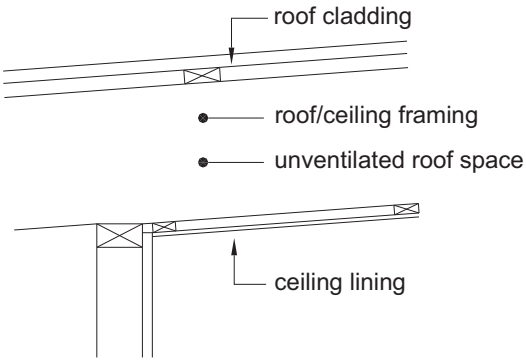
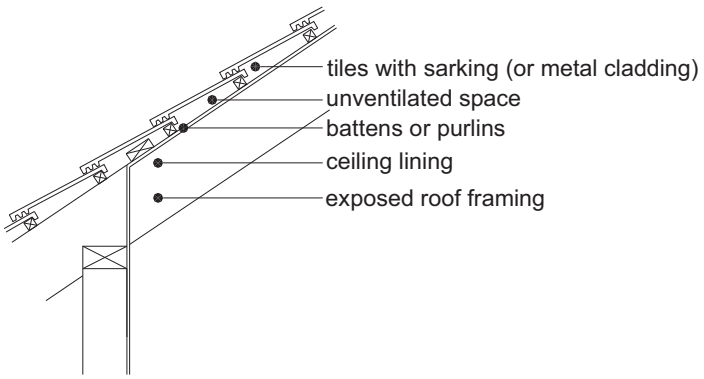
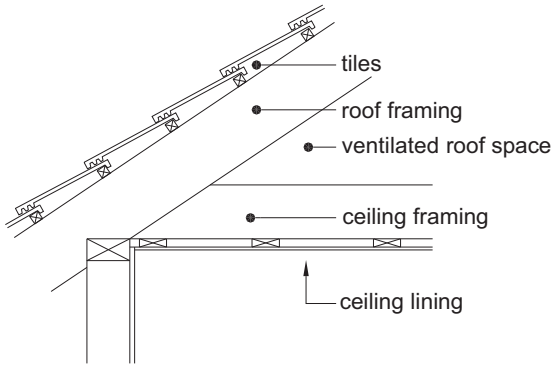
Roof construction description	R-Value
(a) Flat roof, skillion roof and cathedral ceiling – Ceiling lining under rafter 	Unventilated Up 0.36
(b) Flat roof, skillion roof and cathedral ceiling – Exposed rafters 	Unventilated Up 0.38

(c) Pitched roof with flat ceiling – Tiled roof



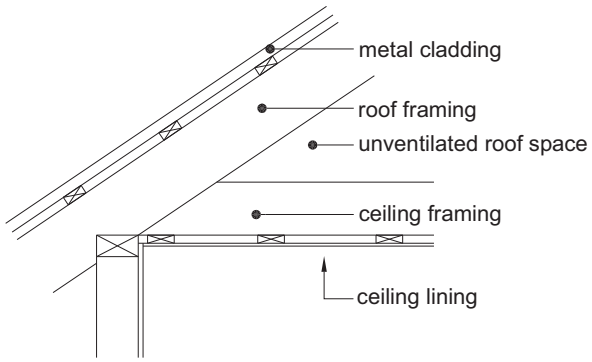
Unventilated

Up 0.41

Ventilated

Up 0.23

(d) Pitched roof with flat ceiling – Metal roof



Unventilated

Up 0.39

Ventilated

Up 0.21

Notes:
The *Total R-Value* of the roof and ceiling construction in **Table H.5 (a)** is based on there being a roof space. If the roof space is filled, the roof space *R-Value* needs to be subtracted from the *Total R-Value* of the roof and ceiling materials.

The *Total R-Value* of the unventilated roof and ceiling construction in **Table H.5 (a) diagram (c)** for tiled roofs are based on there being *sarking-type material* which would prevent ventilation of the roof space through the gaps in the roof tiles.

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TABLE H.5(b) Adjustment of minimum added *R-Value* for loss of ceiling insulation

Percentage of ceiling area uninsulated	Minimum *R-Value* of ceiling insulation *required* to satisfy H.4.4							
	R2.5	R3.0	R3.5	R4.0	R4.5	R5.0	R5.5	R6.0
	Adjustable minimum *R-Value* of ceiling insulation *required* to compensate for loss of ceiling area insulation							
0.5% to less than 1.0%	2.8	3.4	4.0	4.7	5.4	6.2	6.9	
1.0% to less than 1.5%	2.9	3.6	4.4	5.2	6.1	7.0		
1.5% to less than 2.0%	3.1	3.9	4.8	5.8	6.8			
2.0% to less than 2.5%	3.3	4.2	5.3	6.5				
2.5% to less than 3.0%	3.6	4.6	5.9	Not permitted				
3.0% to less than 4.0%	4.2	5.7						
4.0% to less than 5.0%	5.0							

Note:

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1. Where the minimum *R-Value* of ceiling insulation *required* to satisfy **H.4.4** is between the values stated, interpolation may be used to determine the adjusted minimum *R-Value*.
2. **H.4.4(f)** does not require an increase in ceiling insulation for *roof lights*.

Explanatory information:

1. When considering the reduction of insulation because of exhaust fans and recessed downlights, 0.5% of the ceiling area for a 200m^2 house would permit 2 bathroom heater-light assemblies, a laundry exhaust fan, a kitchen exhaust fan and either approximately 20 recessed downlights with 50mm clearance to insulation, 10 recessed downlights with 100mm clearance to insulation or only 3 recessed downlights with 200mm clearance to insulation.
2. Note that **Table H.4** refers to the *R-Value* of the insulation located on the ceiling and is not the *Total R-Value required* of the roof. The roof has an inherent *R-Value* and there may also be insulation at the roofline.

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H.4.5 *Roof lights*

Roof lights (including any associated shaft and diffuser) serving a *habitable room* or an interconnecting space such as a corridor, hallway, stairway or the like must –

(a) if the *roof lights* are not *required* for compliance with **D.2** or **D.3** –

  (i) comply with **Table H.6**; and

  (ii) have an aggregate area of not more then 3% of the *floor area* of the storey served; or

(b) if the *roof lights* are *required* for compliance with **D.2** or **D.3** –

  (i) have an area not more than 150% of the minimum area *required* by **Appendix D**; and

  (ii) have transparent and translucent elements, including any imperforate ceiling diffuser with –

    (A) a *SHGC* of not more than 0.29; and

    (B) a *Total U-Value* of not more than 2.9.

The total area of *roof lights* serving the room or space as a percentage of the *floor area* of the room or space must not exceed 5%.

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TABLE H.6 *Roof lights* - thermal performance of transparent and translucent elements

***Roof light* shaft index[1]**	**Total area of *roof lights*[2] serving the room or space as a percentage of the *floor area* of the room or space.**			
	Not more than 2%	**More than 2% to not more than 3%**	**More than 3% to not more than 4%**	**More than 4% to not more than 5%**
Less than 0.5	*SHGC* of not more than 0.83 and a *Total U-Value* of not more than 8.5	*SHGC* of not more than 0.57 and a *Total U-Value* of not more than 5.7	*SHGC* of not more than 0.43 and a *Total U-Value* of not more than 4.3	*SHGC* of not more than 0.34 and a *Total U-Value* of not more than 3.4
0.5 to less than 1.0	*SHGC* of not more than 0.83 and a *Total U-Value* of not more than 8.5	*SHGC* of not more than 0.72 and a *Total U-Value* of not more than 5.7	*SHGC* of not more than 0.54 and a *Total U-Value* of not more than 4.3	*SHGC* of not more than 0.43 and a *Total U-Value* of not more than 3.4
1.0 to less than 2.5	*SHGC* of not more than 0.83 and a *total U-Value* of not more than 8.5	*SHGC* of not more than 0.83 and a *Total U-Value* of not more than 5.7	*SHGC* of not more than 0.69 and a *Total U-Value* of not more than 4.3	*SHGC* of not more than 0.55 and a *Total U-Value* of not more than 3.4
2.5 and above	*SHGC* of not more than 0.83 and a *Total U-Value* of not more than 8.5	*SHGC* of not more than 0.83 and a *Total U-Value* of not more than 5.7	*SHGC* of not more than 0.83 and a *Total U-Value* of not more than 4.3	*SHGC* of not more than 0.83 and a *Total U-Value* of not more than 3.4

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Notes:

1. *Roof light* shaft index is determined by measuring the distance from the centre of the shaft at the roof to the centre of the shaft at the ceiling level and dividing it by the average internal dimension of the shaft opening at the ceiling level (Length + Width / 2) (or the diameter for a circular shaft) in the same units of measurement.
2. The area of a *roof light* is the area of the roof opening that allows light to enter the building and the total area of *roof lights* is the combined area for all *roof lights* serving the room or space.
3. The thermal performance of an imperforate ceiling diffuser may be included in the *Total U-Value* of the *roof light*.

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Explanatory information:

1. The *SHGC* and *Total U-Values* are expressed as Australian Fenestration Rating Council (AFRC) values.
2. The *SHGC* and *Total U-Values* are for a *roof light* with or without a ceiling diffuser. A *roof light* may achieve the *required* performance on its own or in conjunction with a ceiling diffuser.
3. The *SHGC* and the *Total U-Values* for some simple types of *roof lights* are shown in the table below. Smaller numbers indicate better *glazing* element performance. The table gives worst case assessments, which can be improved by obtaining generic or custom product assessments from suppliers, manufacturers, industry associations (including their online resources) and from competent assessors.

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WORST CASE WHOLE ROOF LIGHT ELEMENT PERFORMANCE VALUES WITHOUT A CEILING DIFFUSER OR WITH A PERFORATED CEILING DIFFUSER				
Translucent or transparent element description	**Domed panel**		**Flat, framed panel**	
	Total U-Value	***SHGC***	***Total U-Value***	***SHGC***
Single layer clear	8.4	0.80	8.0	0.79
Single tinted	8.4	0.66	7.9	0.63
Single layer translucent (‘opal’)	8.4	0.57	7.9	0.56
Double layer clear	5.4	0.71	4.9	0.70

WORST CASE WHOLE ROOF LIGHT ELEMENT PERFORMANCE VALUES WITH AN IMPERFORATED CEILING DIFFUSER				
Translucent or transparent element description	**Domed panel**		**Flat, framed panel**	
	Total U-Value	***SHGC***	***Total U-Value***	***SHGC***
Single layer clear	4.3	0.72	4.2	0.71
Single tinted	4.3	0.59	4.2	0.57
Single layer translucent (‘opal’)	4.3	0.51	4.2	0.50
Double layer clear	3.4	0.64	3.2	0.63

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H.4.6 *External walls*

(a) Each part of an *external wall* must satisfy the requirements of **Table H.7(a)** for all walls or **Table H.7(b)** for walls with a *surface density* of not less than 220kg/m^2 except for -

(i) opaque non-glazed openings in external walls such as doors (including garage doors), vents, penetrations, shutters and the like; and

(ii) glazing unless requi*red* by **Table H.7(b).**

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(b) A wall in **Table H.7(a)** that –

(i) has lightweight external cladding such as weatherboards, fibre cement or metal sheeting fixed directly to the metal frame and;

(ii) does not have a wall lining or has a wall lining that is fixed directly to the metal frame,

must have a thermal break, consisting of a material with an *R-Value* of not less than 0.2, installed between the metal frame and the external cladding.

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TABLE H.7(a) Options for each part of an *external wall*

Climate Zone	**Options**
4 and 5	(a) (i) Achieve a minimum *Total R-Value* of 2.8.
	(b) (i) Achieve a minimum *Total R-Value* of 2.4; and (ii) shade the *external wall* of the storey with a verandah, balcony, eaves, carport or the like which projects at a minimum angle of 15 degrees in accordance with **Figure H.1**
6	(a) Achieve a minimum *Total R-Value* of 2.8

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TABLE H.7(b) Options for each part of an *external wall* with a *surface density* of not less than *220kg/m^2*

Climate Zone	**Options**
5	(a) (i) For a storey, other than one with another storey above, shade the wall with a verandah, balcony, eaves, carport or the like which projects at a minimum angle of 15 degrees in accordance with **Figure H.1**; and (ii) when the *external walls* are not shaded in accordance with (i) and there is another storey above, external *glazing* complies with **H.5** with the applicable value for C_{SHGC} in **Table H.11** reduced by 15%; and (iii) the *external wall* incorporates insulation with an *R-Value* of not less than 0.5; and (iv) the lowest storey containing *habitable room*s has – (A) a concrete slab-on-ground floor; or (B) masonry *internal wall*s.
	(b) (i) Shade the wall with a verandah, balcony, eaves, carport or the like which projects at a minimum angle of 15 degrees in accordance with **Figure H.1;** and (ii) external *glazing* complies with **H.5** with the applicable value for C_{SHGC} in **Table H.11** reduced by 15%; and (iii) the lowest storey containing *habitable room*s has – (A) a concrete slab-on-ground floor; and (B) masonry *internal wall*s.

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Climate Zone	**Options**
4 and 6	(a) (i) The external *glazing* complies with **H.5** with the applicable value for C_U in **Table H.11** reduced by 15%; and (ii) the *external wall* incorporates insulation with a *R-Value* of not less than 0.5; and (iii) the lowest storey containing *habitable room*s has – (A) a concrete slab-on-ground floor; or (B) masonry *internal wall*s.
	(b) The external *glazing* complies with **H.5** with the applicable value for C_U in **Table H.11** reduced by 20%.
	(c) (i) The *external wall* incorporates insulation with an *R-Value* of not less then 1.0; and (ii) the lowest storey containing *habitable rooms* has – (A) a concrete slab-on-ground floor;or (B) masonry *internal walls*.

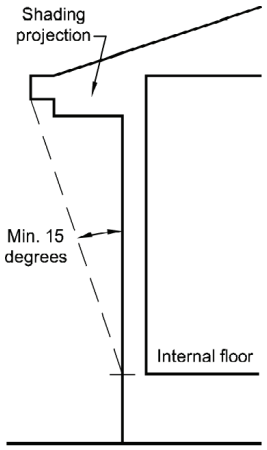

FIGURE H.1 Measurement of a projection for wall shading

(c) A thermal break may be provided by materials such as timber of not less than 20mm thickness, expanded polystyrene strips of not less than 12mm thickness or plastic strips that achieve the required R-Value.

(d) A wall is deemed to have the *Total R-Value* specified in **Figure H.2** if it has an airspace.

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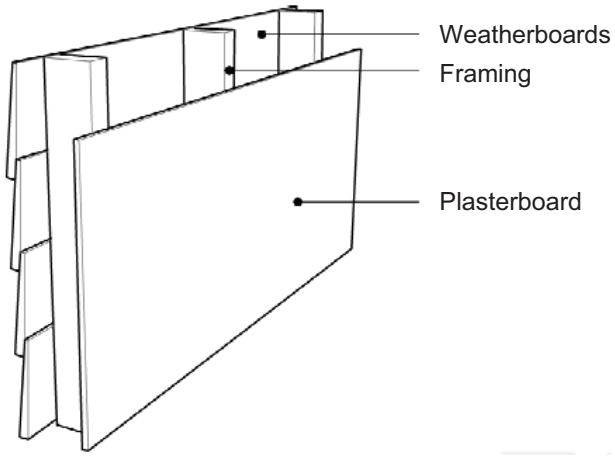
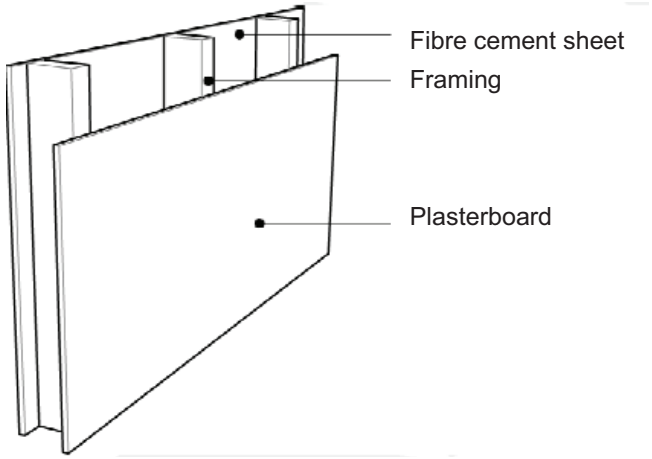
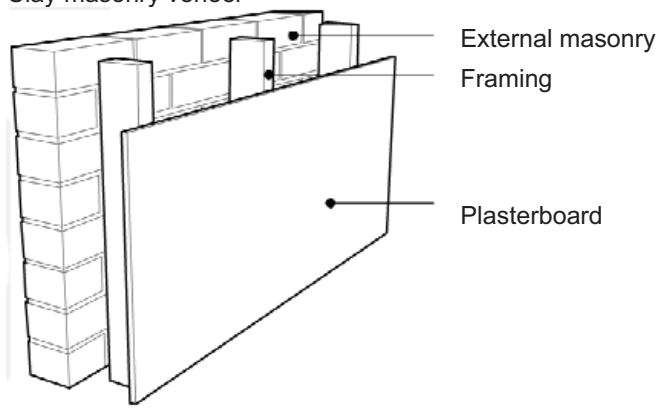
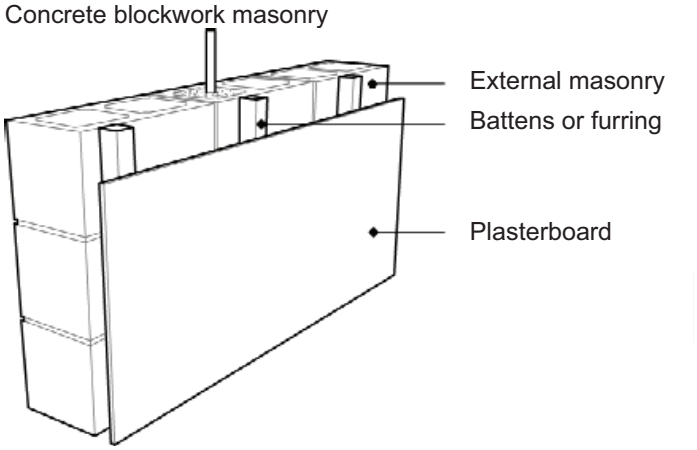
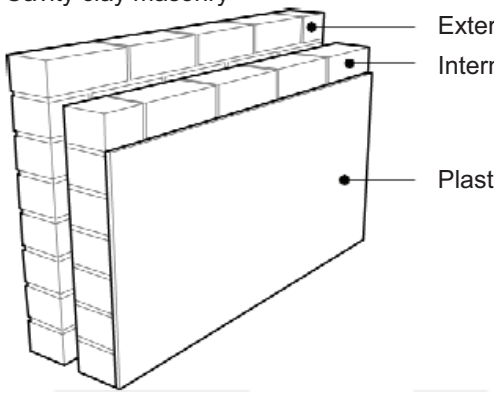
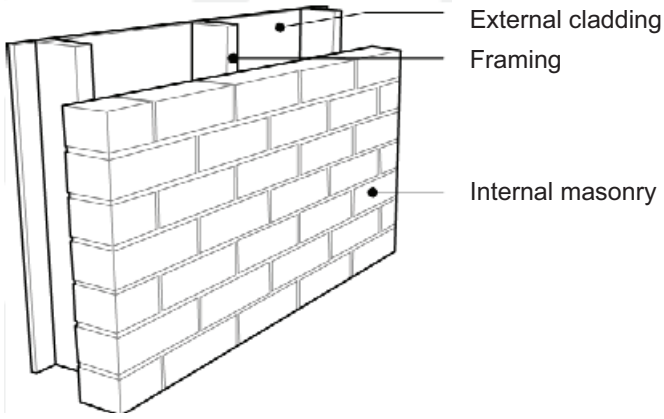
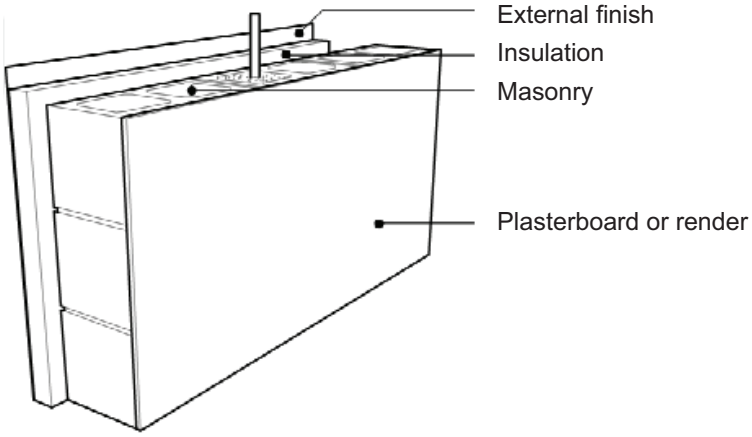
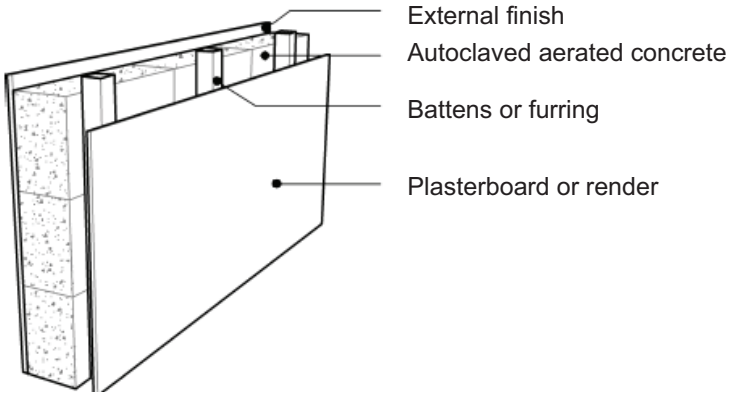
FIGURE H.2 *Total R-Value* for typical wall construction

***External wall* construction description**	***Total R-Value***
a) Weatherboard 	0.48
b) Cement sheet 	0.42
c) Clay masonry veneer 	0.56

d) Concrete blockwork masonry  	0.54
e) Cavity clay masonry  	0.69
f) Externally insulated clay masonry  	0.53

g) Externally insulated concrete masonry  	0.46
h) Autoclaved aerated concrete masonry  	2.42

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Notes:

1. **Figure H.2** provides examples of typical wall construction. The additional *R-Value required* can be calculated by subtracting the inherent *Total R-Value* of the typical wall construction in **Figure H.2** from the *required Total R-Value*.
2. Where a *cavity* or airspace is filled, the *Total R-Value* should be reduced by 0.17 to take into account the loss of the *cavity* or airspace.

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Explanatory information:

The following are examples of some typical wall constructions that achieve a surface density of 220 kg/m^2.

(a) Two leaves each of 90 mm thick or greater clay or concrete masonry.

(b) 140 mm thick or greater dense-weight hollow concrete or clay blocks with –

  (i) 10 mm plasterboard or render; and

  (ii) at least one concrete grouted horizontal bond beam; and

  (iii) vertical cores filled with concrete grout at centres not exceeding 1000 mm.

(c) 140 mm thick or greater concrete wall panels and dense-weight hollow concrete or clay blocks with all vertical cores filled with concrete grout.

(d) 190 mm thick or greater dense-weight hollow concrete or clay blocks with –

  (i) at least one concrete grouted horizontal bond beam; and

  (ii) vertical cores filled with concrete grout at centres not exceeding 1800 mm.

(e) Earth-wall construction with a minimum wall thickness of 200 mm.

H.4.7 Floors

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(a) A concrete slab-on-ground with an in-slab heating or cooling system must have insulation with an *R-Value* of not less than 1.0, installed around the vertical edge of its perimeter; and

(i) be water resistant; and

(ii) be continuous from the adjacent finished ground level –

(A) to a depth of not less than 300mm; or

(B) for at least the full depth of the vertical edge of the concrete slab-on-ground.

An under tile or in-screed heating system is not considered to be an in-slab heating system.

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(b) A suspended floor closest to ground level (that is, not an intermediate floor in a building with more than one storey) must achieve the minimum *required Total R-Value* specified in **Table H.9**; and

(i) where an in-slab heating or cooling system is installed, the suspended floor must be insulated -

(A) around the vertical edge of its perimeter with insulation having an *R-Value* of not less than 1.0; and

(B) underneath the slab with insulation having an *R-Value* of not less than 2.0 which may include insulation *required* by (A).

(ii) where enclosed beneath, must have a barrier installed at floor level between the air space under the floor and any wall *cavities*.

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(c) A suspended floor is deemed to have the *Total R-Value* for construction in **Table H.10**.

Notes:

1. An enclosed perimeter treatment means that the air space under the floor is enclosed between ground and floor level by walls which have only the *required* sub-floor vents.
2. The barrier required by **H.4.7(b)(ii)** could be an imperforate flashing.
3. Specific solutions for concrete slab and timber floors can be found in documents and online resources prepared by industry associations and product suppliers.

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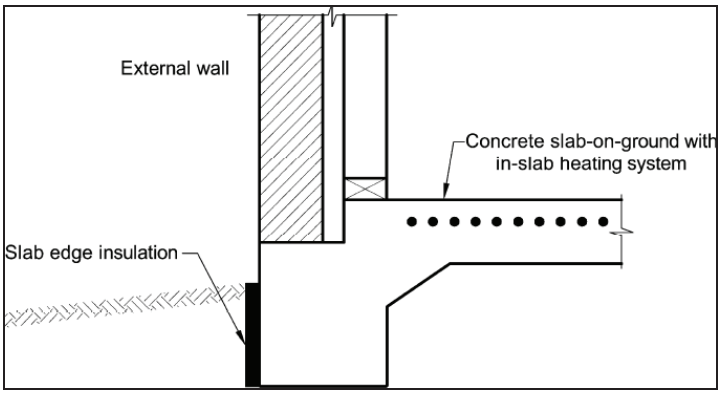

FIGURE H.3 Insulation of slab edge

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TABLE H.9 Suspended floor - Minimum *Total R-Values*

	Climate Zone		
	4	**5**	**6**
Minimum *Total R-Value*	2.25	1.0	2.25

Notes:
1. For an enclosed perimeter treatment, the underfloor air space and its enclosure may be included in the *Total R-Value* calculation.

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TABLE H.10 *Total R-Values* for typical suspended floor construction (for a floor without a floor heating system)

Floor construction description	Enclosure and height of floor	Direction of heat flow	*Total R-Value*			
			Cavity brickwork	1900mm concrete blockwork	Single skin brickwork	9mm fibre cement sheet
Suspended timber floor	**Enclosed** – not more than 0.6m high	Downwards	1.11	1.06	1.01	0.90
	Enclosed – more than 0.6m but to not more than 1.2m high	Downwards	1.0	0.94	0.89	0.77
	Enclosed – more than 1.2m but to not more than 2.4m high	Downwards	0.89	0.84	0.79	0.69
	Unenclosed	Downwards	0.51			
Suspended concrete floor	**Enclosed** – not more than 0.6m high	Downwards	1.06	1.01	0.96	0.85
	Enclosed – more than 0.6m but to not more than 1.2m high	Downwards	0.94	0.89	0.84	0.72
	Enclosed – more than 1.2m but to not more than 2.4m high	Downwards	0.84	0.79	0.74	0.64
	Unenclosed	Downwards	0.46			

Note
1. The height of the floor is measured from ground surface to the underside of the floor or the insulation.

H.4.8 Attached Class 10a buildings

A Class 10a building that is attached to a Class 1a building must –

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(a) comply with the requirements of **clause H.4**; or

(b) be separated from a Class 1a building by construction that complies with **clause H.4**; or

(c) in *climate zone* 5 –

(i) be enclosed by masonry walls other than where there are doors and *glazing*; and

(ii) be separated from the Class 1a building with a masonry wall that extends to the ceiling or roof; and

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(iii) achieve a *Total R-Value* in the roof equivalent to that *required* for a Class 1a building; and

(iv) not have a garage door facing the east or west orientation other than if the Class 1a building *glazing* complies with **clause H.5** with the applicable value for C_{SHGC} in **Table H.11** reduced by 15%.

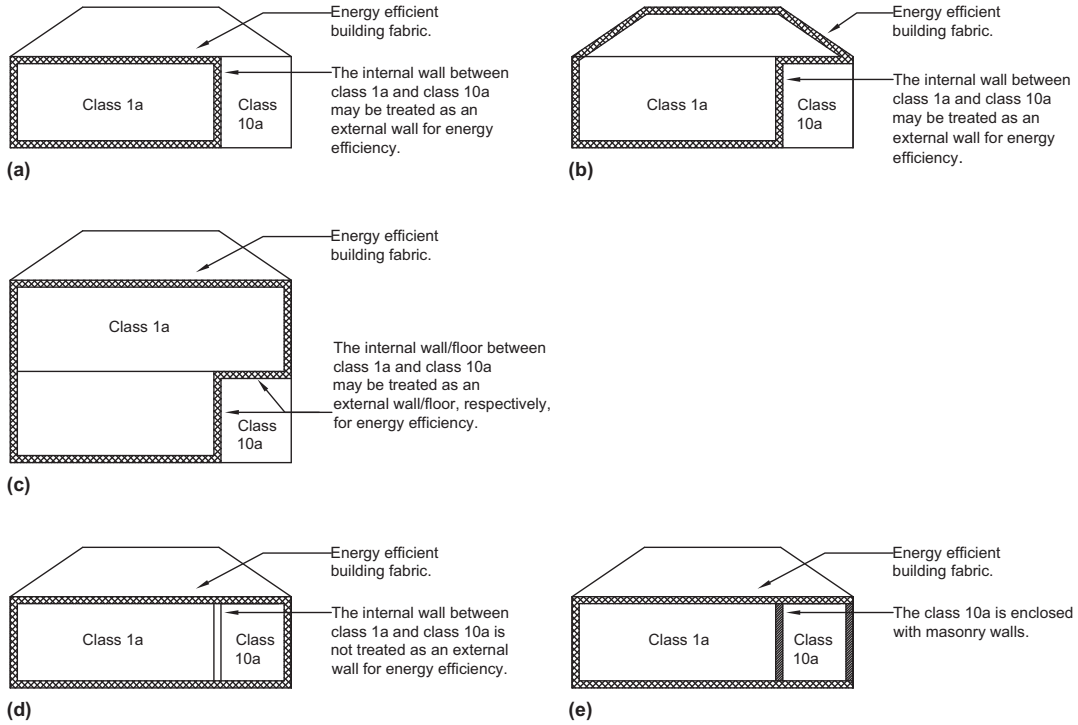

FIGURE H.4 Examples of the location of continuous thermal barriers for attached Class 10a buildings

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H.5 EXTERNAL GLAZING

The *glazing* in each storey of a building must comply with the requirements for conductance (**clause H.5.1**) and solar heat gain (**clause H.5.2**).

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H.5.1 Conductance

The aggregate conductance of the *glazing* in each storey, including any mezzanine, of a building must not exceed the allowances resulting from using the Constant C_U, obtained from **Table H.11**.

$C_{u\ (allowance)} \geq C_{u\ (Aggregate)}$

The aggregate conductance of the *glazing* in each storey, including any mezzanine, of a building must be calculated in accordance with the following formulae –

$$C_{u\ (Aggregate)} = [(A_1 x U_1) + (A_2 x U_2) + ...] / [(A_1 \times SHGC_1 \times E_{W1}) + (A_2 \times SHGC_2 \times E_{W2}) + ...]$$

Where

$A_{1,2\ etc}$ = the area of each *glazing* element
$U_{1,2\ etc}$ = the *Total U-Value* of each *glazing* element
$SHGC_{1,\ 2\ etc}$ = the *SHGC* for each glazing element
$E_{W1\ W2\ etc}$ = the winter exposure factor for each *glazing* element, determined from **Tables H.13(a), H.14(a) and H.15(a).**

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TABLE H.11 Constants for conductance and solar heat gain

Floor construction (refer notes)	Air movement (refer notes)	Constant	*Climate Zone*		
			4	5	6
Floor in direct contact with the ground	Standard	C_U	7.929	13.464	6.418
		C_{SHGC}	0.097	0.122	0.153
	High	C_U	7.929	13.464	6.418
		C_{SHGC}	0.107	0.134	0.168
Suspended Floor	Standard	C_U	7.136	12.118	5.776
		C_{SHGC}	0.087	0.110	0.138
	High	C_U	7.136	12.118	5.776
		C_{SHGC}	0.096	0.121	0.152

Notes:

1. A floor in direct contact with the ground includes a concrete slab-on-ground or concrete slab-on-fill.
2. A suspended floor includes a suspended concrete floor, suspended timber floor or suspended steel framed floor.
3. A storey has Standard air movement if all *habitable room*s comply with **H.7.**1.
4. A storey has High air movement if -
   (a) in *Climate Zone* 4 –
      (i) the total *ventilation opening* area serving the *habitable rooms* is not less than 20% of the *floor area* when no ceiling fans or evaporative coolers are installed; or
      (ii) the total *ventilation opening* area serving the *habitable rooms* is not less than 10% of the *floor area*, and all *habitable rooms* have ceiling fans complying with **H.7.3**.
   (b) in *Climate Zone* 5 –
      (i) the total *ventilation opening* area serving the *habitable rooms* is not less than 15% of the *floor area* when no ceiling fans or evaporative coolers are installed; or
      (ii) the total *ventilation opening* area serving the *habitable rooms* is not less than 7.5% of the *floor area*, and all *habitable rooms* have ceiling fans complying with **H.7.3**.
   (c) in *Climate Zone* 6, the total *ventilation opening* area serving the *habitable rooms* is not less than 10% of the *floor area*.
5. Where the *ventilation opening* area serving the *habitable rooms* is between Standard and High, interpolation may be used to determine the applicable C_{SHGC}
6. Where the floor construction of a storey, including a mezzanine, is partly in direct contat with the ground and partly suspended, the constants for conductance and solar heat gain are to be –
   (a) interpolated between the constants for the two constructions in proportion to their respective areas; or
   (b) those for a suspended floor.
7. The provisions of **H.5** assume that internal *window* coverings will be installed for privacy reasons. This assumption is already incorporated in the allowances for *glazing*.

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An example of the determination of standard or high air movement

The level of a storey's air movement depends on the total *ventilation opening* area provided to the *habitable rooms* on that storey. For example, from **Table H.16** a storey of a house in *climate zone* 5 with ceiling fans in all *habitable rooms* is *required* to have a minimum total *ventilation opening* per *habitable room* of 5%. This equates to standard air movement. To achieve high air movement the total *ventilation opening* for the storey must be increased such that a further amount of *ventilation opening* is provided that is equal to the standard requirement (in this case a further 5%). The additional *ventilation opening* area can be distributed to any of the *habitable room*s on the storey.

TABLE H.12 Indicative ranges of whole *glazing* element performance values

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Glass description	Aluminium framing		Timber or uPVC framing	
	***Total U-Value* range**	***SHGC* range**	***Total U-Value* range**	***SHGC* range**
Single (monolithic or laminated)				
Clear	7.9 – 5.5	0.81 – 0.64	5.6 – 4.3	0.77 – 0.51
Tinted	7.9 – 5.6	0.65 – 0.33	5.6 – 4.3	0.61 – 0.25
Coated	7.8 – 3.8	0.68 – 0.36	5.5 – 2.9	0.64 – 0.27
Tinted and coated	7.8 – 3.8	0.45 – 0.31	5.5 – 3.1	0.42 – 0.23
Double				
Clear	6.2 – 3.1	0.72 – 0.63	3.8 – 2.5	0.68 – 0.47
Tinted	6.2 – 3.1	0.57 – 0.36	3.8 – 2.5	0.57 – 0.27
Coated	6.1 – 2.4	0.60 – 0.22	3.8 – 2.1	0.59 – 0.17

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Note:
Reference to *glazing* elements requires the *Total U-Values* and *SHGC's* to be assessed for the combined effects of the frame and its *glazing*. The measurement of *Total U-Values* and *SHGC's* is specified in the Technical Protocols and Procedures Manual for Energy Rating of Fenestration Products by the Australian Fenestration Rating Council (AFRC). The values in this table are shown for simple types of *glazing* elements. The use of generic or custom assessments from suppliers, manufacturers, industry associations can improve these values.

H.5.2 Solar heat gain

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The aggregate solar heat gain of the *glazing* in each storey, including any mezzanine, of a building must not exceed the allowances resulting from multiplying the floor area of the storey, including any mezzanine, measured within the enclosing walls, by the constant C_{SHGC} determined from **Table H.11**.

$C_{SHGC\ (allowance)} \geq C_{SHGC\ (Aggregate)}$

The aggregate solar heat gain of the *glazing* in each storey, including any mezzanine, of a building is calculated in accordance with the following formula –

$$C_{SHGC\ (Aggregate)} = (A_1 \times SHGC_1 \times E_{S1}) + (A_2 \times SHGC_2 \times E_{S2}) + (A_3 \times SHGC_3 \times E_{S3}) + \ldots$$

Where

$A_{1,2\ etc}$ = the area of each *glazing* element
$SHGC_{1,2\ etc}$ = the *SHGC* for each *glazing* element
$E_{S1,2\ etc}$ = the summer exposure factor for each *glazing* element, determined in accordance with **Tables H.13(b), H.14(b) and H.15(b).**

H.5.3 Determination of exposure factor

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The exposure actor for each *glazing* element must be determined from **Table H.13(b)** for *climate zone* 4, **Table H.14(b)** for *climate zone* 5 or **H.15(b)** for *climate zone* 6.

Note: Exposure factors for P/H values between those shown in **Tables H.13(b), H.14(b)** and **H.15(b)** can be interpolated.

(a) For the purposes of **Tables H.13(b), H.14(b)** and **H.15(b)**, the orientation sector that a *glazing* element faces is the direction of a perpendicular line from that *glazing* element (**Refer Figure H.5(a)**).

Where a *glazing* element faces more than one orientation sector, such as for bay windows and the like, the solar exposure factor for each orientation of the *glazing* element must be determined separately (**Refer Figure H.5(b)**).

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(b) For the purposes of **Tables H.13(b), H.14(b)** and **H.15(b)**, the P/H for the shading associated with each *glazing* element must be determined in accordance with **Figure H.6**.The projection distance (P) must be divided by the vertical distance (H) in mm.

Where a *glazing* element faces more than one orientation sector, such as for bay windows and the like, the P/H for each orientation of the *glazing* element must be determined separately (**Refer Figure H.5(b)**).

Angled *glazing* elements, including those in bay windows, where the projection distance (P) varies, must use the average distance (P_{avg}) to determine the solar factor (**Refer Figure H.5(c)**).

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TABLE H.13(a) Winter exposure factor (E_W) – *Climate Zone* 4

CLIMATE ZONE 4								
P/H (determined from Figure H.6)	**Orientation sector (refer Figure H.5)**							
	North	**North east**	**East**	**South east**	**South**	**South west**	**West**	**North west**
0.00	1.97	1.51	0.83	0.39	0.35	0.39	0.85	1.53
0.05	1.93	1.45	0.76	0.33	0.29	0.33	0.79	1.47
0.10	1.91	1.40	0.74	0.31	0.28	0.31	0.75	1.42
0.20	1.62	1.28	0.67	0.28	0.25	0.28	0.68	1.28
0.40	1.48	1.09	0.56	0.24	0.22	0.24	0.58	1.10
0.60	1.22	0.90	0.49	0.21	0.19	0.21	0.49	0.90
0.80	1.06	0.74	0.43	0.19	0.18	0.19	0.44	0.75
1.00	0.85	0.66	0.37	0.17	0.16	0.17	0.37	0.64
1.20	0.61	0.51	0.33	0.15	0.16	0.16	0.34	0.56
1.40	0.47	0.47	0.30	0.14	0.15	0.15	0.30	0.47
1.60	0.34	0.41	0.28	0.14	0.14	0.14	0.26	0.41
1.80	0.26	0.35	0.25	0.13	0.14	0.13	0.24	0.35
2.00	0.24	0.32	0.22	0.12	0.13	0.12	0.22	0.29

TABLE H.14(a) Winter exposure factor (E_W) – *Climate Zone* 5

CLIMATE ZONE 5								
P/H (determined from Figure H.6)	**Orientation sector (refer Figure H.5)**							
	North	**North east**	**East**	**South east**	**South**	**South west**	**West**	**North west**
0.00	2.01	1.48	0.77	0.39	0.37	0.39	0.85	1.58
0.05	1.95	1.42	0.70	0.33	0.31	0.33	0.78	1.51
0.10	1.95	1.36	0.66	0.31	0.30	0.32	0.75	1.47
0.20	1.63	1.21	0.59	0.28	0.27	0.28	0.67	1.32
0.40	1.49	1.00	0.49	0.24	0.23	0.24	0.55	1.10
0.60	1.21	0.83	0.40	0.21	0.21	0.21	0.47	0.90
0.80	0.98	0.68	0.35	0.19	0.19	0.19	0.42	0.73
1.00	0.80	0.52	0.28	0.17	0.18	0.17	0.36	0.63
1.20	0.54	0.46	0.25	0.16	0.17	0.16	0.29	0.50
1.40	0.40	0.34	0.21	0.15	0.16	0.15	0.28	0.43
1.60	0.28	0.30	0.19	0.14	0.14	0.13	0.23	0.36
1.80	0.22	0.25	0.16	0.13	0.14	0.13	0.20	0.32
2.00	0.18	0.19	0.15	0.12	0.14	0.12	0.19	0.24

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TABLE H.15(a) Winter exposure factor (E_W) – *Climate Zone* 6

CLIMATE ZONE 6								
P/H (determined from Figure H.6)	**Orientation sector (refer Figure H.5)**							
	North	**North east**	**East**	**South east**	**South**	**South west**	**West**	**North west**
0.00	1.90	1.43	0.80	0.45	0.43	0.45	0.88	1.53
0.05	1.84	1.35	0.73	0.38	0.36	0.38	0.81	1.45
0.10	1.82	1.30	0.70	0.36	0.34	0.36	0.76	1.42
0.20	1.56	1.17	0.62	0.32	0.30	0.32	0.70	1.30
0.40	1.43	1.01	0.53	0.27	0.26	0.27	0.60	1.10
0.60	1.22	0.86	0.45	0.23	0.23	0.23	0.52	0.95
0.80	1.08	0.73	0.38	0.21	0.21	0.22	0.46	0.79
1.00	0.86	0.58	0.34	0.19	0.19	0.19	0.39	0.69
1.20	0.70	0.54	0.29	0.18	0.17	0.18	0.36	0.58
1.40	0.53	0.41	0.26	0.16	0.17	0.17	0.32	0.52
1.60	0.44	0.37	0.22	0.15	0.16	0.15	0.28	0.44
1.80	0.32	0.30	0.21	0.14	0.15	0.14	0.27	0.40
2.00	0.25	0.27	0.20	0.13	0.14	0.14	0.24	0.32

Explanatory information

1. Higher exposure factor (E_W) values in **Tables H.13(a), H.14(a) and H.15(a)** indicate greater exposure to desirable winter solar gains and should be adopted as far as possible.

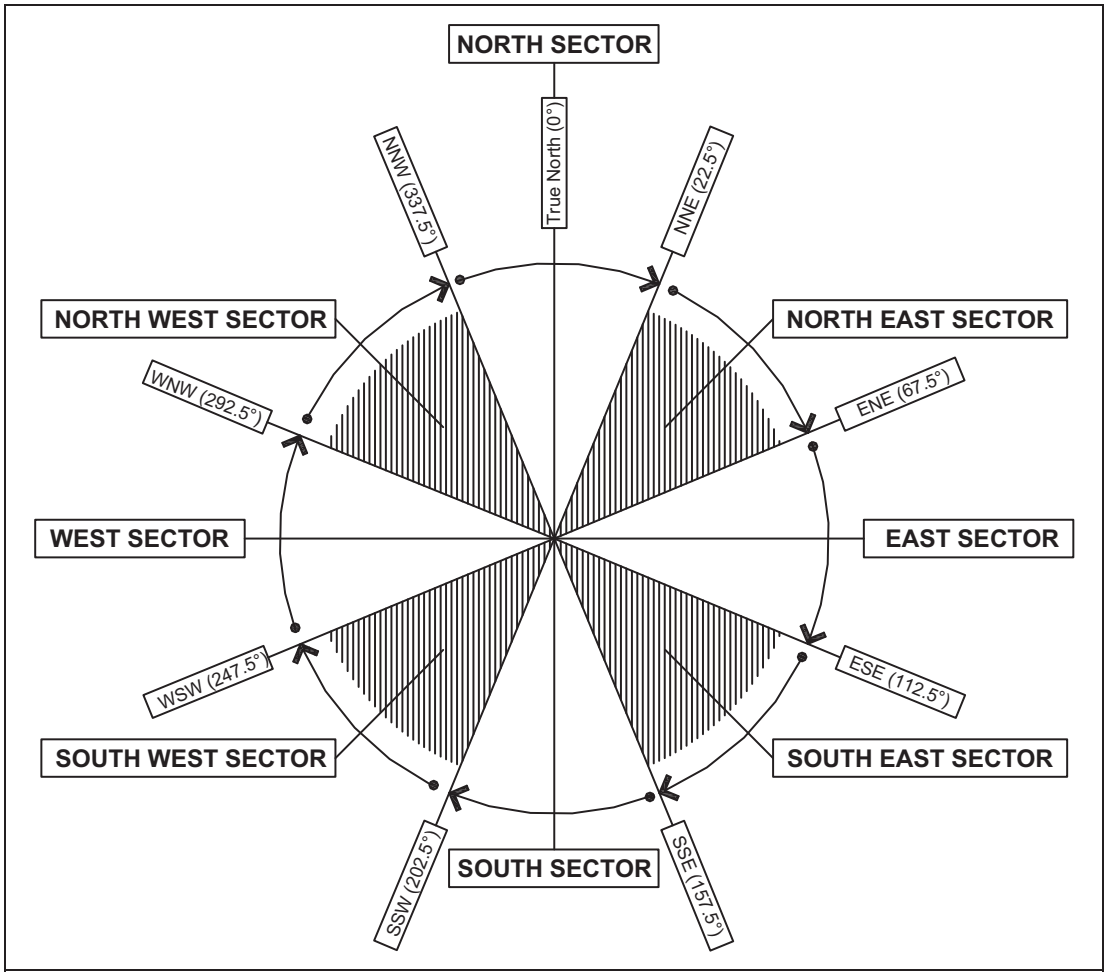

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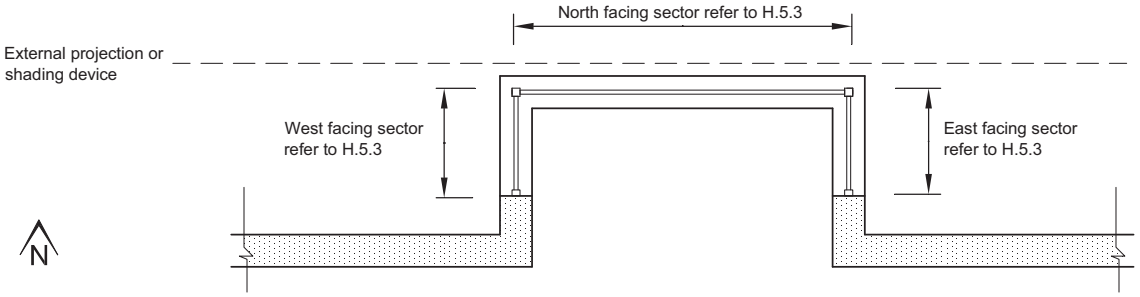
FIGURE H.5(a) Orientation sectors



Determination of orientation sectors for bay windows and the like:

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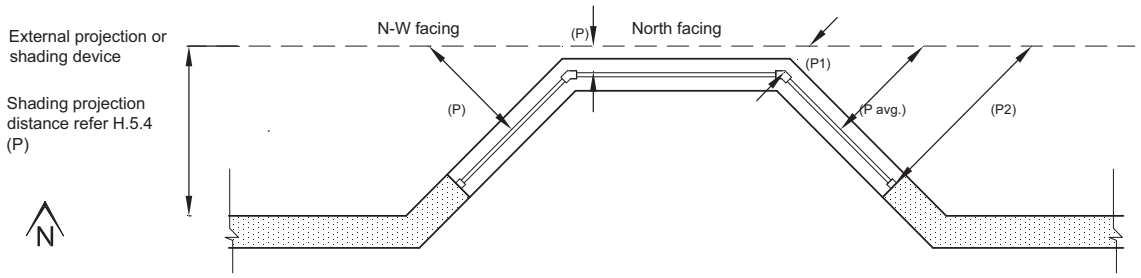
FIGURE H.5(b) Determination of orientation sectors for bay windows and the like



Determination of shading projections for angled glazing:
P avg. = (P1+P2) /2

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FIGURE H.5(c) Determination of shading projections for angled *glazing*

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TABLE H.13(b) Summer exposure factor (E_S) – *Climate Zone* 4

***CLIMATE ZONE* 4**								
P/H (determined from Figure H.6)	**Orientation sector (refer Figure H.5)**							
	North	**North east**	**East**	**South east**	**South**	**South west**	**West**	**North west**
0.00	0.72	1.19	1.40	1.05	0.57	0.99	1.31	1.12
0.05	0.61	1.10	1.31	0.97	0.49	0.91	1.22	1.02
0.10	0.56	1.00	1.24	0.91	0.46	0.85	1.17	0.94
0.20	0.43	0.87	1.12	0.82	0.41	0.76	1.05	0.81
0.40	0.30	0.66	0.92	0.67	0.34	0.62	0.85	0.62
0.60	0.27	0.50	0.74	0.56	0.29	0.53	0.72	0.45
0.80	0.24	0.38	0.63	0.49	0.25	0.45	0.59	0.36
1.00	0.20	0.31	0.55	0.42	0.22	0.39	0.51	0.30
1.20	0.19	0.26	0.46	0.37	0.20	0.35	0.45	0.25
1.40	0.16	0.23	0.39	0.34	0.17	0.33	0.38	0.21
1.60	0.16	0.20	0.38	0.30	0.16	0.29	0.33	0.20
1.80	0.14	0.18	0.32	0.27	0.14	0.25	0.32	0.17
2.00	0.13	0.17	0.28	0.23	0.14	0.24	0.26	0.16

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TABLE H.14(b) Summer exposure factor (E_S) – *Climate Zone* 5

CLIMATE ZONE 5								
P/H (determined from Figure H.6)	**Orientation sector (refer Figure H.5)**							
	North	**North east**	**East**	**South east**	**South**	**South west**	**West**	**North west**
0.00	0.82	1.09	1.19	0.96	0.68	1.04	1.30	1.16
0.05	0.69	0.96	1.07	0.85	0.57	0.92	1.19	1.04
0.10	0.63	0.88	1.01	0.79	0.54	0.86	1.11	0.94
0.20	0.51	0.76	0.89	0.70	0.48	0.76	0.99	0.83
0.40	0.39	0.58	0.71	0.57	0.38	0.62	0.81	0.62
0.60	0.35	0.46	0.58	0.47	0.33	0.51	0.65	0.48
0.80	0.30	0.37	0.50	0.40	0.28	0.43	0.52	0.40
1.00	0.26	0.31	0.42	0.34	0.25	0.37	0.46	0.31
1.20	0.24	0.26	0.36	0.30	0.22	0.33	0.40	0.27
1.40	0.21	0.23	0.32	0.27	0.20	0.29	0.34	0.24
1.60	0.20	0.22	0.29	0.23	0.18	0.27	0.30	0.21
1.80	0.18	0.20	0.25	0.21	0.17	0.23	0.27	0.20
2.00	0.17	0.17	0.24	0.21	0.16	0.21	0.25	0.19

TABLE H.15(b) Summer exposure factor (E_S) – *Climate Zone* 6

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CLIMATE ZONE 6								
P/H (determined from Figure H.6)	**Orientation sector (refer Figure H.5)**							
	North	**North east**	**East**	**South east**	**South**	**South west**	**West**	**North west**
0.00	0.84	1.08	1.15	0.87	0.61	1.05	1.40	1.24
0.05	0.71	0.97	1.05	0.78	0.52	0.96	1.30	1.13
0.10	0.65	0.90	0.99	0.74	0.49	0.91	1.25	1.04
0.20	0.52	0.77	0.88	0.65	0.44	0.82	1.12	0.91
0.40	0.36	0.58	0.71	0.54	0.36	0.67	0.90	0.69
0.60	0.30	0.43	0.61	0.45	0.31	0.58	0.76	0.51
0.80	0.26	0.35	0.50	0.38	0.26	0.50	0.66	0.40
1.00	0.22	0.29	0.42	0.32	0.23	0.42	0.56	0.36
1.20	0.20	0.24	0.37	0.29	0.23	0.39	0.48	0.29
1.40	0.18	0.22	0.32	0.26	0.19	0.34	0.42	0.26
1.60	0.16	0.19	0.28	0.24	0.18	0.31	0.38	0.21
1.80	0.15	0.18	0.26	0.22	0.17	0.28	0.34	0.20
2.00	0.14	0.17	0.24	0.21	0.17	0.26	0.31	0.17

Explanatory information

1. Higher exposure factor (E_S) values in **Tables H.13(b), H.14(b) and H.15(b)** indicate greater exposure to unwanted summer solar gains and should be avoided as far as possible.

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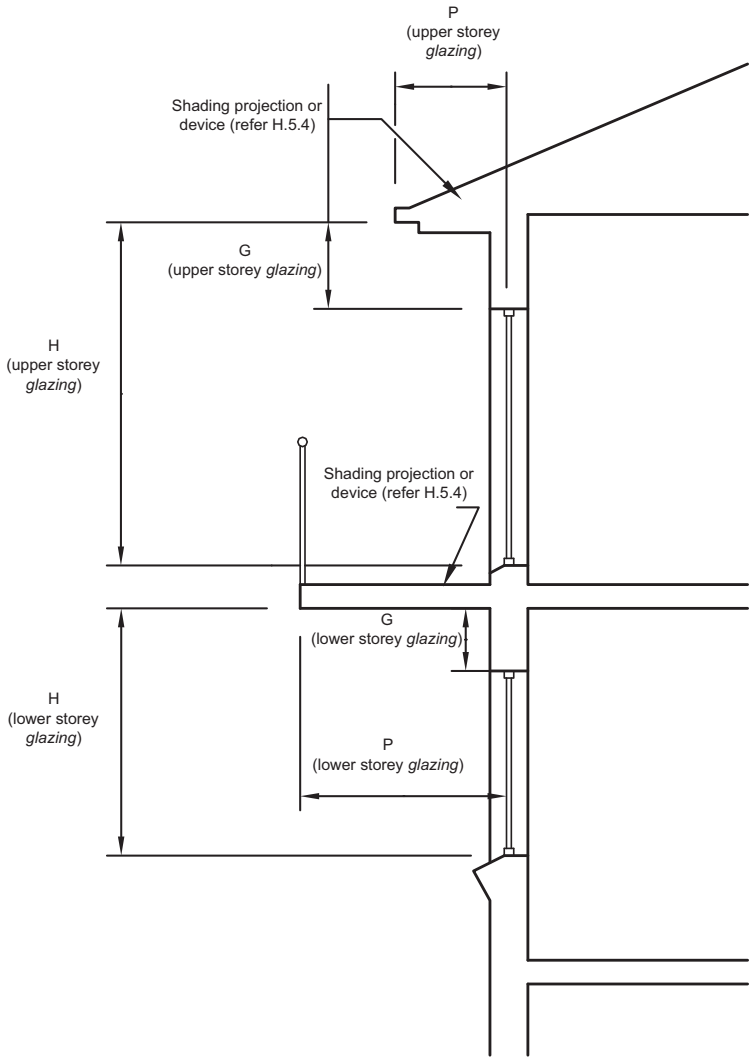

FIGURE H.6 Shading projection – determination of P/H for Tables H.13, H.14 and H.15 (the projection distance (P) in mm, divided by the vertical distance (H) in mm)

Notes:

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1. Where G exceeds 500 mm, the value of P must be halved.
2. An external shading device that complies with **H.5.4(b)** is considered to achieve a P/H value of 2.

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H.5.4 Shading

Shading *required* for compliance with the external *glazing* requirements must-

(a) be provided by an external permanent projection such as a verandah, eaves, balcony fixed canopy, carport or shading hood which -

(i) extends horizontally on both sides of the *glazing* for a distance not less than the projection distance P; or

(ii) provides the equivalent shading to **(i)** with a reveal or the like; or

(b) be provided by an external shading device, such as a shutter, blind, vertical or horizontal building screen with blades, battens or slats, which -

(i) is capable of restricting 80% of the summer solar radiation; and

(ii) if adjustable, is readily operated either manually, mechanically or electronically by the building occupants.

Gutters can be considered as part of the shading device if attached to a shading projection such as verandah, eaves, balcony fixed canopy, carport or shading hood or the like.

Shading devices can be either attached or located adjacent to the building. A free standing lattice can be considered as a shading device if it complies with **H.5.4(b).**

H.6 BUILDING SEALING

H.6.1 General

The requirements of **H.6 Building Sealing** do not apply to:

(a) a permanent building *ventilation opening* that is necessary for the safe operation of a gas appliance; or

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(b) a building in *Climate Zone* 5 where the only means of air-conditioning is by an evaporative cooler; or

(c) a Class 10a building used for the accommodation of vehicles.

H.6.2 Chimneys and flues

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The chimney or flue of an open solid-fuel burning appliance (such as a heater that burns timber, coal and the like), must be provided with a damper or flap that can be closed to seal the chimney or flue.

H.6.3 Roof lights

(a) A *roof light* must be sealed, or capable of being sealed, when serving a *conditioned space* or a *habitable room*.

(b) A *roof light required* by **(a)** to be sealed, or capable of being sealed, must be constructed with –

(i) an imperforate ceiling diffuser or the like installed at the ceiling or internal lining level; or

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(ii) a weatherproof seal; or

(iii) a shutter system readily operated either manually, mechanically or electronically by the occupant.

H.6.4 External *windows* and doors

(a) A seal to restrict air infiltration must be fitted to each edge of an external door and openable *window* when serving a *conditioned space* or a *habitable room*.

(b) A *window* complying with the maximum air infiltration rates specified in AS 2047 need not comply with **(a)**.

(c) A seal *required* by **(a)** –

(i) must be a draught protection device for the bottom edge of an external swing door; and

(ii) for the other edges of an external swing door, or the edges of an openable *window* and other such openings, may be a foam or rubber compressible strip, fibrous seal or the like.

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H.6.5 Exhaust fans

An exhaust fan must be fitted with a sealing device such as a self closing damper, filter or the like when serving a *conditioned space* or a *habitable room*.

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H.6.6 Evaporative coolers

An evaporative cooler must be fitted with a self closing damper or the like when serving a heated space, or a *habitable room*.

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H.6.7 Construction of roofs, walls and floors

(a) Roofs, *external walls*, external floors and any opening such as a *window* frame, door frame, roof light frame or the like must be constructed to minimise air leakage in accordance with **(b)** when forming part of the external fabric of a *conditioned space* or a *habitable room*.

(b) Construction *required* by **(a)** must be –

(i) enclosed by internal lining systems that are close fitting at ceiling, wall and floor junctions; or

(ii) sealed by caulking, skirting, architraves,cornices or the like.

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H.7 AIR MOVEMENT

H.7.1 Air movement in *habitable room*s

(a) Air movement must be provided to habitable rooms in accordance with Table H.16.

(b) Where air movement cannot be provided to a *habitable room* through a *ventilation opening* in an *external wall*, it may be provided through an opening from an adjoining room (including an enclosed verandah) if –

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(i) the adjoining room is not a sanitary compartment; and

(ii) the opening between the adjoining room and the habitable room complies with Table H.16 as if it were a ventilation opening to the habitable room or a portion thereof if some ventilation is provided to the habitable room from another source; and

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(iii) the ventilation opening to the adjoining room complies with Table H.16 for the total area of the floor of the adjoining room and the proportion of the habitable room that is ventilated from the adjoining room.

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TABLE H.16 Provision for air movement in *habitable room*s

Climate zones	**Minimum total *ventilation opening* area per *habitable room* (percentage of the area of the floor of the *habitable room*)**	
	Without a ceiling fan	**With a ceiling fan**
4	10 %	5 %
5	7.5 %	5 %
6	As *required* by Clause D.6	

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H.7.2 Ventilation openings

(a) In *climate zones* 4 and 5, the total *ventilation opening* area *required* by **Table H.16**, for a *habitable room* must be –

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(i) a single *ventilation opening* that must be connected by a breeze path to another ventilation opening in another room or space; or

(ii) provided by a minimum of two ventilation openings located within the same habitable room, with each ventilation opening having an area of not less than 25% of the area *required* by **Table H.16**.

(b) A breeze path *required* by this clause must -

(i) not pass through more than two openings in the internal walls, with each opening having an area of not less than 1.5 m2; and

(ii) have a distance between *ventilation openings* of not more than 20 m (**Refer Figure H.7**).

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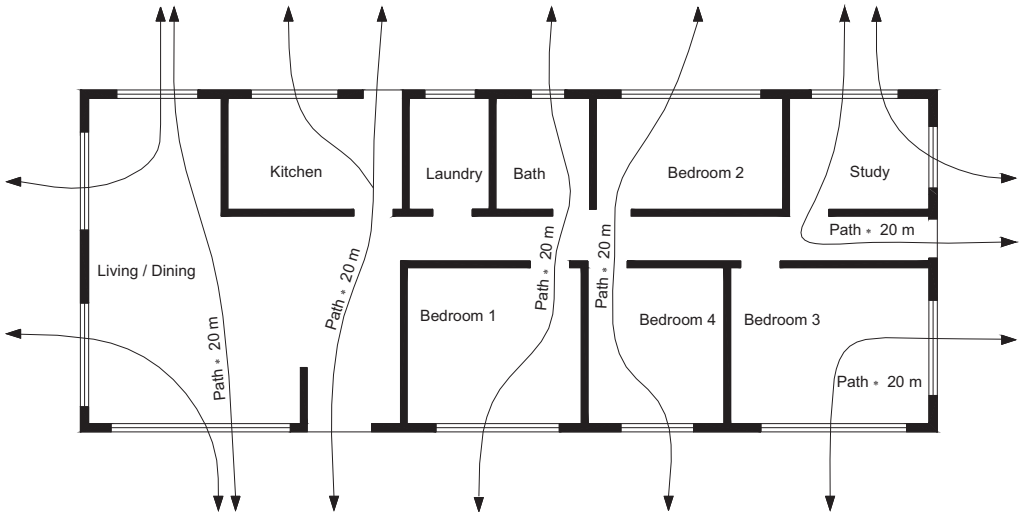

FIGURE H.7 Breeze paths

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H.7.3 Ceiling fans and evaporative coolers

A ceiling fan or evaporative cooler *required* to comply with **H.1(a)(ii)**, **Table H.11** or **Table H.16** must –

(a) be permanently installed; and

(b) have a speed controller; and

(c) for a ceiling fan, have a blade rotation diameter of not less than –

(i) 900 mm for a space of not more than $15m^2$; and

(ii) 1200 mm for a space of not more than $25m^2$.

H.8 SERVICES

H.8.1 General

The energy efficiency requirements of the *BCA* contain provisions for the insulation of hot water supply systems. These requirements are satisfied if the hot water supply system / heated water service is designed and installed in accordance with the Waterworks Act 1932 and the Waterworks Regulations 1996.

Refer to **Section 8** for typical materials for pipes and fittings and their limitations.

H.8.2 Heating and cooling ductwork and fittings

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(a) Heating and cooling ductwork and fittings must -

(i) achieve the material *R-value* in accordance with **Table H.17**; and

(ii) be sealed against air loss –

(A) by closing all openings in the surface, joints and seams of ductwork with adhesives, mastics, sealants or gaskets in accordance with AS 4254 for a Class C seal; or

(B) for flexible ductwork, with a draw band in conjunction with a sealant or adhesive tape.

(b) Duct insulation must –

(i) abut adjoining duct insulation to form a continuous barrier; and

(ii) be installed so that it maintains its position and thickness, other than at flanges and supports; and

(iii) where located outside of the building, under a suspended floor, in an attached Class 10a building or in a roof space –

(A) be protected by an outer sleeve of protective sheeting to prevent the insulation becoming damp; and

(B) have the outer protective sleeve sealed with adhesive tape not less than 48mm wide creating an airtight and waterproof seal.

(c) Any flexible ductwork used for the transfer of products, initiating from a heat source that contains a flame, must also achieve the fire hazard properties *required* by **clause F.7.5**.

TABLE H.17 Minimum material *R-Value* for heating and cooling ductwork and fittings

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Ductwork element	Heating only system or cooling only system including an evaporative cooling system	Combined heating and refrigerated cooling system	
	***Climate Zones* 4, 5 and 6**	***Climate Zones* 4 and 6**	***Climate Zone* 5**
Ductwork	1.0	1.5	1.0
Fittings	0.4		

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(d) Materials that can be used to insulate heating and cooling ductwork and fittings and their relative material *R-Values* are given in **Table H.18**.

TABLE H.18 Material *R-Values* of heating and cooling ductwork and fitting insulation

Insulation	*R-Value*
Fittings	
11mm polyurethane	**0.4**
Flexible ductwork	
45 mm glasswool (11 kg/m^3)	**1.0**
70 mm polyester (6.4 kg/m^3)	**1.0**
63 mm glasswool (11 kg/m^3)	**1.5**
90 mm polyester (8.9 kg/m^3)	**1.5**
85 mm glasswool (11 kg/m^3)	**2.0**
Sheetmetal ductwork – external insulation	
38 mm glasswool (22 kg/m^3)	**1.0**
50 mm polyester (20 kg/m^3)	**1.1**
50 mm glasswool (22 kg/m^3)	**1.5**
75 mm polyester (20 kg/m^3)	**1.7**
Sheetmetal ductwork – internal insulation	
38 mm glasswool (32 kg/m^3)	**1.0**
50 mm polyester (32 kg/m^3)	**1.3**
50 mm glasswool (32 kg/m^3)	**1.5**

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(e) The minimum material *R-Value required* for ductwork may be reduced by 0.5 for the combined heating and refrigerated cooling systems in *Climate Zones* 4 and 6 if the ducts are positioned–

(a) under a suspended floor with an enclosed perimeter; or

(b) in a roof space that has insulation of not less than 0.5 directly beneath the roofing.

For information regarding enclosed perimeters, refer to the explanatory note following **Table H.9.**

H.8.3 Water heater in a hot water supply system

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(a) A water heater in a hot water supply system must be:

(i) a solar water heater complying with **(b)**; or

(ii) a heat pump water heater complying with **(b)**; or

(iii) a gas water heater complying with **(c)**; or

(iv) an electric resistance heater only in the circumstances described in **(d)**; or

(v) a wood combustion water heater with a tank volume of not more than 700 litres and no additional heating mechanisms.

(b) A solar heater and heat pump heater must have the following performance:

(i) An electric boosted solar heated water service or heat pump heated water service (air source or solar boosted) with a single tank and a volume of 400 litres or more and not more than 700 litres:

(A) at least 38 *Renewable Energy Certificates* in zone 3; and/or

(B) at least 36 Renewable Energy Certificates in zone 4.

(ii) An electric boosted solar heated water service or heat pump heated water service (air source or solar boosted) with a single tank and a volume of more than 220 litres and not more than 400 litres-

(A) at least 27 *Renewable Energy Certificates* in zone 3; and/or

(B) at least 26 Renewable Energy Certificates in zone 4.

(iii) An electric boosted solar heated water service or heat pump heated water service (air source or solar boosted) with a single tank and a tank volume of not more than 220 litres:

(A) at least 17 *Renewable Energy Certificates* in zone 3; and/or

(B) at least 16 Renewable Energy Certificates in zone 4.

(iv) An electric boosted preheat solar heated water service with a series connected instantaneous booster or a second tank and a preheat tank volume of 200 litres or more and not more than 350 litres:

(A) at least 38 *Renewable Energy Certificates* in zone 3; and/or

(B) at least 36 Renewable Energy Certificates in zone 4.

(v) An electric boosted preheat solar heated water service with a series connected instantaneous booster or a second tank and a preheat tank volume of more than 110 litres and not more than 200 litres:

(A) at least 27 *Renewable Energy Certificates* in zone 3; and/or

(B) at least 26 Renewable Energy Certificates in zone 4.

(vi) An electric boosted preheat solar heated water service with a series connected instantaneous booster or a second tank and a preheat tank volume of not more than 110 litres:

(A) at least 17 *Renewable Energy Certificates* in zone 3; and/or

(B) at least 16 Renewable Energy Certificates in zone 4.

(vii) A natural gas or LPG boosted solar heated water service with a total tank volume of not more than 700 litres and at least 1 or more *Renewable Energy Certificates* in any zone.

(viii) A wood combustion boosted solar water heater, with no additional heating mechanism and a total tank volume not more than 700 litres.

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(c) A gas heater must be rated at not less that 5 stars in accordance with AS 4552.

(d) An electric resistance water heater may be installed when:

(i) The Class 1a building has:

(A) a water heater that complies with **(b)** or **(c)**; and

(B) not more than 1 electric resistance water heater is installed; and

(ii) The electric resistance water heater:

(A) has no storage capacity or a hot water delivery of not more than 50 L in accordance with AS 1056.1; and

(B) it does not supply heated water to more than one room; and

(C) it does not supply heated water to a bath or a shower.

Notes:
1. The zones referred to in **H.8.3(b)** are the *climate zones* used in Figure A1 of AS/NZS 4234 for identifying load conditions for heated water services.
2. In clauses **H.8.3(b) (i) to (vi)** above, a heated water service that meets either the requirement in (A), the requirement in (B), or both may be installed regardless of the actual zone in which the heated water service is to be installed

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H.8.4 Electric resistance space heating

An electric resistance space heating system that serves more than one room must have:

(a) separate isolating switches for each room; and

(b) a separate temperature controller and time switch for each group of rooms with common heating needs; and

(c) power loads of not more than 110 W/m^2 for living areas, and 150 W/m^2 for bathrooms.

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H.8.5 Artificial lighting

(a) The *lamp power density* or *illumination power density* of artificial lighting, excluding heaters that emit light, must not exceed:

(i) within a Class 1a building, 5 W/m² of *floor area*; and

(ii) on a verandah or balcony attached to a Class 1a building, 4 W/m² ; and

(iii) in a Class 10a building, 3 W/m²; and

where *illumination power density* is used, it may be increased by dividing it by the *illumination power density* adjustment factor in **Table H.19** where applicable.

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(b) When designing the *lamp power density* or *illumination power density*, the power of the proposed light fittings must be used rather than a nominal allowance for exposed batten or lamp holder or luminaires.

(c) Halogen lamps must be separately switched from fluorescent lamps.

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(d) Artificial lighting around the perimeter of a building must:

(i) be controlled by a daylight sensor; or

(ii) have an average light source efficacy of not less than 40 Lumens/W.

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TABLE H.19 *Illumination power density* adjustment factor

Item	Description	*Illumination power density* adjustment factor
Lighting timer	For corridor lighting	0.7
Motion detector	(a) Where – (i) not less than 75% of the *floor area* of the space is controlled by one or more motion detectors; or (ii) an area of less than 200m^2 is switched as a block by one or more detectors	0.9
	(b) Where up to 6 lights are switched as a block by one or more detectors	0.7
	(c) Where up to 2 lights are switched as a block by one or more detectors	0.55
Manual dimming system Note1	Where not less than 75% of the *floor area* of a space is controlled by manually operated dimmers	0.85
Programmable dimming system Note2	Where not less than 75% of the *floor area* of a space is controlled by programmable dimmers	0.85
Dynamic dimming system Note3	Automatic compensation for lumen depreciation	The design lumen depreciation factor of not less than - (a) 0.9 for fluorescent lights; or (b) 0.8 for high pressure discharge lights.
Fixed dimming Note4	Where not less than 75% of the *floor area* of a space is controlled by fixed dimmers that reduce the overall lighting level and the power consumption of the lighting	% of full power to which the dimmer is set divided by 0.95
Daylight sensor and dynamic lighting control device – dimmed or stepped switching of lights adjacent *window*s	(a) Lights within the space adjacent to *window*s other than *roof lights* for a distance from the *window* equal to the depth of the floor to *window* head height	0.5 Note5
	(b) Lights within the space adjacent to *roof lights*	0.6 Note5

Notes:

1. Manual dimming is where lights are controlled by a knob, slider or other mechanism or where there are pre-selected scenes that are manually selected.
2. Programmed dimming is where pre-selected scenes or levels are automatically selected by the time of day, photoelectric cell or occupancy sensor.
3. Dynamic dimming is where the lighting level is varied automatically by a photoelectric cell to either proportionally compensate for the availability of daylight or the lumen depreciation of the lamps.
4. Fixed dimming is where lights are controlled to a level and that level cannot be adjusted by the user.
5. The *illumination power density* adjustment factor is only applied to lights controlled by that item. This adjustment factor does not apply to tungsten halogen or other incandescent sources.