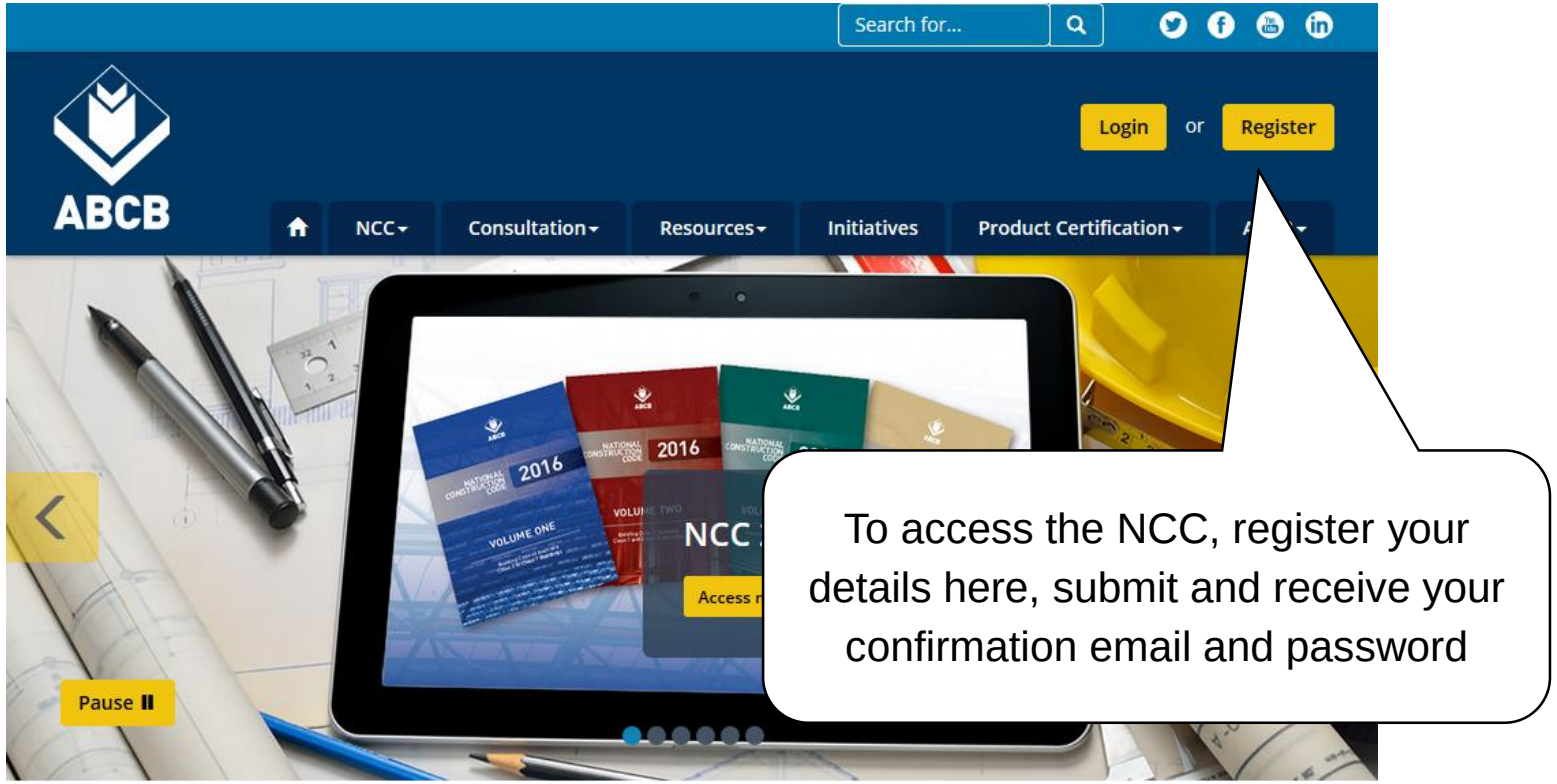
NCC Volume Two Energy Efficiency

Table of contents

How to access the NCC

- To access the NCC visit: www.abcb.gov.au



What you will learn

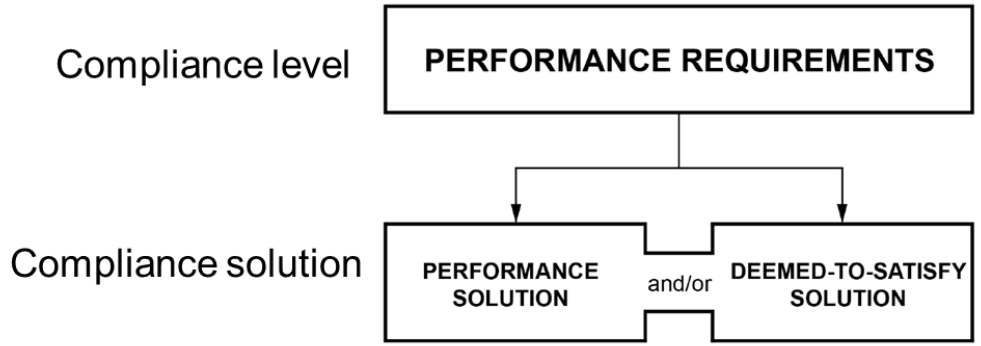
- Aims & Objectives:
  - To acquire a basic understanding of the energy efficiency provisions within NCC Volume Two
- Who this material is for:
  - All building and plumbing professionals.

Overview of the NCC

- The role of the NCC is to provide:
  - Nationally consistent minimum necessary regulations
  - A technical base for the design and construction of buildings and certain structures
- There are three volumes currently in the NCC and all three are performance based
  - The Building Code of Australia (BCA) is Volume One and Volume Two of the NCC
  - The Plumbing Code of Australia (PCA) is Volume Three of the NCC

NCC Volume Two: Overview

- NCC Volume Two is a performance based code
- Compliance with the NCC is achieved by satisfying the Performance Requirements and the supporting General Requirements

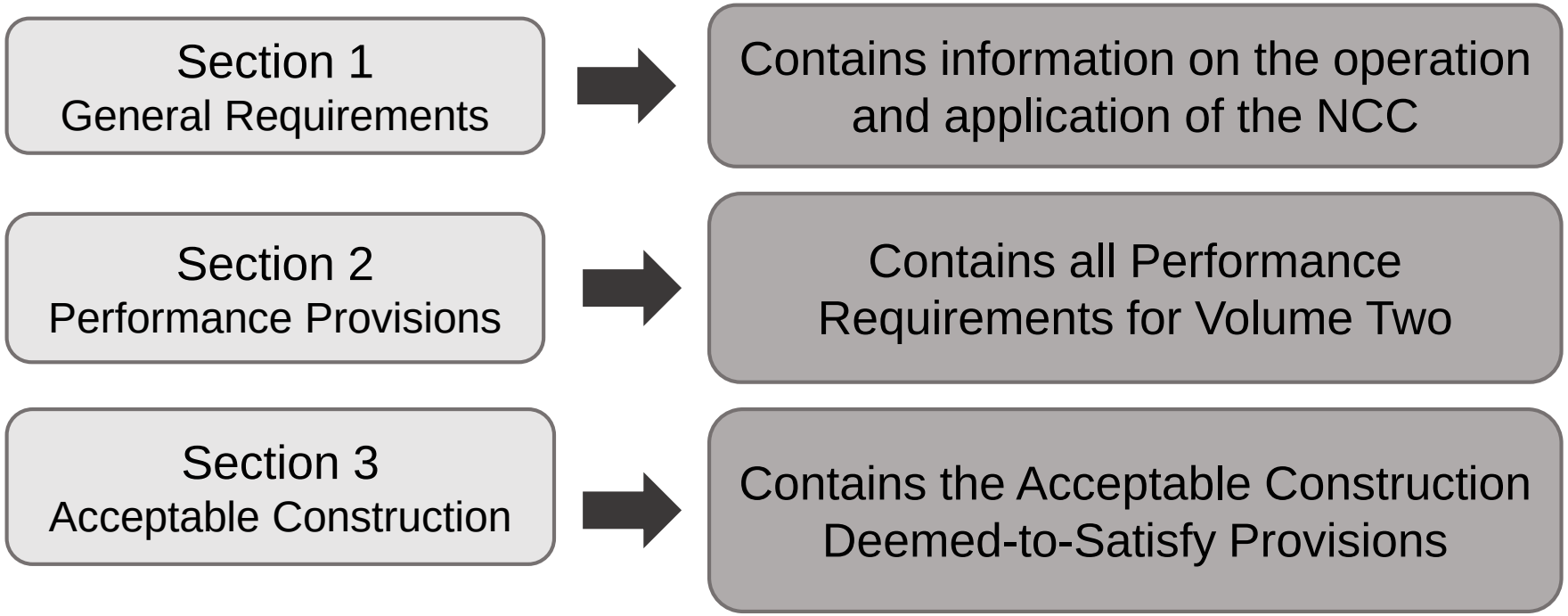


Notes:

1. The term **Performance Solution** was formerly known as **Alternative Solution.**
2. The terms **Performance Solution** and **Deemed-to-Satisfy Solution** were formerly used under the term **Building Solution**.

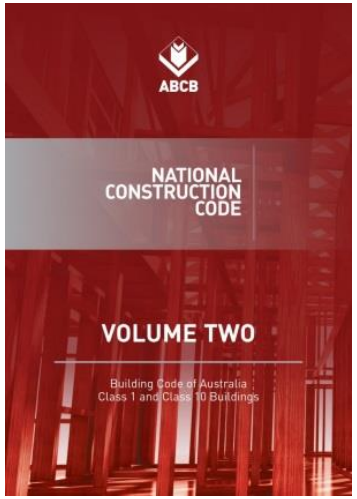
NCC Volume Two: Structure

- NCC Volume Two is divided into three Sections:



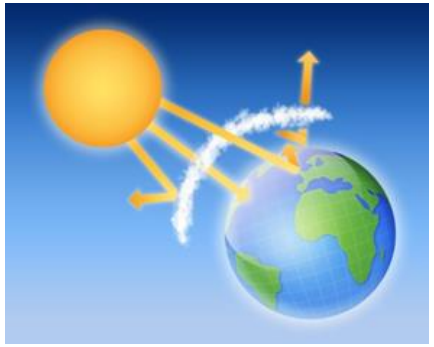
NCC Volume Two: Relevant Parts

- The relevant parts in Volume Two of the NCC for the energy efficiency provisions are:
  - Part 1 - General Requirements
  - Part 2.6 - Energy Efficiency
    - Performance Requirements and Verification Method
  - Part 3.12 - Energy Efficiency
    - Deemed-to-Satisfy Provisions



Background to Energy Efficiency

- Human induced climate change arising from greenhouse gas (GHG) emissions are a concern
- GHG emissions predominantly come from the burning of fossil fuels (coal, oil, gas)
- Australia's building and construction industry is having an increasing impact on society and on our environment
- Increases in population place further pressure on resources and infrastructure such as water, electricity, and land



Application of the NCC Energy Efficiency Provisions

- NCC provisions primarily address:
  - Thermal performance of building fabric
  - Domestic services

Achieving Energy Efficiency

- A more energy efficient home should consider:
  - The climate related to its location
  - Appropriate shading, glazing and insulation
  - Thermal mass
  - Adequate building sealing (to minimise air leakage)
  - Optimal orientation
  - Adequate ventilation (to allow for cooling)
  - Improving the efficiency of heating, cooling, lighting, heated water systems and swimming pool equipment

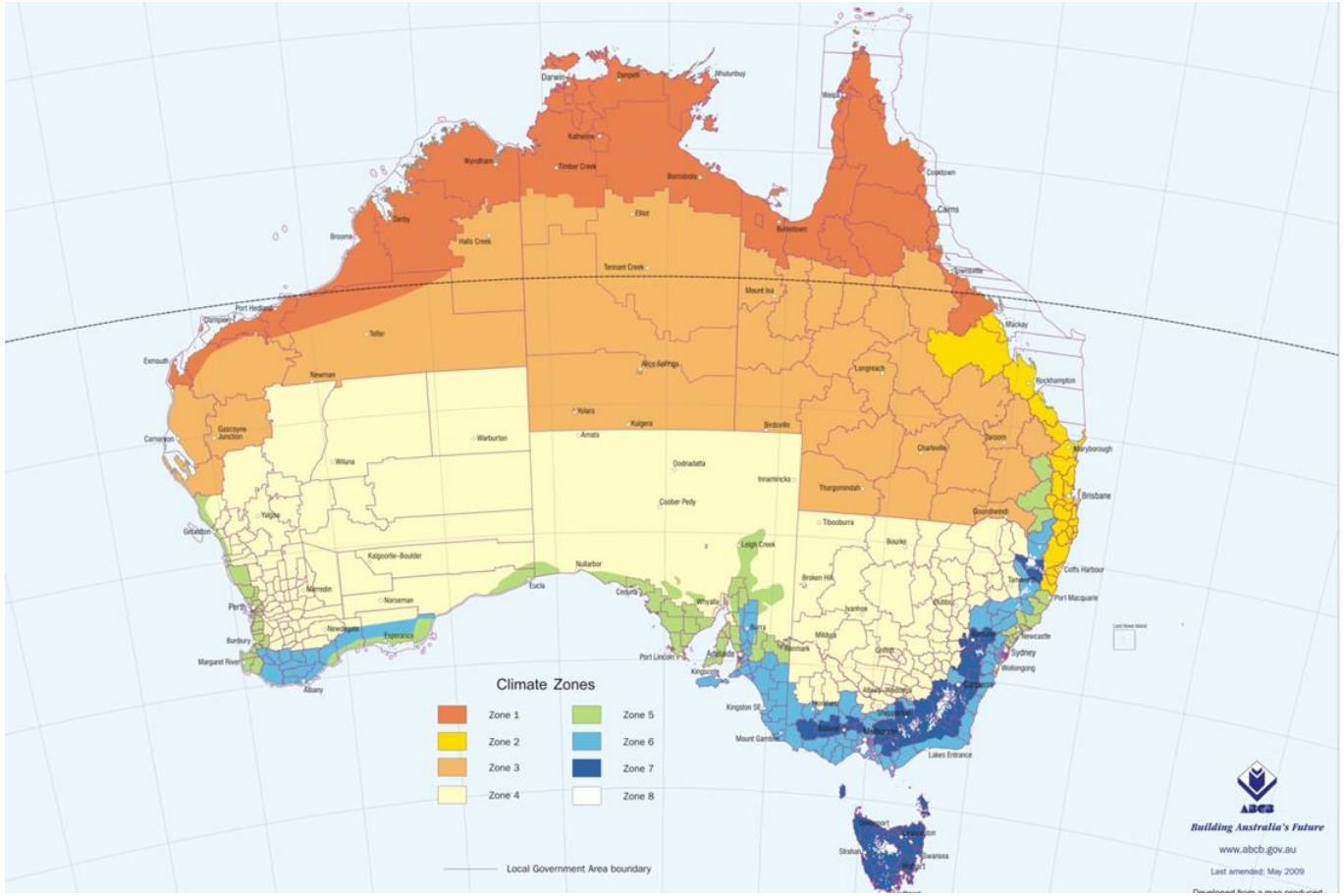
Energy Efficiency: Defined Terms

“Conditioned space” is defined as:

> “a space within a building that is heated or cooled by the building's domestic services, excluding a non- habitable room in which a heater with a capacity of not more than 1.2 kW or 4.3 MJ/hour is installed”

Application by Climate Zone

- Australian Climate Zones – Figure 1.1.4



Energy Efficiency: Other Key Defined Terms

- Additional defined terms relevant to energy efficiency are included in NCC Volume Two
- The most relevant of these are:
  - House energy rating software
  - R-Value
  - Total System Solar Heat Gain Coefficient
  - Total System U-Value

Energy Efficiency Performance Requirements: An overview

- There are two mandatory Performance Requirements for energy efficiency:
  - P2.6.1 Building
    - states the thermal performance of a building’s fabric
  - P2.6.2 Services
    - states the efficiency and source of the energy for domestic services
- Both of these Performance Requirements consider:
  - Facilitating the efficient use of energy
  - Relevance to its function, use and geographic location
  - To the degree necessary

Energy Efficiency Performance Requirements

- For buildings, P2.6.1 addresses the need for artificial heating and/or cooling in consideration of:
  - The building’s internal environment
  - Nearby permanent features (e.g. other buildings)
  - Solar radiation
  - Building sealing
  - Air movement
- For services, P2.6.2 also considers the source of energy used for heating

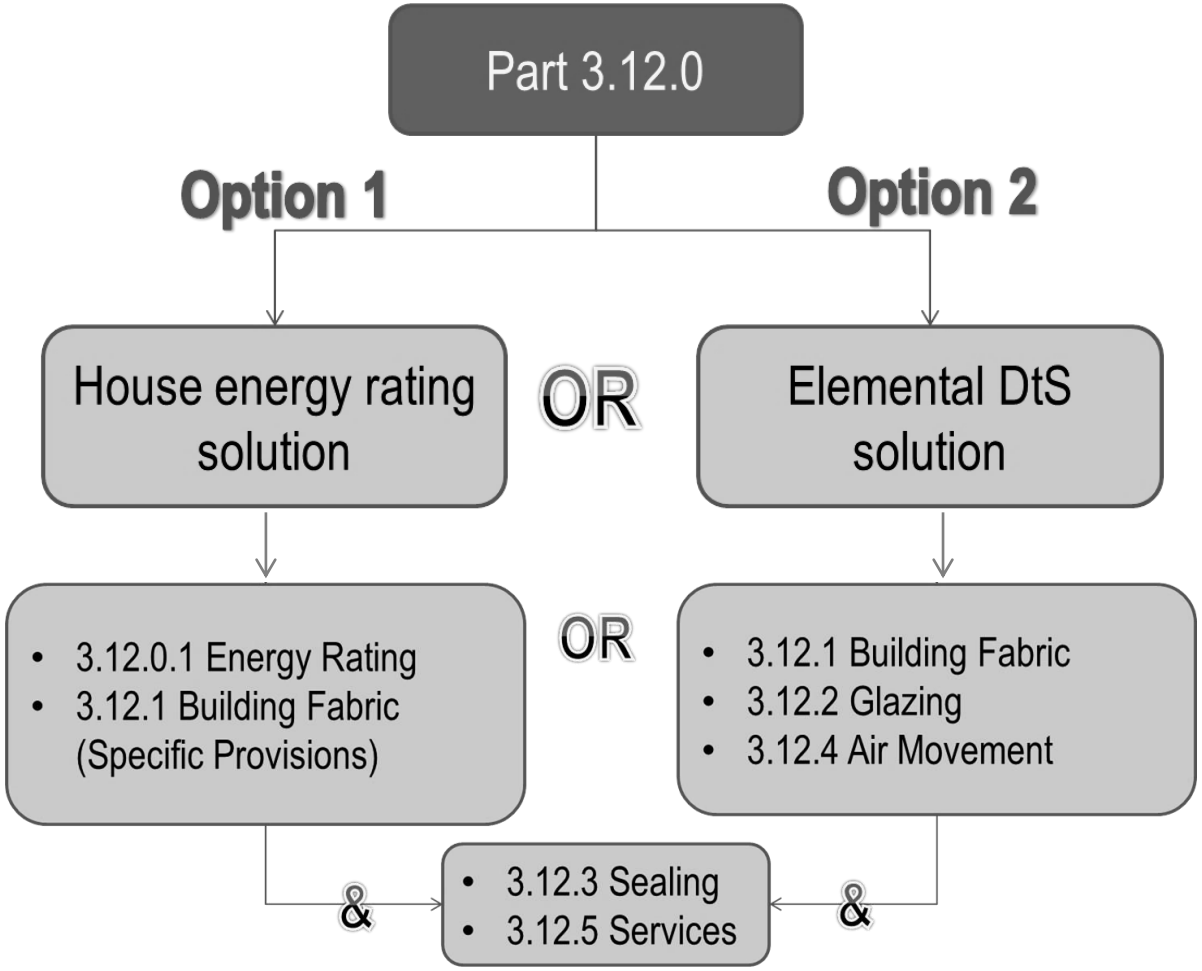
Options to meet the Performance Requirements

- Options to meet Performance Requirement P2.6.1:
  - Meeting the prescriptive requirements of the DtS Provisions of Part 3.12
  - Meeting the energy rating requirements using the DtS Provisions of Part 3.12
  - Using the Verification Method, V2.6.2.2 and showing lower annual heating and/or cooling loads compared to the reference building
  - Using another Verification Method such as an overseas code or standard (e.g. LEEDS, ASHRAE)
  - Providing a comparison to the DtS Provisions of Part 3.12
  - Using expert judgement

Meeting the Performance Requirements

- All options for compliance are required to be:
  - Supported with suitable evidence and / or documentation to support that compliance has been achieved
  - Assessed and approved by the Approval Authority

Energy Efficiency and Deemed-to-Satisfy Provisions

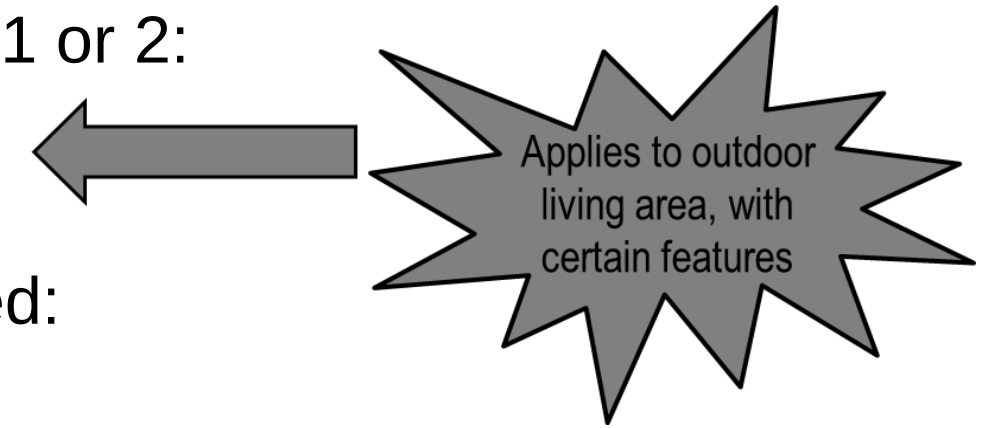


Energy Efficiency and Energy Ratings

- House energy rating software
  - A quantified benchmark used to describe energy efficiency in stars
  - Based on an annual energy load and climate
  - The rating is derived using NatHERS accredited computer software tools

Energy Efficiency and Energy Ratings

- The minimum energy rating required by the NCC is:
  - 6 stars
- Concession available in NCC climate zones 1 or 2:
  - 5.5 stars or
  - 5 stars
- Additional DtS requirements are also required:
  - Insulation installation
  - Thermal breaks
  - Floor edge insulation
  - Building sealing
  - Services



Energy Efficiency and Energy Ratings: the Deemed-to-Satisfy Provisions

- The prescriptive requirements of the DtS Provisions in Part 3.12 address:
  - 3.12.1 Building fabric
  - 3.12.2 Glazing
  - 3.12.3 Building sealing
  - 3.12.4 Air movement
  - 3.12.5 Services

Energy Efficiency: Australian Standards

- The energy efficiency provisions also contain key referenced documents, being Australian Standards.
- The key standards are:
  - AS/NZS 4859.1 – Materials for the thermal insulation of buildings
  - AS2047 – Windows in buildings
  - AS 4254 Parts 1 & 2 – Ductwork for air-handling systems in buildings

Energy Efficiency and Building Fabric

Building fabric provisions – Part 3.12.1

- Roofs & ceilings
- Floors
- Walls
- Installation of insulation
- Roof lights

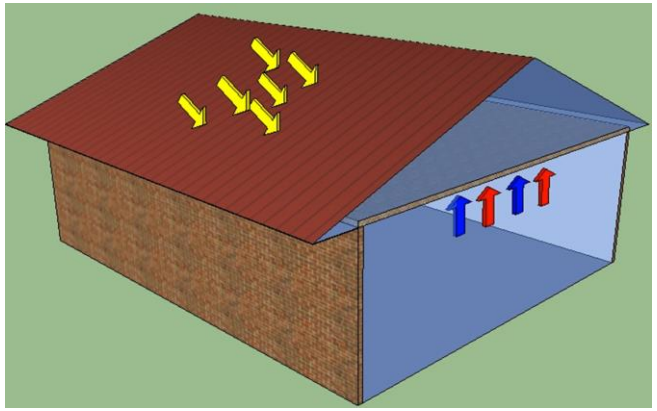
Energy Efficiency and Building Fabric: R-Value

Insulation

- NCC Definition of R-Value ($m^2.K/W$)
  - ‘the thermal resistance of a component calculated by dividing its thickness by its thermal conductivity’
- Otherwise known as how well a material insulates
- A higher R-Value indicates it is a better insulator
- For example, with bulk insulation, a R4.0 batt is a better insulator than an R2.0 batt
- In the NCC, Total R-Value is a defined term and includes the thermal resistance of the building material, insulation material and any air spaces

Energy Efficiency and Building Fabric: Roofs & Ceilings

- Must achieve the required minimum Total R-Value in Table 3.12.1.1a.
- This minimum requirement considers:
  - Climate zone
  - Direction of heat flow
  - Roof solar absorptance
  - Where the insulation is located
  - Roof ventilation
- Account for ceiling penetrations



Energy Efficiency and Building Fabric: Roofs & Ceilings

Table 3.12.1.1a ROOF AND CEILING—MINIMUM TOTAL R-VALUE

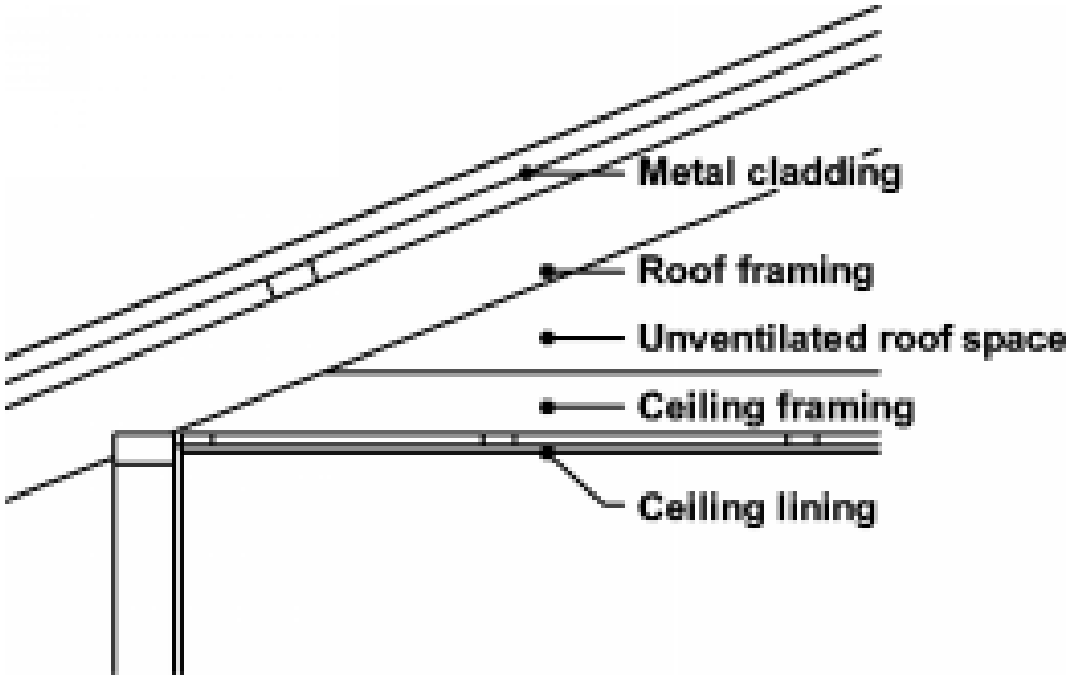
Climate zone	1	2		3	4 and 5	6 and 7	8
		Altitude less than 300 m	Altitude 300 m or more				
Direction of heat flow	Downwards		Downwards and upwards		Upwards		
Minimum *Total R-Value* for a roof with an upper surface solar absorptance value of not more than 0.4	3.1	4.1	4.1		4.1	4.6	6.3
Minimum *Total R-Value* for a roof with an upper surface solar absorptance value of more than 0.4 but not more than 0.6	4.1	4.6	4.6		4.6	5.1	6.3

Energy Efficiency and Building Fabric: Roofs & Ceilings

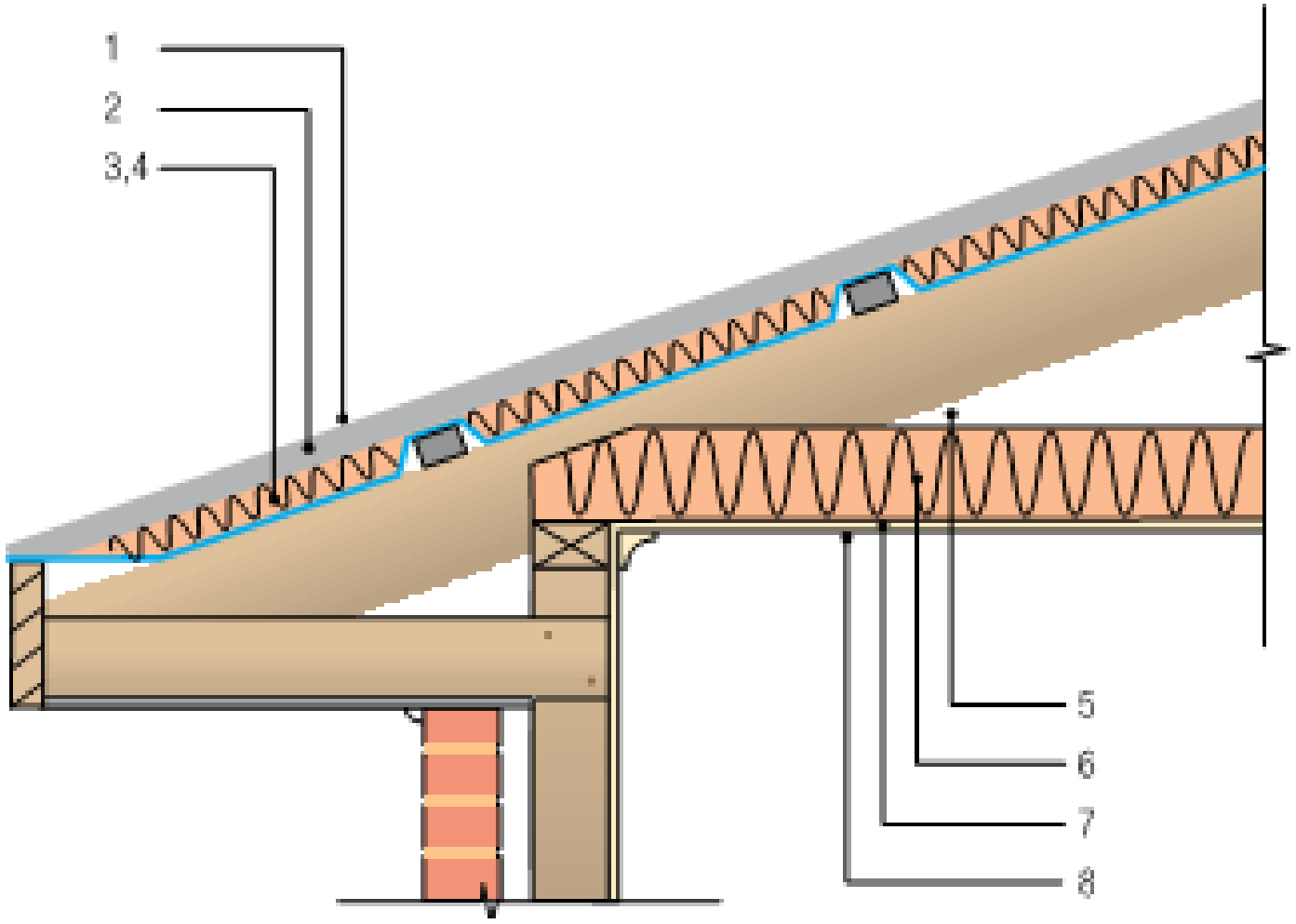
Table 3.12.1.1a ROOF AND CEILING—MINIMUM TOTAL R-VALUE — continued

Climate zone	1	2		3	4 and 5	6 and 7	8
		Altitude less than 300 m	Altitude 300 m or more				
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		5.1	5.1	6.3
Note: Altitude means the height above the Australian Height Datum at the location where the building is to be constructed.							

Energy Efficiency and Building Fabric: Roofs & Ceilings

(d) Pitched roof with flat ceiling — Metal roof 	Ventilated	Down	0.72
		Up	0.21
	Unventilated	Down	0.54
		Up	0.39

Energy Efficiency and Building Fabric: Roofs & Ceilings



Energy Efficiency and Building Fabric: Roofs & Ceilings

R-VALUES FOR SYSTEM R0200		FOIL FACED R1.3 BLANKET WITH R3.5 CEILING BATTS			
		NON-VENTILATED		VENTILATED	
		R0211W	R0211S	R0212W	R0212S
No:	Element Description:	WINTER	SUMMER	WINTER	SUMMER
1	Outdoor Air Film	0.040	0.040	0.040	0.040
2	Metal Roof	0.000	0.000	0.000	0.000
3	Unventilated 40mm Air Space				
4	Reflective Insulation Material R-value	1.387	1.201	1.386	1.201
5	Attic Space	0.560	1.090	0.340	1.360
6	Ceiling Insulation	3.661	3.389	3.663	3.393
7	10mm Plasterboard	0.059	0.059	0.059	0.059
8	Indoor Air-Film (Non-Reflective Surface)	0.110	0.160	0.110	0.160
	Total R-Value	**5.8**	**5.9**	**5.6**	**6.2**
	Total R-Value of roof and ceiling materials	0.39	0.54	0.21	0.72
	Added R-Value of insulation	5.4	5.4	5.4	5.5

Energy Efficiency and Building Fabric: Roofs & Ceilings

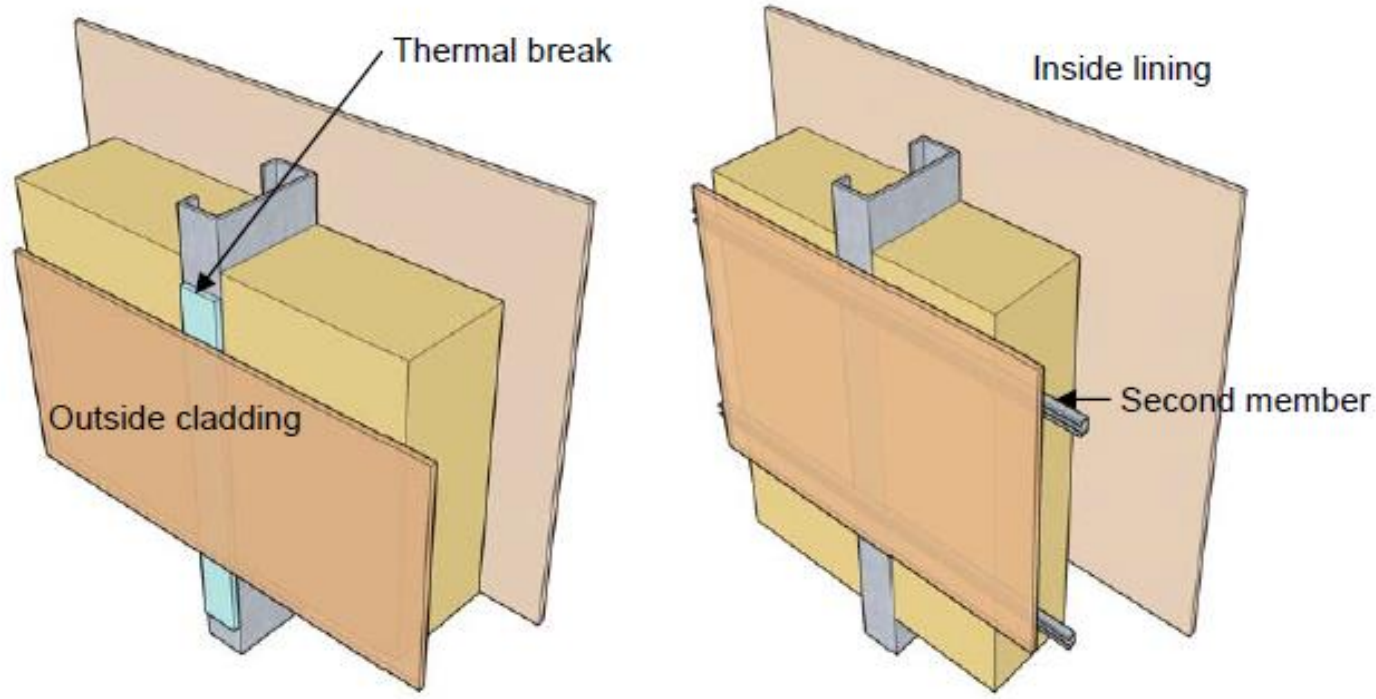
Emittance of added *reflective insulation*	Direction of heat flow	*R-Value* added by *reflective insulation*					
		Pitched roof (>10°) with horizontal ceiling		Flat skillion or pitched roof (≤10°) with horizontal ceiling	Pitched roof with cathedral ceilings		
		Unventilated roof space	Ventilated roof space		15° to not more than 25° pitch	more than 25° to not more than 35° pitch	more than 35° to 45° pitch
0.2 outer 0.05 inner	Downwards	1.12	1.21	1.28	0.96	0.86	0.66
0.2 outer 0.05 inner	Upwards	0.75	0.59	0.68	0.72	0.74	0.77
0.9 outer 0.05 inner	Downwards	0.92	1.01	1.06	0.74	0.64	0.44
0.9 outer 0.05 inner	Upwards	0.55	0.40	0.49	0.51	0.52	0.53

Notes:

1. The direction of heat flow applicable in each *climate zones* specified in **Table 3.12.1.1a**.
2. Ventilated roof space means ventilated in accordance with **3.12.1.2(b)**.

Energy Efficiency and Building Fabric: Roofs & Ceilings : Thermal Break

Figure 6.10 – Thermal break



Energy Efficiency and Building Fabric: Roofs & Ceilings

Table 3.12.1.1b ADJUSTMENT OF MINIMUM R-VALUE FOR LOSS OF CEILING INSULATION

Percentage of ceiling area uninsulated	Minimum *R-Value* of ceiling insulation *required* to satisfy 3.12.1.2(a)										
	1.0	**1.5**	**2.0**	**2.5**	**3.0**	**3.5**	**4.0**	**4.5**	**5.0**	**5.5**	**6.0**
	Adjusted minimum *R-Value* of ceiling insulation *required* to compensate for loss of ceiling insulation area										
0.5% to less than 1.0%	1.0	1.6	2.2	2.8	3.4	4.0	4.7	5.4	6.2	6.9	
1.0% to less than 1.5%	1.1	1.7	2.3	2.9	3.6	4.4	5.2	6.1	7.0		
1.5% to less than 2.0%	1.1	1.7	2.4	3.1	3.9	4.8	5.8	6.8			
2.0% to less than 2.5%	1.1	1.8	2.5	3.3	4.2	5.3	6.5				
2.5% to less than 3.0%	1.2	1.9	2.6	3.6	4.6	5.9					
3.0% to less than 4.0%	1.2	2.0	3.0	4.2	5.7						
4.0% to less than 5.0%	1.3	2.2	3.4	5.0							
5.0% or more											

Not permitted

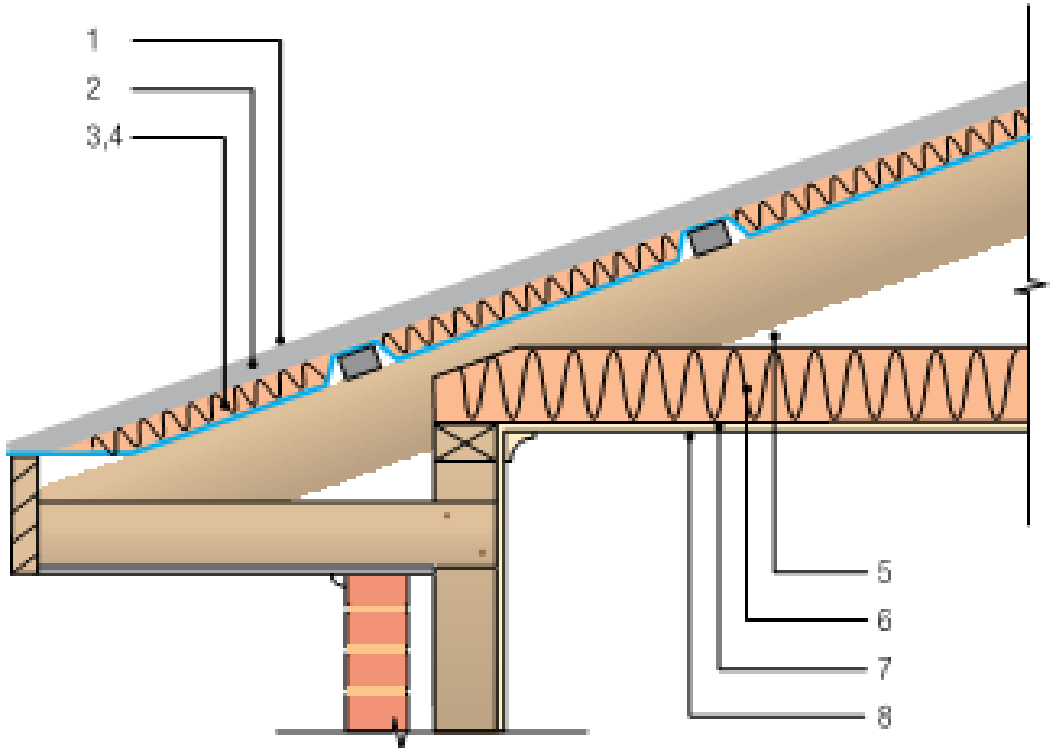
Note: Where the minimum *R-Value* of ceiling insulation *required* to satisfy **3.12.1.2(a)** is between the values stated, interpolation may be used to determine the adjusted minimum *R-Value*.

Energy Efficiency and Building Fabric: Roofs & Ceilings

Roof/Ceiling		
	Upwards	Downwards
Air Film (Outdoor)	0.04	0.04
Membrane	0.01	0.01
Concrete - 250mm	0.1725	0.1725
Insulation - R1.3 Blanket	1.3	1.3
Reflective air gap (0.05/0.9)	0.49	1.06
Insulation - R2.5	2.5	2.5
13mm plasterboard	0.0767	0.0767
Air Film (Indoor)	0.11	0.16
Total	4.6992	5.3192

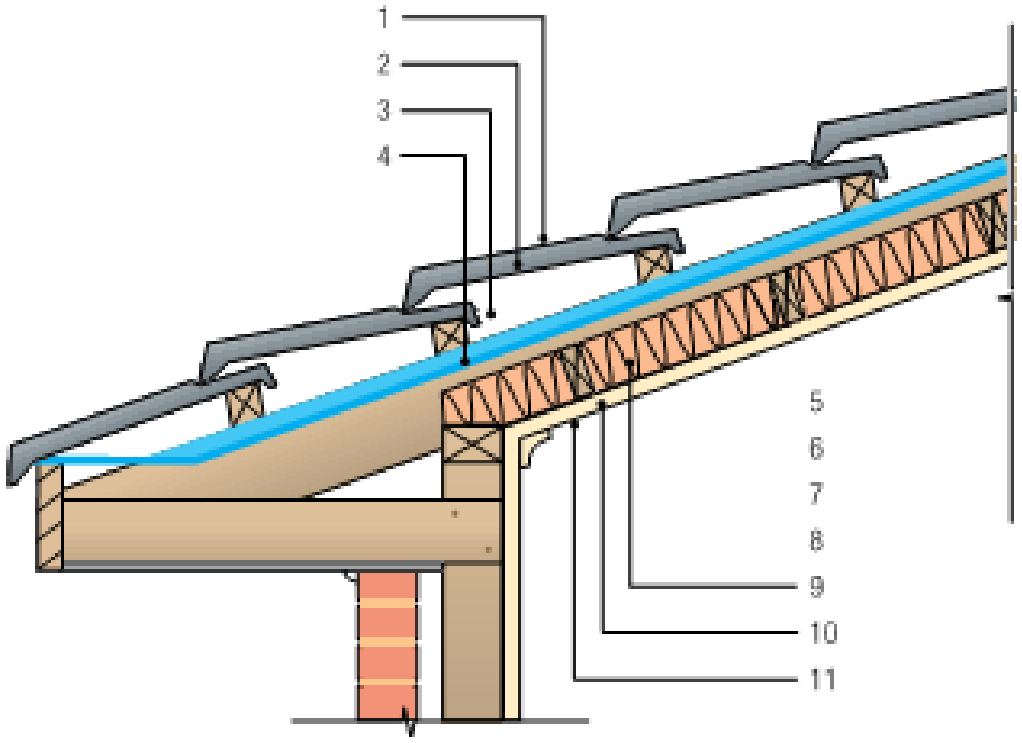
Energy Efficiency and Building Fabric: Roofs & Ceilings – Task

- Metal roof
- 55mm Anticon
- R3.0 insulation
- 10mm plasterboard ceilings



Energy Efficiency and Building Fabric: Roofs & Ceilings – Task

- Concrete tile roof
- Antiglare sarking
- R2.0 insulation
- 10mm plasterboard ceilings



Energy Efficiency and Building Fabric: Roof lights

- Roof light is a defined term in the NCC
  - Thermal performance for roof lights is expressed in Total System SHGC (Solar Heat Gain Coefficient) and Total System U-Values
  - Roof light area to floor area and the shaft index determine what performance is required

Energy Efficiency and Building Fabric: Roof Lights

Table 3.12.1.2 ROOF LIGHTS — THERMAL PERFORMANCE OF TRANSPARENT AND TRANSLUCENT ELEMENTS

Roof lights shaft index (see Note 1)	Constant	Total area of *roof lights* 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	*Total System SHGC*	Not more than 0.83	Not more than 0.57	Not more than 0.43	Not more than 0.34
	Total System U-Value	Not more than 8.5	Not more than 5.7	Not more than 4.3	Not more than 3.4
0.5 to less than 1.0	*Total System SHGC*	Not more than 0.83	Not more than 0.72	Not more than 0.54	Not more than 0.43
	Total System U-Value	Not more than 8.5	Not more than 5.7	Not more than 4.3	Not more than 3.4
1.0 to less than 2.5	*Total System SHGC*	Not more than 0.83	Not more than 0.83	Not more than 0.69	Not more than 0.55
	Total System U-Value	Not more than 8.5	Not more than 5.7	Not more than 4.3	Not more than 3.4

Energy Efficiency and Building Fabric: Roof Lights

Table 3.12.1.2 ROOF LIGHTS — THERMAL PERFORMANCE OF TRANSPARENT AND TRANSLUCENT ELEMENTS — continued

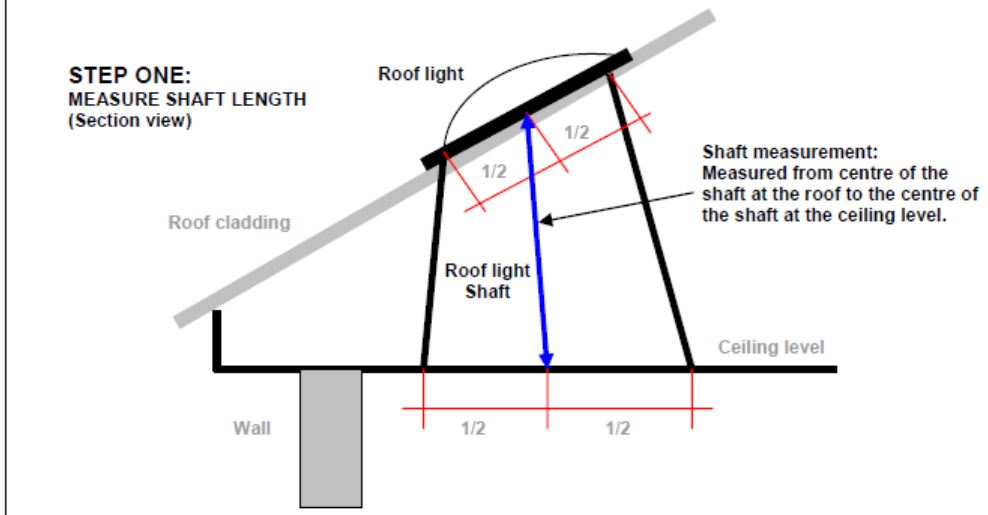
Roof lights shaft index (see Note 1)	Constant	Total area of *roof lights* serving the room or space as a percentage of the *floor area* of the room or space			
		Not more than 2%	More than 2% to not more than 3%	More than 3% to not more than 4%	More than 4% to not more than 5%
2.5 and above	*Total System SHGC*	Not more than 0.83	Not more than 0.83	Not more than 0.83	Not more than 0.83
	Total System U-Value	Not more than 8.5	Not more than 5.7	Not more than 4.3	Not more than 3.4

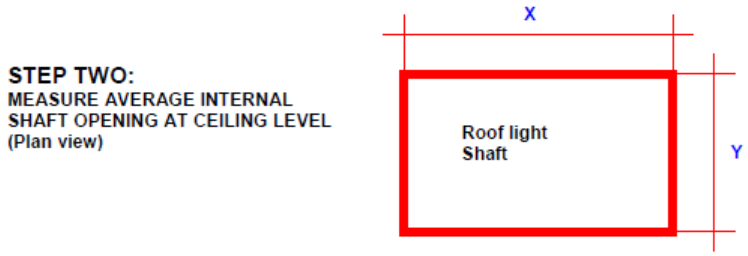
Notes:

1. The *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 (or the diameter for a circular shaft) in the same units of measurement.
2. The total area of *roof lights* is the combined area for all *roof lights* serving the room or space.
3. The area of a *roof light* is the area of the roof opening that allows light to enter the building.
4. The thermal performance of an imperforate ceiling diffuser may be included in the *Total System U-Value* of the *roof light*.
5. 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% unless allowed by **3.12.1.3(b)**.

Energy Efficiency and Building Fabric: Roof Lights

Figure 6.9 – Determining roof light shaft index



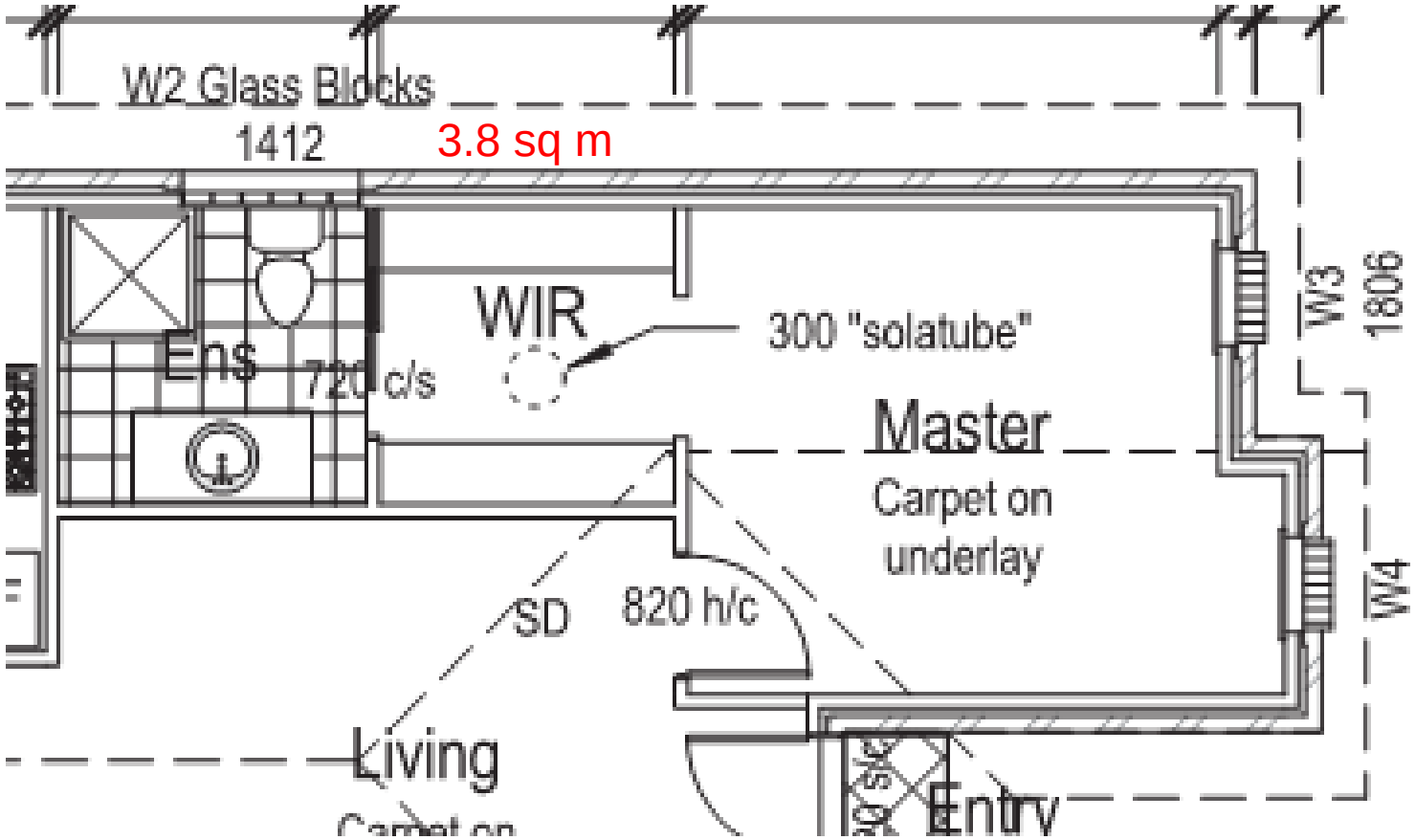


Average internal opening = (X + Y) / 2

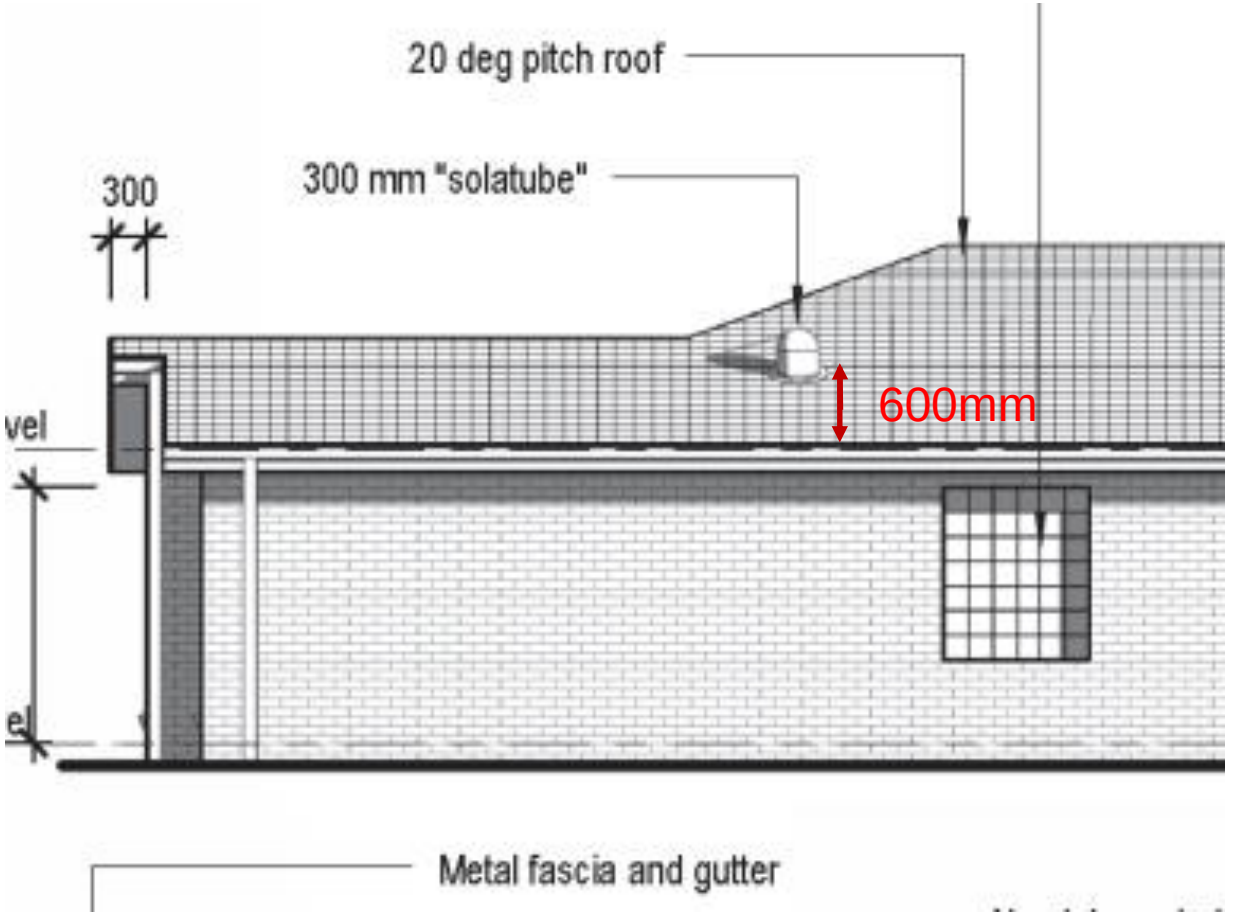
STEP THREE:
DIVIDE THE CENTRE SHAFT LENGTH (STEP ONE) BY THE AVERAGE INTERNAL SHAFT OPENING (STEP TWO)

Roof light shaft index = Roof light shaft length / Average internal opening

Energy Efficiency and Building Fabric: Roof Lights



Energy Efficiency and Building Fabric: Roof Lights



Energy Efficiency and Building Fabric: Roof Lights

Shaft Length	600mm	(Measured off plan)		
Average Internal Shaft Opening	300mm	(Diameter of solatube)		
Roof Light Shaft Index (600mm/300mm)	2			
Area of Room	3.85			
Area of Solatube	0.071			
Percentage	1.84%			

Energy Efficiency and Building Fabric: Roof Lights

Table 3.12.1.2 ROOF LIGHTS — THERMAL PERFORMANCE OF TRANSPARENT AND TRANSLUCENT ELEMENTS

Roof lights shaft index (see Note 1)	Constant	Total area of *roof lights* 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	*Total System SHGC*	Not more than 0.83	Not more than 0.57	Not more than 0.43	Not more than 0.34
	Total System U-Value	Not more than 8.5	Not more than 5.7	Not more than 4.3	Not more than 3.4
0.5 to less than 1.0	*Total System SHGC*	Not more than 0.83	Not more than 0.72	Not more than 0.54	Not more than 0.43
	Total System U-Value	Not more than 8.5	Not more than 5.7	Not more than 4.3	Not more than 3.4
1.0 to less than 2.5	*Total System SHGC*	Not more than 0.83	Not more than 0.83	Not more than 0.69	Not more than 0.55
	Total System U-Value	Not more than 8.5	Not more than 5.7	Not more than 4.3	Not more than 3.4

Energy Efficiency and Building Fabric: Roof Lights

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 System SHGC	*Total System U-Values*	*Total System SHGC*	*Total System U-Values*
Single layer clear	0.80	8.4	0.79	8.0
WORST CASE WHOLE ROOF LIGHT ELEMENT PERFORMANCE VALUES WITHOUT A CEILING DIFFUSER OR WITH A PERFORATED CEILING DIFFUSER				
Single tinted	0.66	8.4	0.63	7.9
Single layer translucent ("opal")	0.57	8.4	0.56	7.9
Double layer clear	0.71	5.4	0.70	4.9
WORST CASE WHOLE ROOF LIGHT ELEMENT PERFORMANCE VALUES WITH AN IMPERFORATE CEILING DIFFUSER				
Translucent or transparent element description	Domed panel		Flat, framed panel	
	Total System SHGC	*Total System U-Values*	*Total System SHGC*	*Total System U-Values*
Single layer clear	0.72	4.3	0.71	4.2
Single tinted	0.59	4.3	0.57	4.2
Single layer translucent ("opal")	0.51	4.3	0.50	4.2
Double layer clear	0.64	3.4	0.63	3.2

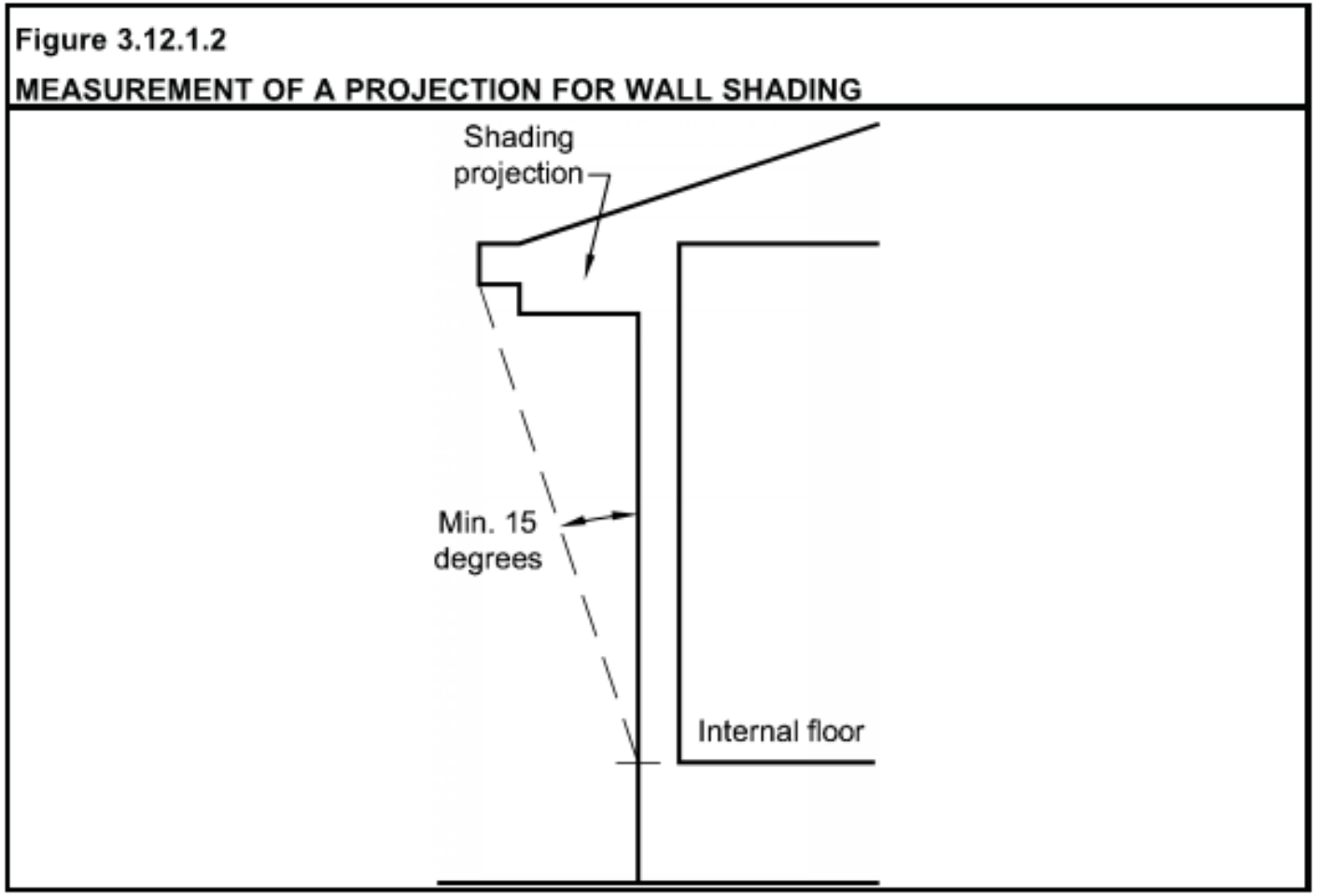
Energy Efficiency and Building Fabric: External Walls - Lightweight

- Minimum Total R-Value in Table 3.12.1.3a or Table 3.12.1.3b for high mass walls.

Table 3.12.1.3a — OPTIONS FOR EACH PART OF AN EXTERNAL WALL

Climate Zone	Options
1, 2, 3, 4 and 5	(a) 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 3.12.1.2.
6 and 7	Achieve a minimum *Total R-Value* of 2.8.
8	Achieve a minimum *Total R-Value* of 3.8.

Energy Efficiency and Building Fabric: External Walls - Shading



Energy Efficiency and Building Fabric: External Walls – Heavy Mass

Table 3.12.1.3b — OPTIONS FOR EACH PART OF AN EXTERNAL WALL WITH A SURFACE DENSITY OF NOT LESS THAN 220 kg/m^2

4. Walls with a surface density of 220 kg/m^2 or more are deemed to achieve acceptable levels of thermal performance in certain *climate zones* due to their ability to store heat and therefore slow the heat transfer through the building *fabric*. These walls are defined by surface density (kg/m^2), which is the mass of one vertical square metre of wall, in order to reduce the complexity when measuring the mass of walls with voids.

   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.

Energy Efficiency and Building Fabric: External Walls – Heavy Mass

Climate Zone	Options
1, 2 and 3	(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 3.12.1.2**; and (ii) when the *external walls* are not shaded in accordance with (i) and there is another storey above, external *glazing* complies with **3.12.2.1** with the applicable value for C_{SHGC} in **Table 3.12.2.1** reduced by 20%; and (iii) the *external wall* incorporates insulation with an *R-Value* of not less than 0.5; and (iv) the lowest storey containing *habitable rooms* has— (A) a concrete slab-on-ground floor; or (B) masonry *internal walls*.

Energy Efficiency and Building Fabric: External Walls – Heavy Mass

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 3.12.1.2**; and
		(ii)	when the *external walls* are not shaded in accordance with (i) and there is another storey above, external *glazing* complies with **3.12.2.1** with the applicable value for C_{SHGC} in **Table 3.12.2.1** 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 rooms* has—
			(A) a concrete slab-on-ground floor; or
			(B) masonry *internal walls*.
	(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 3.12.1.2**; and
		(ii)	external *glazing* complies with **3.12.2.1** with the applicable value for C_{SHGC} in **Table 3.12.2.1** reduced by 15%; and
		(iii)	the lowest storey containing *habitable rooms* has—
			(A) a concrete slab-on-ground floor; and
			(B) masonry *internal walls*.

Energy Efficiency and Building Fabric: External Walls – Heavy Mass

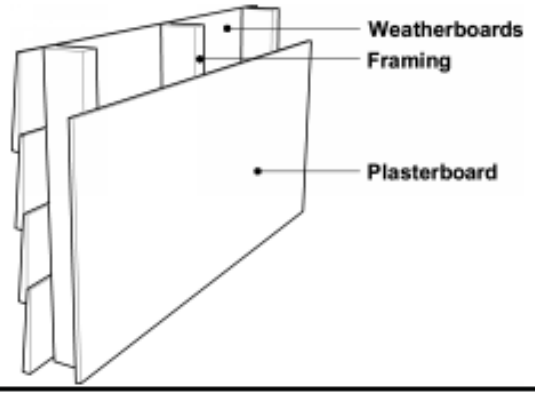
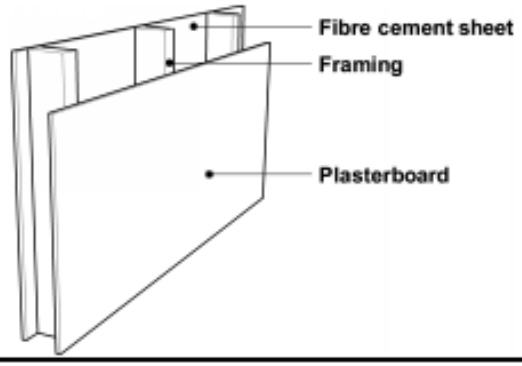
Climate Zone	Options
4 and 6	(a) (i) The external *glazing* complies with **3.12.2.1** with the applicable value for C_u in **Table 3.12.2.1** reduced by 15%; and (ii) the *external wall* incorporates insulation with an *R-Value* of not less than 0.5; and (iii) the lowest storey containing *habitable rooms* has— (A) a concrete slab-on-ground floor; or (B) masonry *internal walls*.
	(b) The external *glazing* complies with **3.12.2.1** with the applicable value for C_u in **Table 3.12.2.1** reduced by 20%.
	(c) (i) The *external wall* incorporates insulation with an *R-Value* of not less than 1.0; and (ii) the lowest storey containing *habitable rooms* has— (A) a concrete slab-on-ground floor; or (B) masonry *internal walls*.

Energy Efficiency and Building Fabric: External Walls – Heavy Mass

7	(a)	(i)	The external *glazing* complies with **3.12.2.1** with the applicable value for C_u in **Table 3.12.2.1** reduced by 15%; and
		(ii)	the *external wall* incorporates insulation with an *R-Value* of not less than 1.0.
	(b)	(i)	The external *glazing* complies with **3.12.2.1** with the applicable value for C_u in **Table 3.12.2.1** reduced by 20%; and
		(ii)	the *external wall* incorporates insulation with an *R-Value* of not less than 0.5.
	(c)		The *external wall* incorporates insulation with an *R-Value* of not less than 1.5.
8	Achieve a minimum *Total R-Value* of 3.8.		

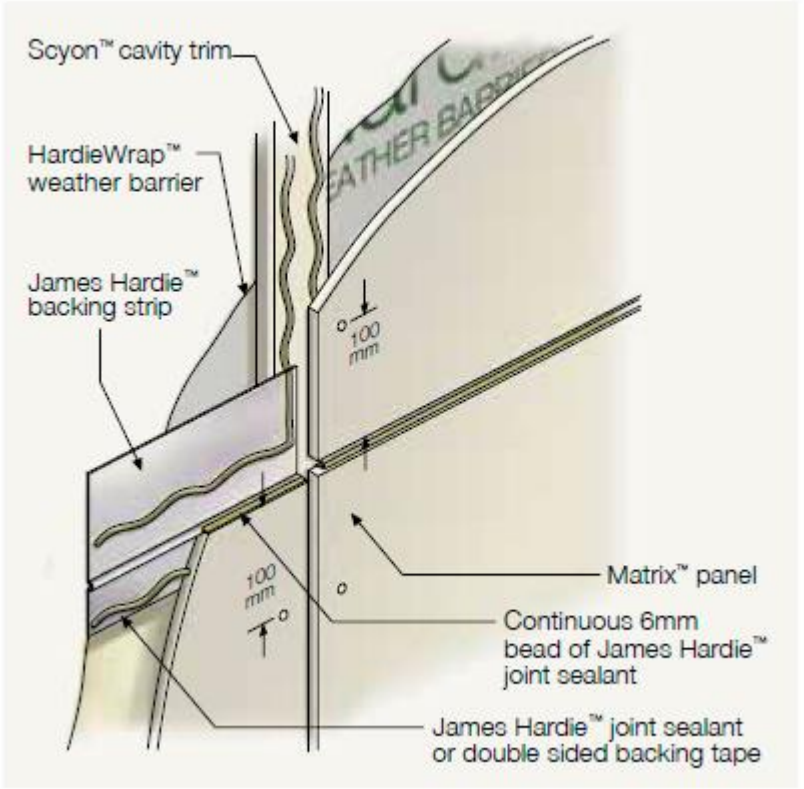
Energy Efficiency and Building Fabric: External Walls

Figure 3.12.1.3 TOTAL R-VALUE FOR TYPICAL WALL CONSTRUCTION

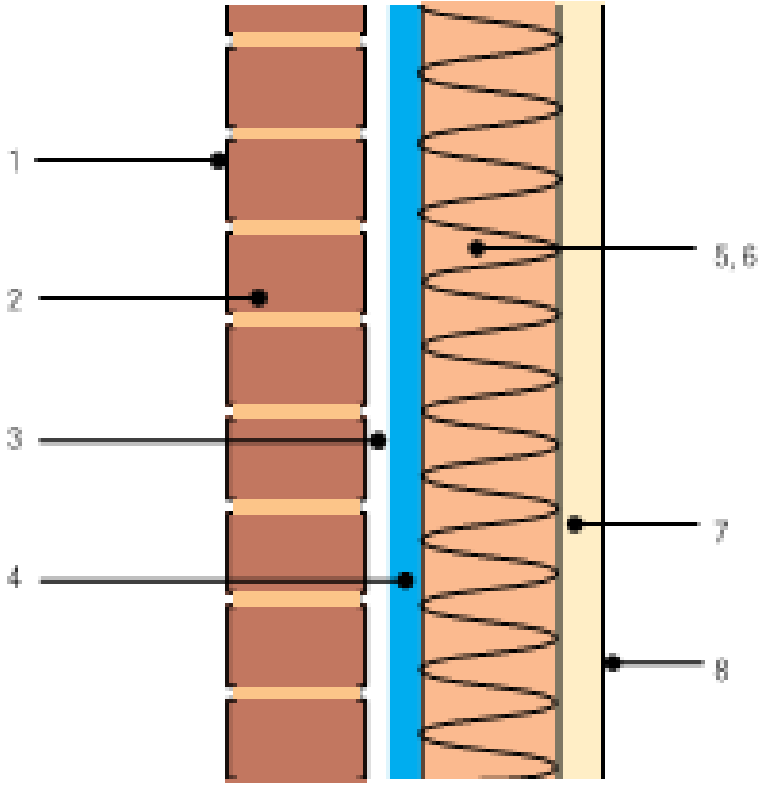
External wall construction description	*Total R-Value*
(a) Weatherboard 	0.48
(b) Fibre-cement sheet 	0.42

Energy Efficiency and Building Fabric: External Walls

External Walls	
System 2	
Air Film (Outdoor)	0.04
Scyon	0.04
Air Gap (Vertical) 19mm	0.58
Sisalation	0
Insulation	2.5
Plasterboard - 10mm	0.06
Air Film (Indoor)	0.12
Total	3.34



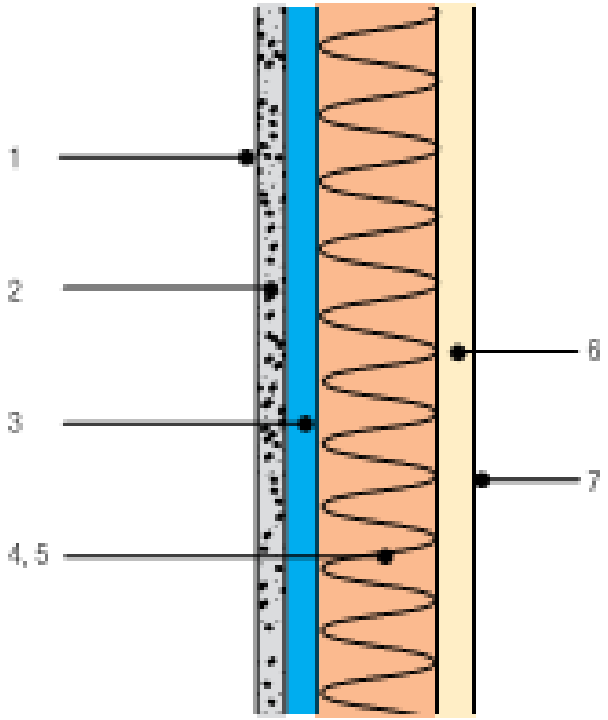
Energy Efficiency and Building Fabric: External Walls



R-VALUES FOR SYSTEM W0100		SINGLE SIDED POLYWEAVE FOIL WITH R2.5 WALL BATTS	
		NON-VENTILATED	
		W0111W	W0111S
No:	Element Description:	WINTER	SUMMER
1	Outdoor Air Film	0.040	0.040
2	110mm Brickwork	0.180	0.180
3	Unventilated 40mm Air Space		
	Unventilated 43mm Air Space		
	Unventilated 50mm Air Space	0.200	0.187
4	Reflective Insulation Material R-value	0.000	0.000
5	Unventilated 90mm Air Space		
6	Bulk Insulation Wall Batt	2.626	2.374
7	10mm Plasterboard	0.059	0.059
8	Indoor Air-Film (Non-Reflective Surface)	0.120	0.120
	Total R-Value	**3.2**	**3.0**
	Total R-Value of wall materials	0.56	0.56
	Added R-Value of insulation	2.7	2.4

Energy Efficiency and Building Fabric: External Walls - Task

- 16mm FC Cladding
- Antiglare Wall Wrap
- R2.7 insulation
- 10mm plasterboard



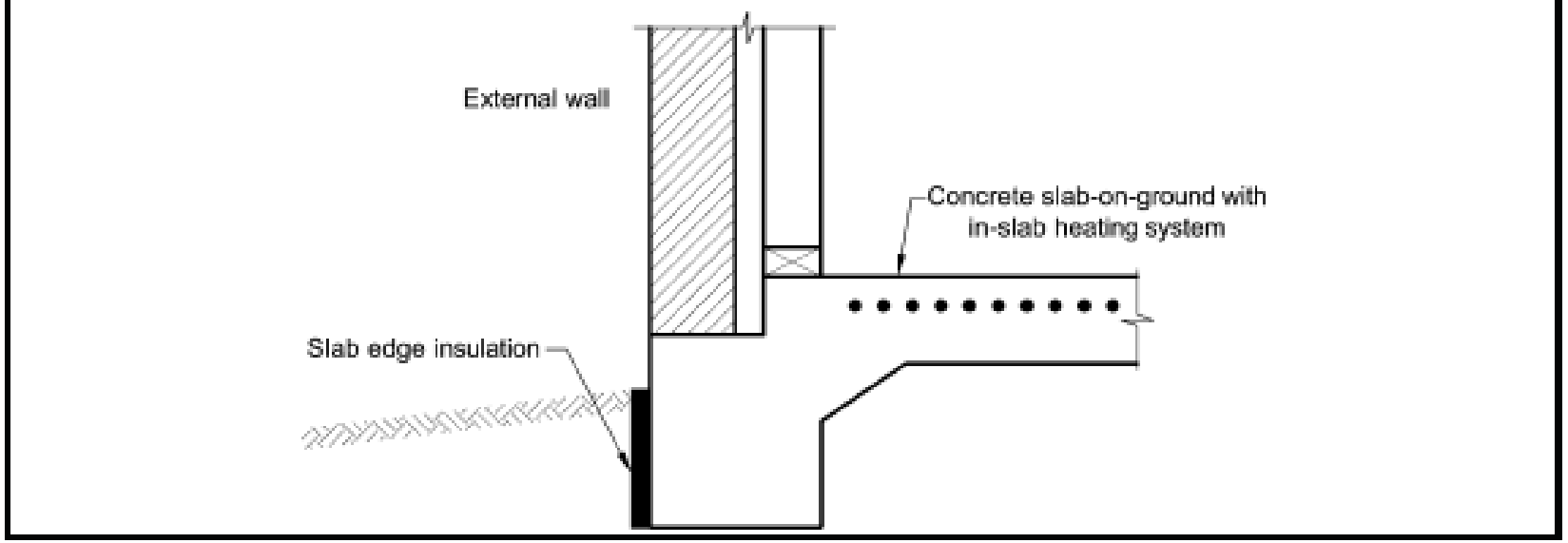
Energy Efficiency and Building Fabric: Floors

- Different insulation requirements based on floor type
- Slab-on-ground construction
  - No additional slab insulation is needed
  - Except for climate zone 8 (alpine regions) and where built-in heating or cooling is installed
- Suspended floor construction
  - The minimum insulation to be added is based on climate zone, floor material and how enclosed the sub-floor space is.
- Built-in heating or cooling
  - The minimum insulation needed underfloor varies depending on climate zone and floor material.
  - Edge insulation is also needed
  - Concession for that solely used in a bathroom or amenity area

Energy Efficiency and Building Fabric: Floors

Figure 3.12.1.4

INSULATION OF SLAB EDGE



Energy Efficiency and Building Fabric: Floors

Table 3.12.1.4 SUSPENDED FLOOR – MINIMUM TOTAL R-VALUE

Climate Zone	1	2	3	4	5	6	7	8
	Direction of heat flow							
	Upwards			Downwards				
Minimum *Total R-Value*	1.5	1.0	1.5	2.25	1.0	2.25	2.75	3.25
Note: For an enclosed perimeter treatment, the underfloor airspace and its enclosure may be included in the *Total R-Value* calculation.								

Energy Efficiency and Building Fabric: Floors

Table 3.12.1.5 TOTAL R-VALUE FOR TYPICAL SUSPENDED FLOOR CONSTRUCTION

Enclosure and height of floor	Direction of heat flow	*Total R-Value*			
		Cavity masonry	190 mm concrete masonry	Single skin masonry	9 mm fibre-cement sheet
(a) Suspended timber floor					
Enclosed - not more than 0.6 m high	Upwards	1.00	0.93	0.88	0.77
	Downwards	1.11	1.06	1.01	0.90
Enclosed - more than 0.6 m but to not more than 1.2 m high	Upwards	0.86	0.81	0.76	0.65
	Downwards	1.00	0.94	0.89	0.77
Enclosed - more than 1.2 m to not more than 2.4 m high	Upwards	0.76	0.72	0.67	0.57
	Downwards	0.89	0.84	0.79	0.69

Energy Efficiency and Building Fabric: Floors

Enclosure and height of floor	Direction of heat flow	*Total R-Value*			
		Cavity masonry	**190 mm concrete masonry**	**Single skin masonry**	**9 mm fibre-cement sheet**
Unenclosed	Upwards	0.39			
	Downwards	0.51			
(b) Suspended concrete floor					
Enclosed - not more than 0.6 m high	Upwards	0.93	0.88	0.83	0.72
	Downwards	1.06	1.01	0.96	0.85
Enclosed - more than 0.6 m but to not more than 1.2 m high	Upwards	0.81	0.76	0.71	0.60
	Downwards	0.94	0.89	0.84	0.72
Enclosed - more than 1.2 m to not more than 2.4 m high	Upwards	0.71	0.67	0.62	0.52
	Downwards	0.84	0.79	0.74	0.64
Unenclosed	Upwards	0.34			
	Downwards	0.46			

Notes:

1. The height of the floor is measured from ground surface to the underside of the floor or the insulation.
2. For the purposes of calculating the *Total R-Value* of a floor, the *R-Value* attributable to an in-slab or in-screed heating or cooling system is ignored.

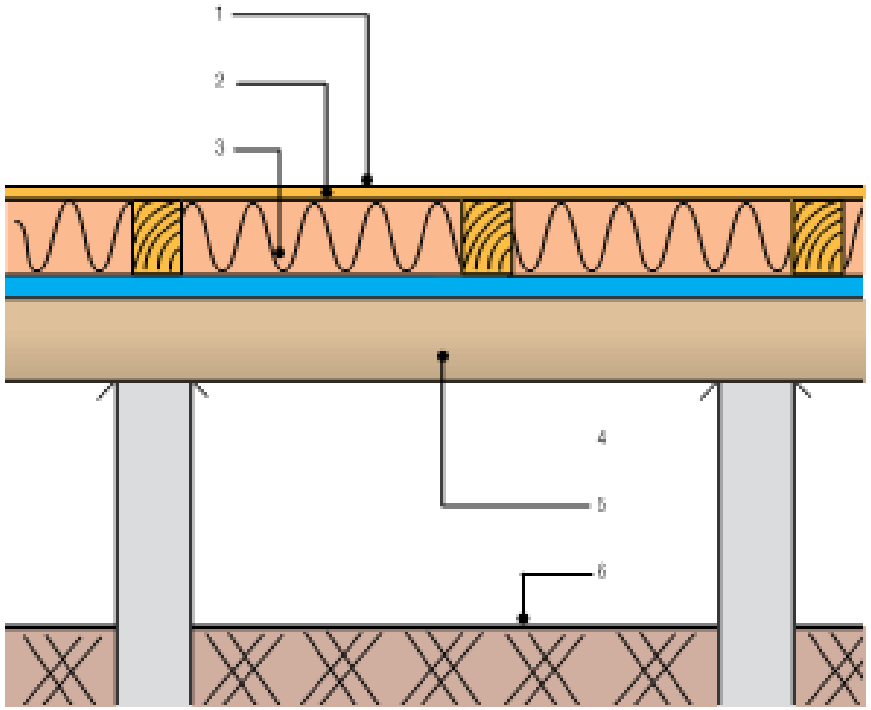
Energy Efficiency and Building Fabric: Floors

Enclosure and height of floor	Direction of heat flow	*Total R-Value*			
		Cavity masonry	**190 mm concrete masonry**	**Single skin masonry**	**9 mm fibre-cement sheet**
Unenclosed	Upwards	0.39			
	Downwards	0.51			
(b) Suspended concrete floor					
Enclosed - not more than 0.6 m high	Upwards	0.93	0.88	0.83	0.72
	Downwards	1.06	1.01	0.96	0.85
Enclosed - more than 0.6 m but to not more than 1.2 m high	Upwards	0.81	0.76	0.71	0.60
	Downwards	0.94	0.89	0.84	0.72
Enclosed - more than 1.2 m to not more than 2.4 m high	Upwards	0.71	0.67	0.62	0.52
	Downwards	0.84	0.79	0.74	0.64
Unenclosed	Upwards	0.34			
	Downwards	0.46			

Notes:

1. The height of the floor is measured from ground surface to the underside of the floor or the insulation.
2. For the purposes of calculating the *Total R-Value* of a floor, the *R-Value* attributable to an in-slab or in-screed heating or cooling system is ignored.

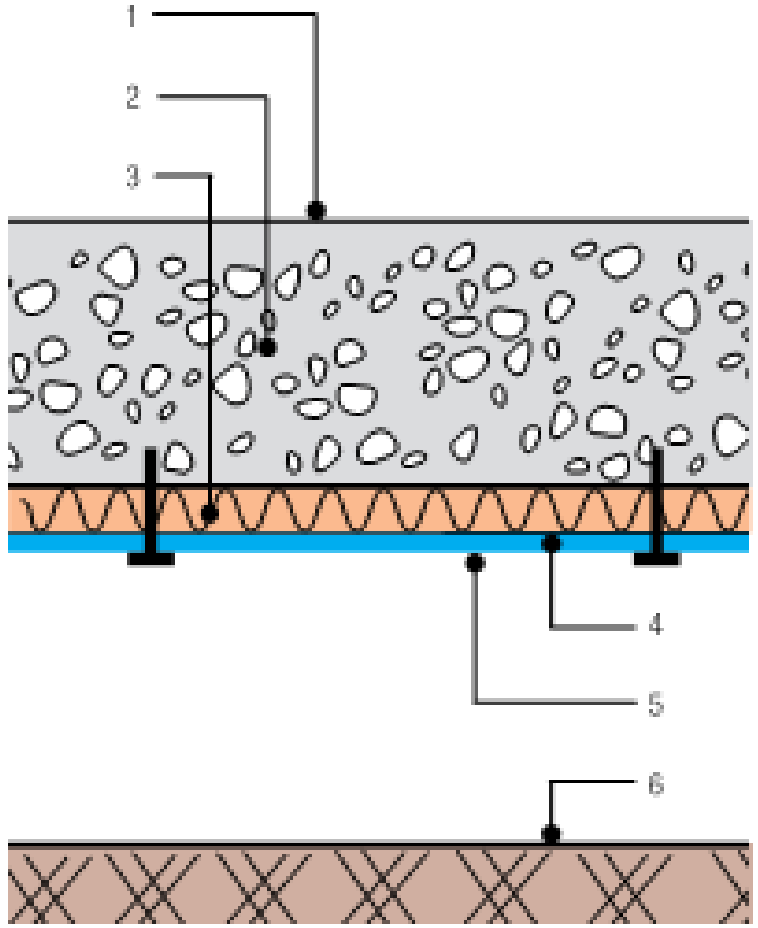
Energy Efficiency and Building Fabric: Floors



R-VALUES FOR SYSTEM F0100		R1.5 BATT			
		NON-VENTILATED		VENTILATED	
		F0113W	F0113S	F0114W	F0114S
No:	Element Description:	WINTER	SUMMER	WINTER	SUMMER
1	Indoor Air Film	0.160	0.110	0.160	0.110
2	19mm T&G Timber Floor	0.120	0.120	0.120	0.120
3	Unventilated 90mm Air Space or Batts	1.568	1.445	1.568	1.445
4	Reflective Insulation Material R-value				
5	Subfloor Air Film	0.160	0.110	0.080	0.080
6	Ground Thermal Resistance (R_{gs})	0.580	0.560		
	Total R-Value	**2.6**	**2.3**	**1.9**	**1.8**
	Total R-Value of floor materials	1.0	0.90	0.40	0.34
	Added R-Value of insulation	1.6	1.4	1.5	1.4

Energy Efficiency and Building Fabric: Floors

- 250mm concrete
- 15mm EPS Board with antiglare foil (facing downwards)
- 500mm enclosed air space AGL (brick)



Energy Efficiency and Building Fabric: Thermal Insulation

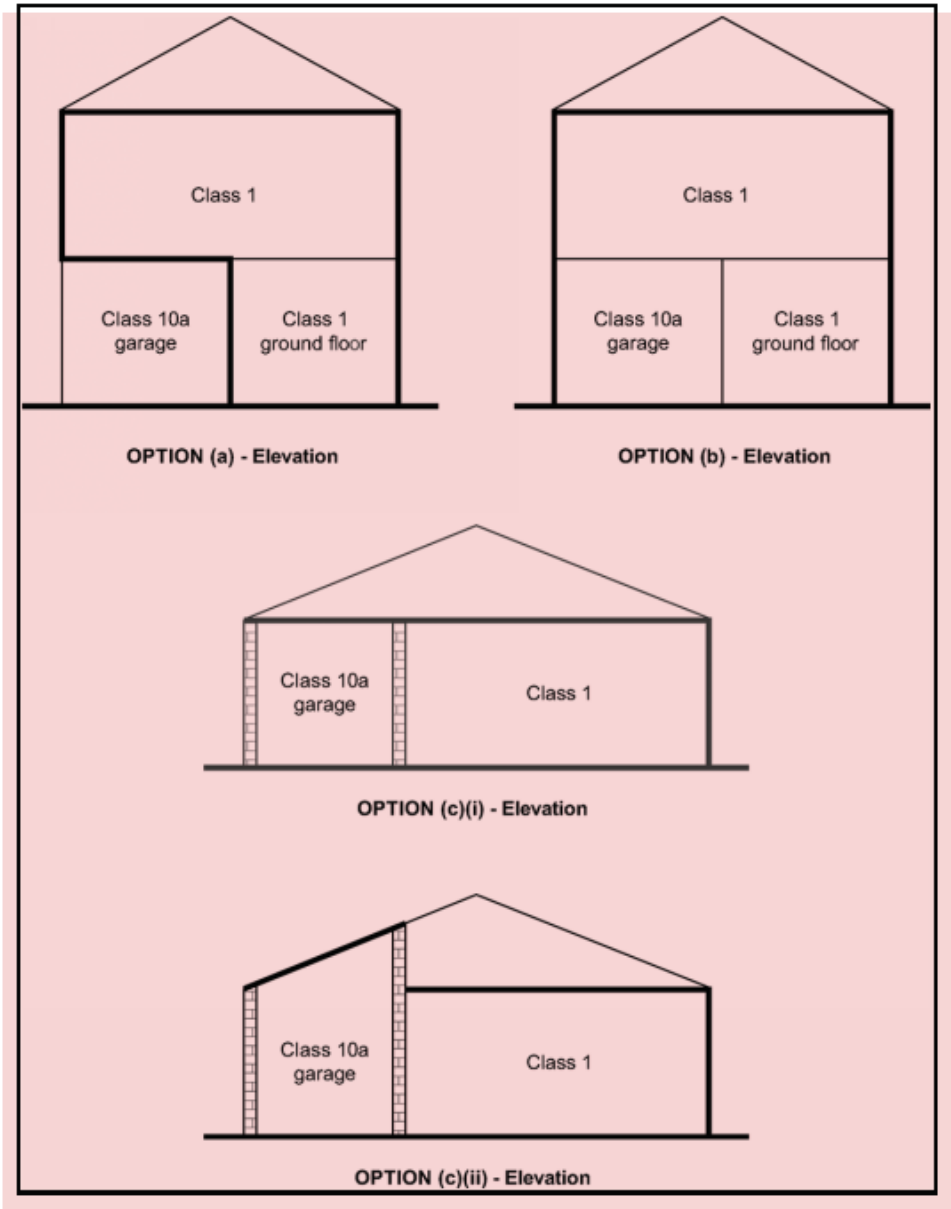
Building fabric thermal insulation

- Thermal insulation may be -
  - Added to elements of the building fabric to achieve the required Total R-Value
  - Either reflective insulation or bulk insulation
- Thermal insulation must -
  - Comply with AS/NZS 4859.1
  - Form a consistent and continuous barrier when installed
  - Not interfere with the operation of domestic services or fittings, such as downlights

Energy Efficiency and Building Fabric: Installation of insulation

- Thermal insulation needs to be installed so that–
  - Any required airspace is provided adjacent to the reflective surface of reflective insulation
  - The thickness and position of bulk insulation is maintained
- Compensating for reduced ceiling insulation due to downlights, exhaust fans etc. -
  - 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 3.12.1.1b

Energy Efficiency and Building Fabric: Installation of insulation



Energy Efficiency and Glazing

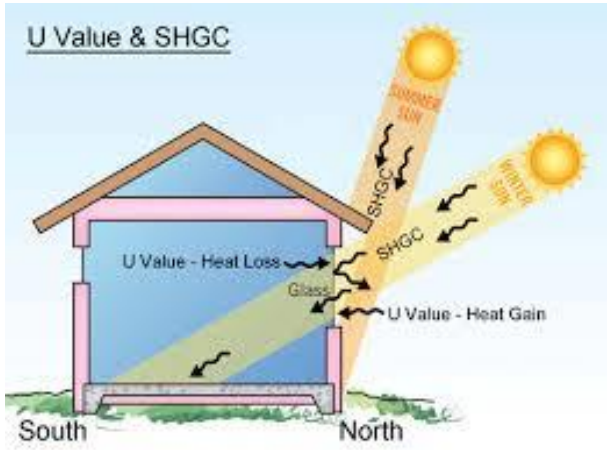
Glazing provisions – Part 3.12.2

- NCC definition of glazing:
  - "a transparent or translucent element and its supporting frame located in the external fabric of the building, and includes a window other than a roof light”
- Glazing design is assessed based on
  - Conductance
  - Solar heat gain
- The design must not exceed the allowances.
- Formula is provided in 3.12.2.1
- ABCB Glazing Calculator can assist with calculations

Energy Efficiency and Glazing

Glazing performance

- NCC definitions for Total System U-Value and Total System Solar Heat Gain Coefficient (SHGC)
- Includes the glass, frame and any air spaces
- Total System U-Value (W/m².K)
  - Conductance
  - Low Total U-Values are better
  - at minimising heat flow (i.e. better insulator)
- Total System SHGC
  - Solar heat gain
  - Lower SHGC values allow less solar energy (radiation) into a room



Energy Efficiency and Glazing

- Factors affecting heat transfer for glazing
  - Location of the building (climate zone)
  - Total area of glazing
  - Degree of exposure to the sun: orientation and shading
  - The likelihood of the building being air-conditioned
  - Type of frame and glass used

Energy Efficiency and Glazing

3.12.2.1 External glazing

(a) The aggregate conductance of the *glazing* in each storey, including any mezzanine, of a building must—

(i) not exceed the allowances resulting from—

(A) in *climate zone* 1, multiplying the area of the storey, including any mezzanine, measured within the enclosing walls, by the constant C_U obtained from **Table 3.12.2.1**; and

(B) in *climate zones* 2 to 8, using the constant C_U obtained from **Table 3.12.2.1**.

Energy Efficiency and Glazing

(ii) be calculated in accordance with the following calculation—

(A) in *climate zone* 1—

$$(A_1 \times U_1) + (A_2 \times U_2) + (A_3 \times U_3) + \ldots\ldots\ldots\ldots$$

where—

$A_{1,\ 2,\ etc}$ = the area of each *glazing* element; and

$U_{1,\ 2,\ etc}$ = the *Total System U-Value* of each *glazing* element; and

(B) in *climate zones* 2 to 8—

$$[(A_1 \times U_1) + (A_2 \times U_2) + \ldots\ldots] / [(A_1 \times SHGC_1 \times E_{W1}) + (A_2 \times SHGC_2 \times E_{W2}) + \ldots\ldots\ldots]$$

where—

$A_{1,\ 2,\ etc}$ = the area of each *glazing* element; and

$U_{1,\ 2,\ etc}$ = the *Total System U-Value* of each *glazing* element; and

$SHGC_{1,\ 2,\ etc}$ = the *Total System SHGC* for each *glazing* element; and

$E_{W1,\ W2\ etc}$ = the winter exposure factor for each *glazing* element obtained from **Table 3.12.2.2a**.

Energy Efficiency and Glazing

(b) The aggregate solar heat gain of the *glazing* in each storey, including any mezzanine, of a building must—

(i) not exceed the allowances resulting from multiplying the area of the storey, including any mezzanine, measured within the enclosing walls, by the constant C_{SHGC} obtained from **Table 3.12.2.1**; and

(ii) be calculated in accordance with the following calculation—

$$(A_1 \times SHGC_1 \times E_{S1}) + (A_2 \times SHGC_2 \times E_{S2}) + ...$$

where—

$A_{1, 2, etc}$	=	the area of each *glazing* element; and
$SHGC_{1, 2, etc}$	=	the *Total System SHGC* for each *glazing* element; and
$E_{S1, S2, etc}$	=	the summer exposure factor for each *glazing* element obtained from **Table 3.12.2.2b**.

Energy Efficiency and Glazing

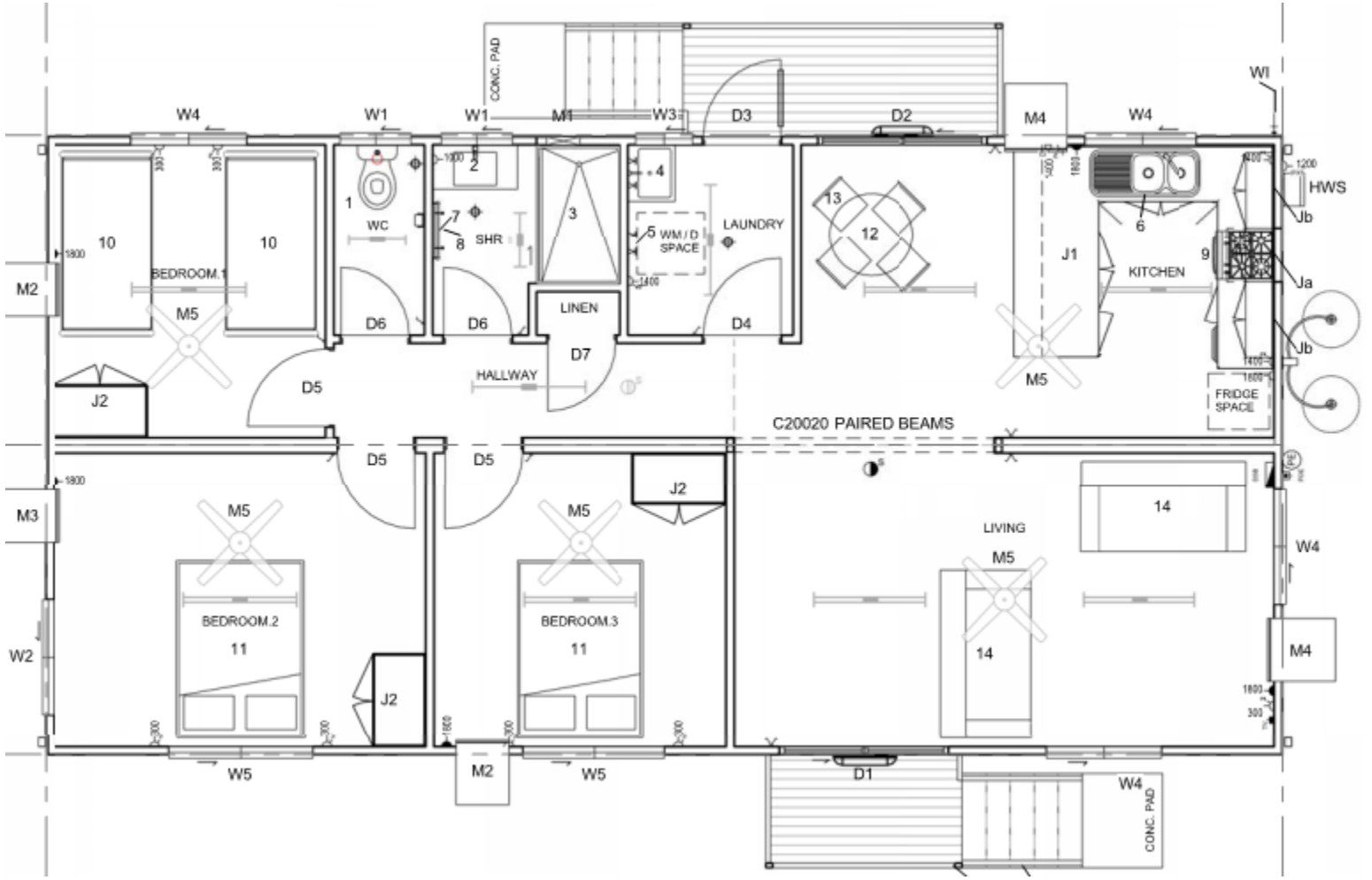
Table 3.12.2.1 CONSTANTS FOR CONDUCTANCE AND SOLAR HEAT GAIN

Floor construction	Air Movement (refer Notes)	Constant	*Climate zone* 1	2	3	4	5	6	7	8
Floor in direct contact with the ground	**Standard**	C_U	1.650	18.387	14.641	7.929	13.464	6.418	5.486	3.987
		C_{SHGC}	0.063	0.074	0.062	0.097	0.122	0.153	0.189	0.234
	High	C_U	1.650	18.387	14.641	7.929	13.464	6.418	5.486	3.987
		C_{SHGC}	0.069	0.081	0.068	0.107	0.134	0.168	0.208	0.257
Suspended floor	**Standard**	C_U	1.485	16.548	13.177	7.136	12.118	5.776	4.937	3.588
		C_{SHGC}	0.057	0.067	0.056	0.087	0.110	0.138	0.170	0.211
	High	C_U	1.485	16.548	13.177	7.136	12.118	5.776	4.937	3.588
		C_{SHGC}	0.063	0.074	0.062	0.096	0.121	0.152	0.187	0.232

Notes:

1. A storey has Standard air movement if all *habitable rooms* comply with **Part 3.12.4**.
2. A storey has High air movement if the total *ventilation opening* area serving the *habitable room* is—
   (a) in *climate zones* 1, 2, 3, 4 and 5, not less than that for Standard air movement without a ceiling fan or evaporative cooler, but with ceiling fans complying with **3.12.4.3** installed in all *habitable rooms*; or
   (b) not less than twice that for Standard air movement without a ceiling fan or evaporative cooler.
3. Where the *ventilation opening* area serving the *habitable rooms* is between Standard and High, interpolation may be used to determine the applicable C_{SHGC}.
4. Where the floor construction of a storey, including a mezzanine, is partly in direct contact 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.

Energy Efficiency and Glazing



Energy Efficiency and Glazing

Energy Efficiency and Glazing

Energy Efficiency and Glazing

Report from Glazing Calculator - 160947.xlsx *printed 12/11/2016*

NCC VOLUME TWO GLAZING CALCULATOR (first issued with NCC 2014)

Building name/description: **13.2 x 6.6m Living Quarters 3 Bed**

Climate zone: **3**

	C_U	C_{SHGC}
CONSTANTS	13.177	0.058

Storey: **Ground**

Air Movement: **1.4 x Std**

Floor Construction — Area

Direct contact:

Suspended: **87m²**

Area of storey: **87m²**

Area of glazing *17.0m² (20% of area of storey)*

Wall insulation option chosen for 3.12.1.4: ***No wall insulation concession used***

	C_U (only)	C_{SHGC} x Area
ALLOWANCES	13.2	5.1

Number of rows for table below: **11** *(as currently displayed)*

GLAZING ELEMENTS, ORIENTATION SECTOR, SIZE and PERFORMANCE CHARACTERISTICS							SHADING		CALCULATION DATA			CALCULATED OUTCOMES - OK (if inputs are valid)			
Glazing element		Orientation	Size			Performance		P&H or device		Exposure		Size	Conductance - PASSED		Solar heat gain - PASSED	
ID	Description (optional)	Facing sector	Height (m)	Width (m)	Area (m²)	Total System U-Value (AFRC)	Total System SHGC (AFRC)	P (m)	H (m)	P/H	Es	Area used (m²)	U x area / winter access	Element share of % of allowance used	SHGC x Es x area	Element share of % of allowance used
1	W4	N	0.90	1.21		6.40	0.74				0.56	1.09	0.92	8% of 88%	0.5	9% of 99%
2	W1 x 2	N	0.35	1.50		6.40	0.74				0.56	0.53	0.44	4% of 88%	0.2	4% of 99%
3	W3	N	0.60	0.60		6.40	0.74				0.56	0.36	0.30	3% of 88%	0.1	3% of 99%
4	D3 Half Glass	N	0.60	0.60		6.80	0.76	1.20	0.94	1.28	0.18	0.36	0.32	3% of 88%	0.0	1% of 99%
5	D2	N	2.10	1.80		4.50	0.36	1.20	2.22	0.54	0.29	3.78	2.24	19% of 88%	0.4	8% of 99%
6	W4	N	0.90	1.21		6.40	0.74				0.56	1.09	0.92	8% of 88%	0.5	9% of 99%
7	W4	E	0.90	1.21		6.40	0.74				1.42	1.09	0.92	8% of 88%	1.1	23% of 99%
8	W4	S	0.90	1.21		6.40	0.74				0.66	1.09	0.92	8% of 88%	0.5	11% of 99%
9	D1	S	2.10	1.80		4.50	0.36	1.20	2.22	0.54	0.33	3.78	2.24	19% of 88%	0.5	9% of 99%
10	W5 x 2	S	0.90	3.02		4.70	0.37				0.66	2.71	1.68	15% of 88%	0.7	13% of 99%
11	W2	W	0.90	1.21		4.70	0.37				1.36	1.09	0.67	6% of 88%	0.5	11% of 99%

IMPORTANT NOTICE AND DISCLAIMER IN RESPECT OF THE GLAZING CALCULATOR

If inputs (including air movement levels) are valid

The Glazing Calculator has been developed by the ABCB to assist in developing a better understanding of glazing energy efficiency parameters. While the ABCB believes that the Glazing Calculator, if used correctly, will produce accurate results, it is provided "as is" and without any representation or warranty of any kind, including that it is fit for any purpose or of merchantable quality, or functions as intended or at all. Your use of the Glazing Calculator is entirely at your own risk and the ABCB accepts no liability of any kind.

Energy Efficiency and Building Sealing

Building Sealing – Part 3.12.3

- The provisions for building sealing address:
  - Chimneys and flues
  - Roof lights
  - External windows and doors
  - Exhaust fans
  - Construction of roofs, walls and floors
  - Evaporative coolers

Energy Efficiency and Building Sealing

Building Sealing – Part 3.12.3.1 Chimneys and flues

“The chimney or flue of an open solid fuel burning appliance must be provided with a damper or flap that can be closed to seal the chimney or flue”

Energy Efficiency and Building Sealing

Building Sealing – Part 3.12.3.2 Roof lights

“The roof lights are sealed, or capable of being sealed in accordance with ***Part J3.12.3.2 (a) & (b)”.***

Applies to conditioned spaces or a habitable room in climate zones 4, 5, 6, 7 & 8

Energy Efficiency and Building Sealing

Building Sealing – Part 3.12.3.3 External windows and doors

“All external doors must be fitted with air infiltration seals”

Applies to conditioned spaces or a habitable room in climate zones 4, 5, 6, 7 & 8

Energy Efficiency and Building Sealing

Building Sealing – Part 3.12.3.4 Exhaust Fans

“Exhaust fans, where installed, must be fitted with self-closing dampers or similar”

Applies to conditioned spaces or a habitable room in climate zones 4, 5, 6, 7 & 8

Energy Efficiency and Building Sealing

Building Sealing – Part 3.12.3.5 Construction of roofs, walls and floors

“All roofs, walls and floors must be constructed to minimise air leakage”

Applies to conditioned spaces or a habitable room in climate zones 4, 5, 6, 7 & 8

Energy Efficiency and Building Sealing

Building Sealing – Part 3.12.3.6 Evaporative Coolers

“An evaporative cooler must be fitted with a self closing damper or the like”

Applies to a heated space or a habitable room in climate zones 4, 5, 6, 7 & 8

Energy Efficiency and Air Movement

Air movement – Part 3.12.4

- The intent of these provisions is to:
  - Maximise the cooling effects of natural air movement
  - Facilitate internal cross-flow ventilation
  - Reduce demand for air-conditioning
- The provisions apply to habitable rooms in Class 1 buildings in climate zones 1 to 5
- They are separate to the ventilation requirements which are Part 3.8.5 of NCC Volume Two

Energy Efficiency and Air Movement

3.12.4.1 Air movement

(a) Air movement must be provided to *habitable rooms* in accordance with **Table 3.12.4.1**.

(b) Air movement *required* by **(a)** may be provided through an opening from an adjoining room (including an enclosed verandah) if—

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

(ii) the opening between the adjoining room and the *habitable room* complies with **Table 3.12.4.1** as if it were a *ventilation opening* to the *habitable room* or a proportion thereof if some ventilation is provided from another source; and

(iii) the *ventilation opening* to the adjoining room complies with **Table 3.12.4.1** for the *floor area* of the adjoining room and the proportion of the *habitable room* that is ventilated from the adjoining room.

Energy Efficiency and Air Movement

(c) The requirements of **(a)** do not apply to buildings in Region D severe tropical cyclone areas (see **Figure 3.10.1.4**) provided the *external walls* are shaded with a verandah, balcony, eaves, carport or the like that projects at a minimum angle of 15 degrees in accordance with **Figure 3.12.1.2**.

Energy Efficiency and Air Movement

Table 3.12.4.1 PROVISION FOR AIR MOVEMENT

Climate zones	Minimum total ventilation opening area as a percentage of the floor area for each habitable room		
	Without a ceiling fan or evaporative cooler	With a ceiling fan	With an evaporative cooler
1	10%	7.5%	10% (see Note)
2	10%	7.5%	10% (see Note)
3	10%	7.5%	7.5%
4	10%	5%	5%
5	7.5%	5%	7.5% (see Note)
6, 7, 8	As *required* by **Part 3.8.5**		

Note: Because evaporative coolers are less effective than ceiling fans in more humid locations, the requirement for *ventilation opening* in *climate zones* 1, 2 and 5 with an evaporative cooler is the same as without one.

Energy Efficiency and Air Movement

3.12.4.2 Ventilation openings

(a) In *climate zones* 1, 2, 3, 4 and 5, the total *ventilation opening* area *required* by **Table 3.12.4.1** to a *habitable room* must—

(i) be connected by a breeze path complying with **(b)** to another *ventilation opening* in another room or space; or

(ii) be 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 3.12.4.1**.

(b) A breeze path *required* by **(a)(i)** must—

(i) pass through not more than two openings in the internal walls with each opening having an area of not less than 1.5 m^2; and

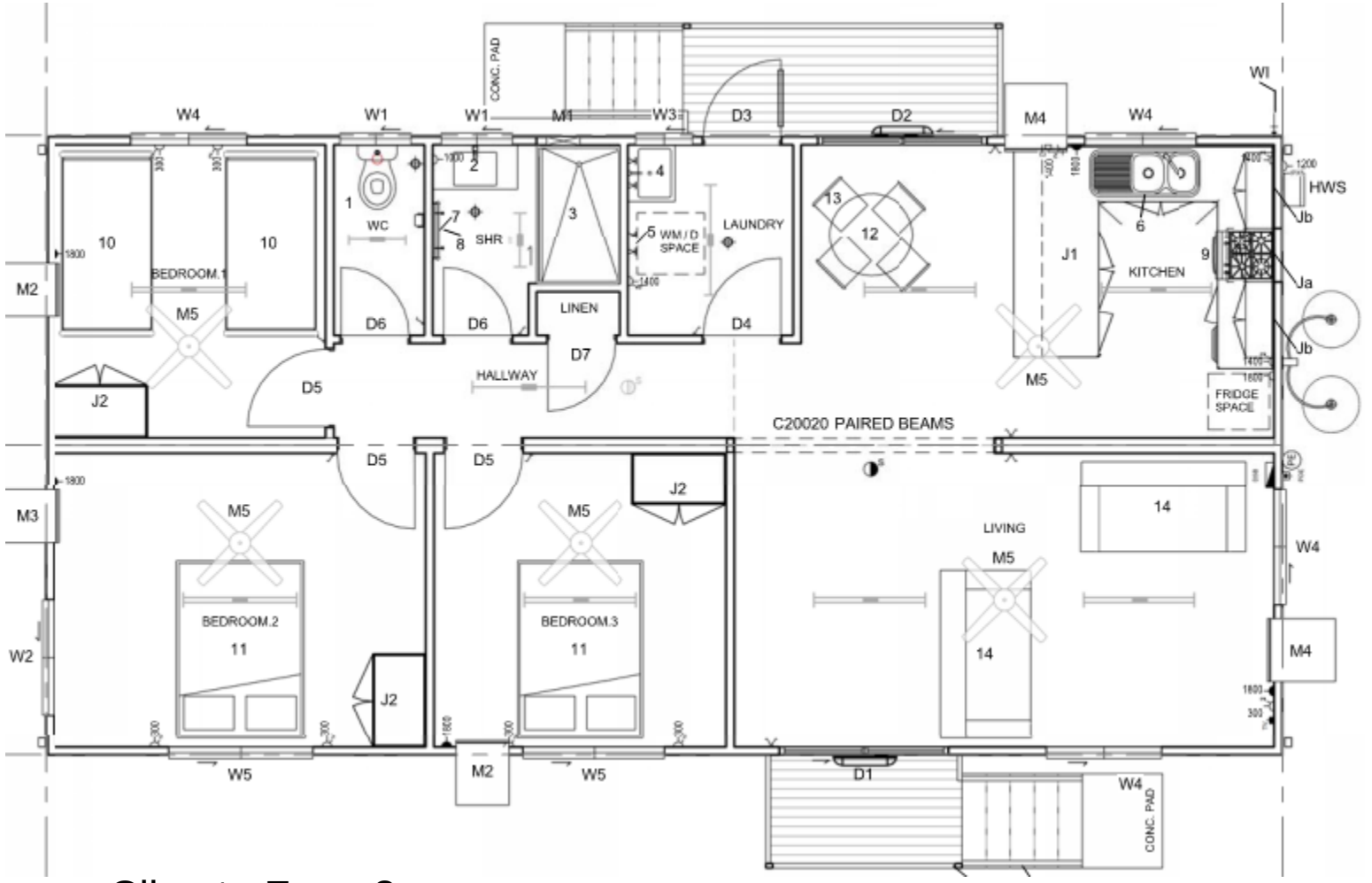
(ii) have a distance along the breeze path between *ventilation openings* of not more than 20 m.

Energy Efficiency and Air Movement

Explanatory information:

1. *Ventilation openings* should be designed to allow the interior of the building to take full advantage of any natural breeze. Careful consideration should be given to the type and location of openings to ensure optimum effect is achieved and that internal "dead air pockets" are avoided.
2. An opening may serve more than one breeze path.
3. Two openings are stated in **(b)(i)** as the limit of the number of openings permitted in a breeze path. These are typically doorways. Larger openings, such as those between adjoining lounge and dining areas in the same space are unlikely to restrict air movement significantly.

Energy Efficiency and Air Movement



Climate Zone 3

Energy Efficiency and Air Movement

Habitable Room	Room Floor Area m^2	Min Opening Ventilation	% Req. (Table 3.12.4.1)	Openable Area m^2	% Opening	Shared OR Breezepath	Fans Req'd
Bedroom 1	9.02	0.68 m^2	7.5%	2.22 m^2	24.61%	Shared	1
Bedroom 2	12.47	0.93 m^2	7.5%	2.35 m^2	18.85%	Shared	1
Bedroom 3	9.77	0.73 m^2	7.5%	2.35 m^2	24.10%	Shared	1
Living / Kitchen / Hall	39.96	3.00 m^2	7.5%	5.41 m^2	13.54%	Breezepath	2

Energy Efficiency and Air Movement

3.12.4.3 Ceiling fans and evaporative coolers

Ceiling fans or evaporative coolers *required* to comply with **3.12.0.1**, **Table 3.12.2.1** or **Table 3.12.4.1** must—

(a) be permanently installed; and

(b) have a speed controller; and

(c) for ceiling fans, serve the whole room, with the *floor area* that a single fan serves not exceeding—

  (i) 15 m^2 if it has a blade rotation diameter of not less than 900 mm; and

  (ii) 25 m^2 if it has a blade rotation diameter of not less than 1200 mm.

Energy Efficiency and Services

Services – Part 3.12.5

- Minimise energy lost through operation of:
  - Air-conditioning
  - Central heating
  - Lighting
  - Heated water supply
  - Pool & spa heating and pumping
- Applies to domestic services in both Class 1 and Class 10a buildings and Class 10b swimming pools

Energy Efficiency and Lighting

Artificial lighting – Part 3.12.5.5

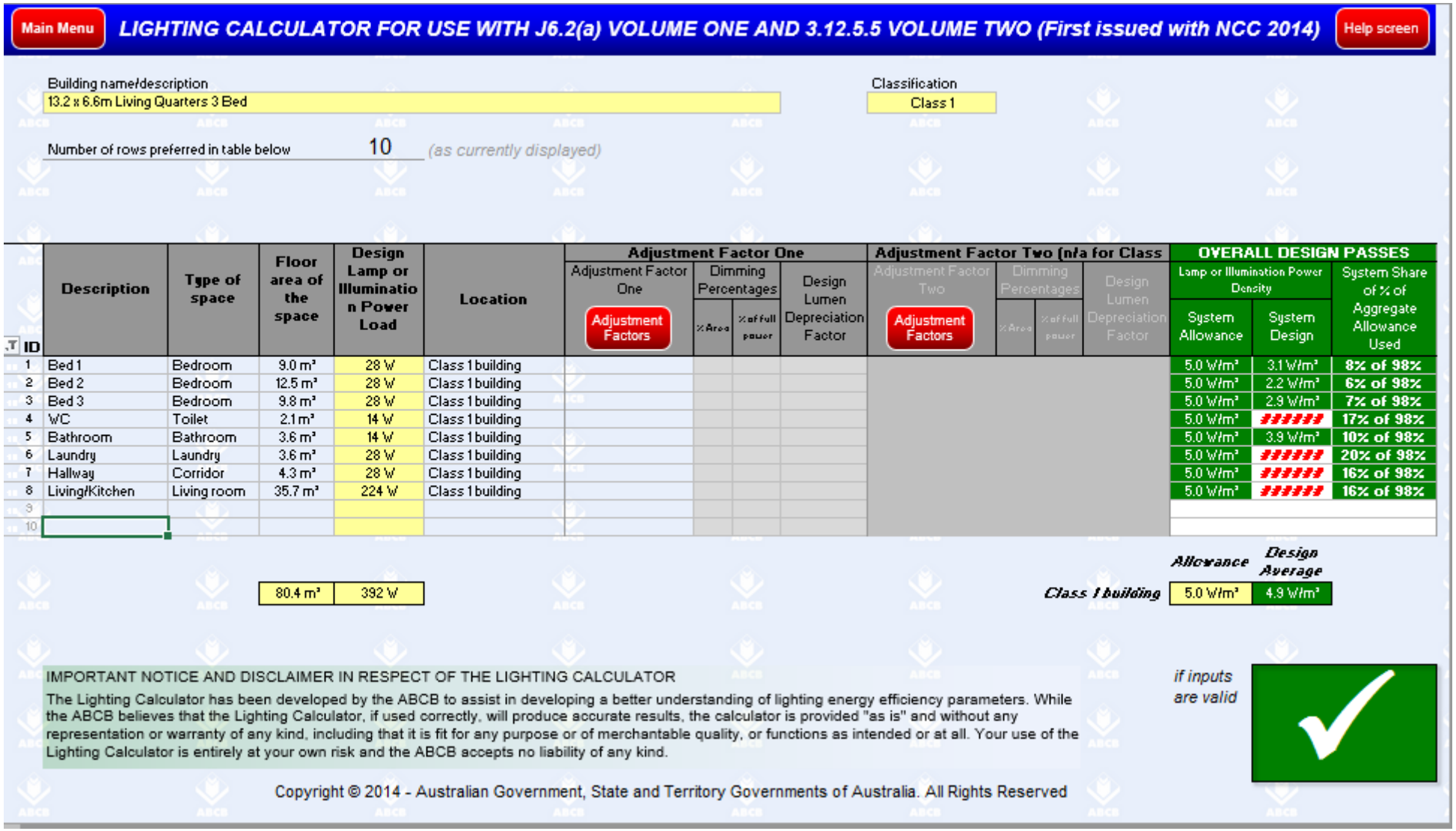
- Lighting must not exceed power allowances
- Allowance can be increased if there are sophisticated lighting controls
- Halogens must be separately switched from fluorescents
- Outside lighting must be controlled by a motion sensor or be of high efficacy

Energy Efficiency and Lighting

Artificial lighting – Part 3.12.5.5

- The lamp power density or illumination power density allowances are as follows:
- 5 watts per square metre in a Class 1 building
- 4 watts per square metre on a verandah, balcony or the like attached to a Class 1 building; and
- 3 watts per square metre in a Class 10a building associated with a Class 1 building

Energy Efficiency and Lighting



Main Menu

LIGHTING CALCULATOR FOR USE WITH J6.2(a) VOLUME ONE AND 3.12.5.5 VOLUME TWO (First issued with NCC 2014)

Help screen

Building name/description: 13.2 x 6.6m Living Quarters 3 Bed

Classification: Class 1

Number of rows preferred in table below: 10 *(as currently displayed)*

ID	Description	Type of space	Floor area of the space	Design Lamp or Illumination Power Load	Location	Adjustment Factor One	Dimming Percentages		Design Lumen Depreciation Factor	Adjustment Factor Two	Dimming Percentages		Design Lumen Depreciation Factor	OVERALL DESIGN PASSES		
						Adjustment Factors	% Area	% of full power		Adjustment Factors	% Area	% of full power		Lamp or Illumination Power Density		System Share of % of Aggregate Allowance Used
														System Allowance	System Design	
1	Bed 1	Bedroom	9.0 m²	28 W	Class 1 building									5.0 W/m²	3.1 W/m²	8% of 98%
2	Bed 2	Bedroom	12.5 m²	28 W	Class 1 building									5.0 W/m²	2.2 W/m²	6% of 98%
3	Bed 3	Bedroom	9.8 m²	28 W	Class 1 building									5.0 W/m²	2.9 W/m²	7% of 98%
4	WC	Toilet	2.1 m²	14 W	Class 1 building									5.0 W/m²	//////	17% of 98%
5	Bathroom	Bathroom	3.6 m²	14 W	Class 1 building									5.0 W/m²	3.9 W/m²	10% of 98%
6	Laundry	Laundry	3.6 m²	28 W	Class 1 building									5.0 W/m²	//////	20% of 98%
7	Hallway	Corridor	4.3 m²	28 W	Class 1 building									5.0 W/m²	//////	16% of 98%
8	Living/Kitchen	Living room	35.7 m²	224 W	Class 1 building									5.0 W/m²	//////	16% of 98%
9																
10																
			80.4 m²	392 W										Allowance	Design Average	
														Class 1 building	5.0 W/m²	4.9 W/m²

IMPORTANT NOTICE AND DISCLAIMER IN RESPECT OF THE LIGHTING CALCULATOR

The Lighting Calculator has been developed by the ABCB to assist in developing a better understanding of lighting energy efficiency parameters. While the ABCB believes that the Lighting Calculator, if used correctly, will produce accurate results, the calculator is provided "as is" and without any representation or warranty of any kind, including that it is fit for any purpose or of merchantable quality, or functions as intended or at all. Your use of the Lighting Calculator is entirely at your own risk and the ABCB accepts no liability of any kind.

if inputs are valid

Energy Efficiency and Lighting

Additional Information

ID	Description	Location	Lamp / Illumination Power Density Allowance *(prior to use of any Adjustment Factors)*	Adjustment Factor One	Adjustment Factor Two	Lamp / Illumination Power Density Allowance *(after use of any Adjustment Factors)*
1	Bed 1	Class 1 building	5.0 W/m²			5.0 W/m²
2	Bed 2	Class 1 building	5.0 W/m²			5.0 W/m²
3	Bed 3	Class 1 building	5.0 W/m²			5.0 W/m²
4	WC	Class 1 building	5.0 W/m²			5.0 W/m²
5	Bathroom	Class 1 building	5.0 W/m²			5.0 W/m²
6	Laundry	Class 1 building	5.0 W/m²			5.0 W/m²
7	Hallway	Class 1 building	5.0 W/m²			5.0 W/m²
8	Living/Kitchen	Class 1 building	5.0 W/m²			5.0 W/m²
9						
10						
			Average	5.0 W/m²		***Average***	5.0 W/m²

Energy Efficiency and Heated Water Supply

Heated water supply

- Since 2014 heated water supply system requirements have been located in NCC Volume Three Part B2
- Heated water supply system must be:
  - Solar
  - Heat pump
  - Gas (5 star)
  - In some circumstances electric resistance or wood fired

Energy Efficiency and Heated Water Supply

3.12.5.7 Swimming pool heating and pumping

(a) Heating for a *swimming pool* must be by—

- (i) a solar heater not boosted by electric resistance heating; or
- (ii) a heater using reclaimed energy; or
- (iii) a gas heater; or
- (iv) a heat pump; or
- (v) a combination of **(i)** to **(iv)**.

(b) Where some or all of the heating *required* by **(a)** is by a gas heater or a heat pump, the *swimming pool* must have—

- (i) a cover unless located in a *conditioned space*; and
- (ii) a time switch to control the operation of the heater.

(c) A time switch must be provided to control the operation of a circulation pump for a *swimming pool*.

(d) For the purposes of **3.12.5.7**, a *swimming pool* does not include a spa pool.

Energy Efficiency and Heated Water Supply

3.12.5.8 Spa pool heating and pumping

(a) Heating for a spa pool that shares a water recirculation system with a *swimming pool* must be by—

- (i) a solar heater; or
- (ii) a heater using reclaimed energy; or
- (iii) a gas heater; or
- (iv) a heat pump; or
- (v) a combination of **(i)** to **(iv)**.

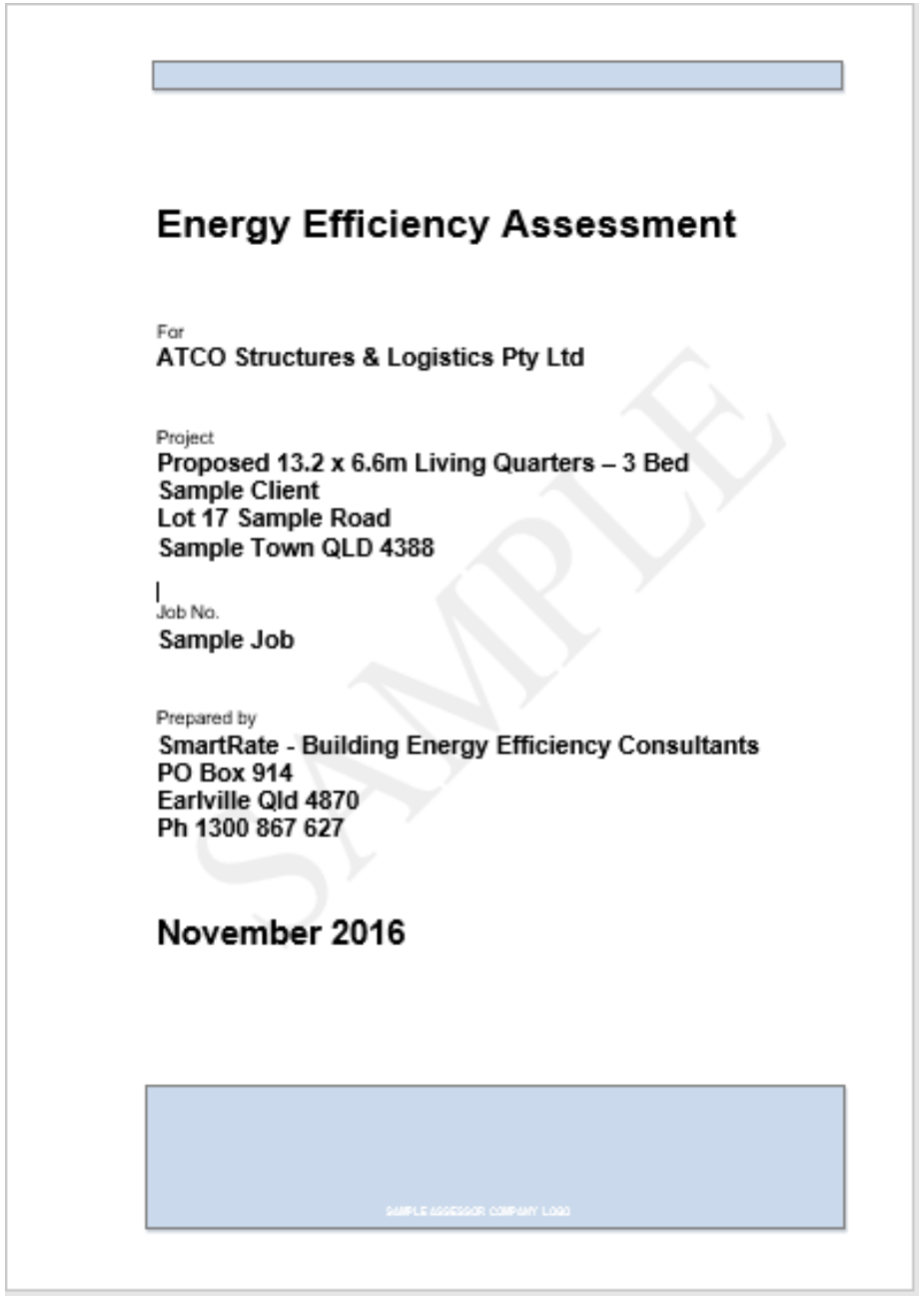
(b) Where some or all of the heating *required* by **(a)** is by a gas heater or a heat pump, the spa pool must have—

- (i) a cover; and
- (ii) a push button and a time switch to control the operation of the heater.

(c) A time switch must be provided to control the operation of a circulation pump for a spa pool having a capacity of 680 L or more.

Assessment Report

- Assessment Report
- Glazing Calculator
- Lighting Calculator
- Additional forms



Energy Efficiency Assessment

For
ATCO Structures & Logistics Pty Ltd

Project
Proposed 13.2 x 6.6m Living Quarters – 3 Bed
Sample Client
Lot 17 Sample Road
Sample Town QLD 4388

Job No.
Sample Job

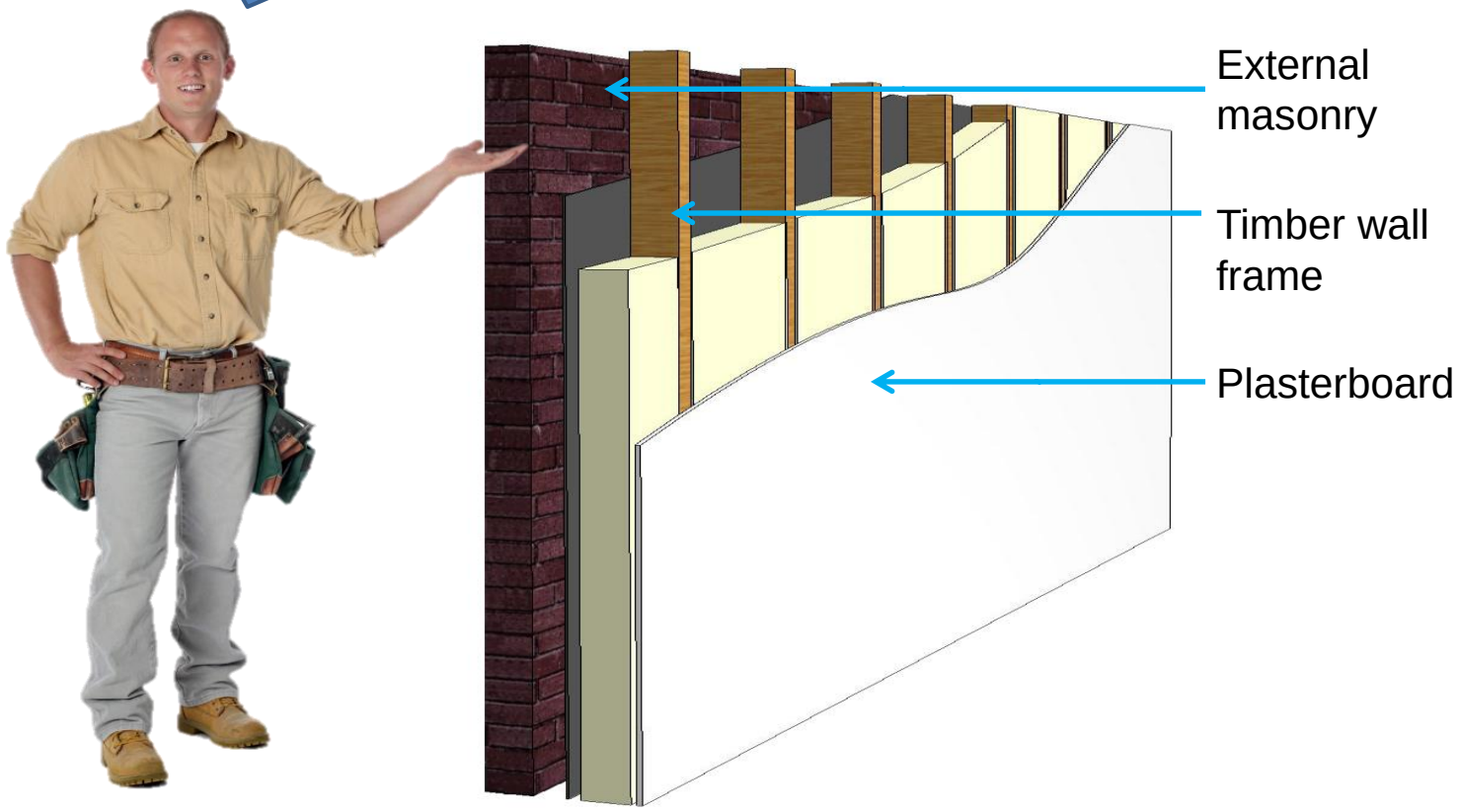
Prepared by
SmartRate - Building Energy Efficiency Consultants
PO Box 914
Earlville Qld 4870
Ph 1300 867 627

November 2016

SAMPLE ASSESSOR COMPANY LOGO

Example:
Applying NCC Volume Two

Now let's look at an example of applying the DtS provisions to this external wall for a home in Adelaide



Construction type

Climate zone

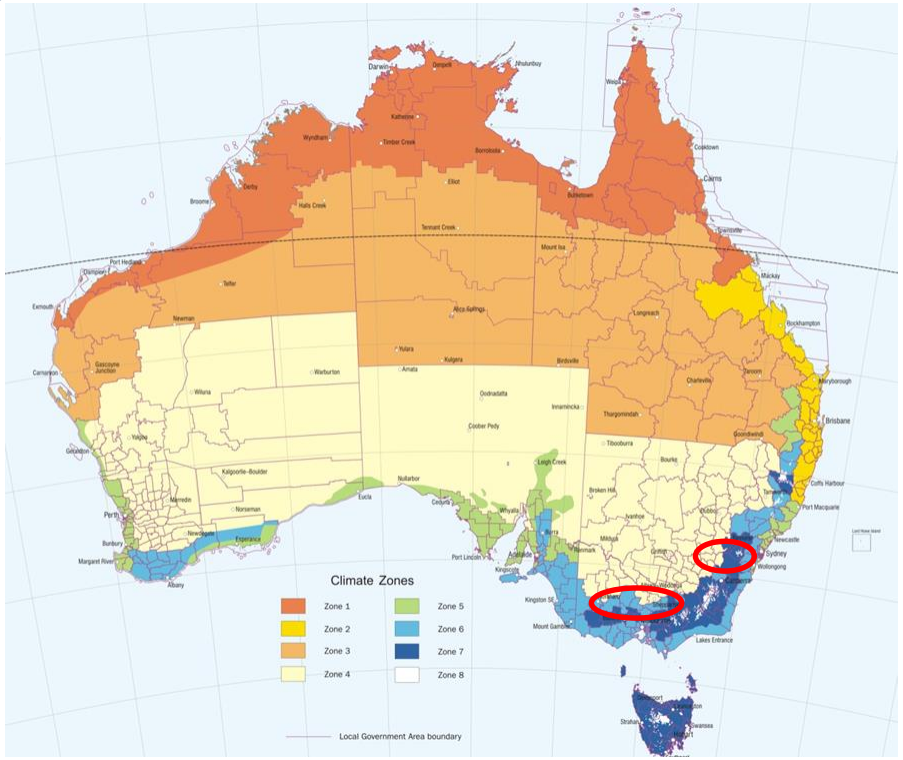
Required Total R-Value

Wall R-Value

Insulation R-Value

Example:
Applying NCC Volume Two

If this house is to be built in Adelaide, what climate zone is it in?

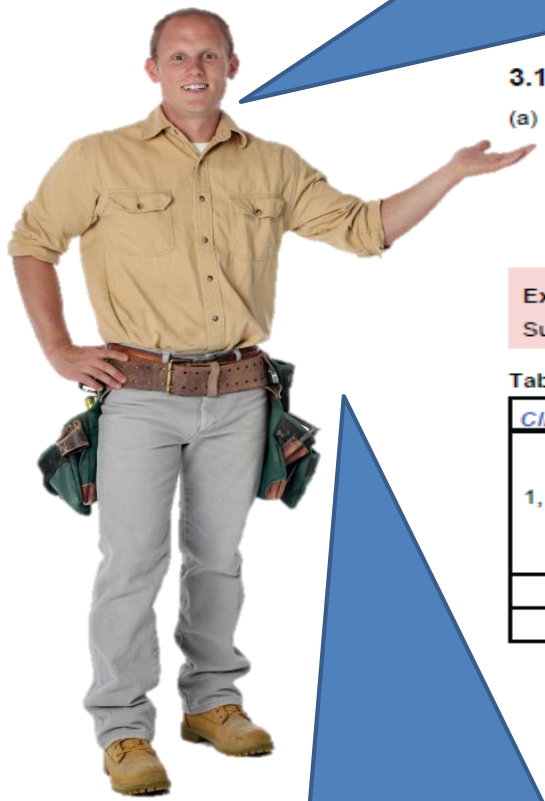


Answer:
climate zone 5

- Construction type
- Climate zone
- Required Total R-Value
- Wall R-Value
- Insulation R-Value

Example:
Applying NCC Volume Two

What is the minimum Total R-Value required for the external masonry veneer wall for this house in Adelaide?



3.12.1.4 External walls

(a) Each part of an *external wall* must satisfy the requirements of Table 3.12.1.3a for all walls, or Table 3.12.1.3b for walls with a surface density of not less than 220 kg/m^2, except for—

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

(ii) *glazing* unless covered by Table 3.12.1.3b.

Explanatory information:

Surface density is the mass of one vertical square metre of wall.

Table 3.12.1.3a — OPTIONS FOR EACH PART OF AN EXTERNAL WALL

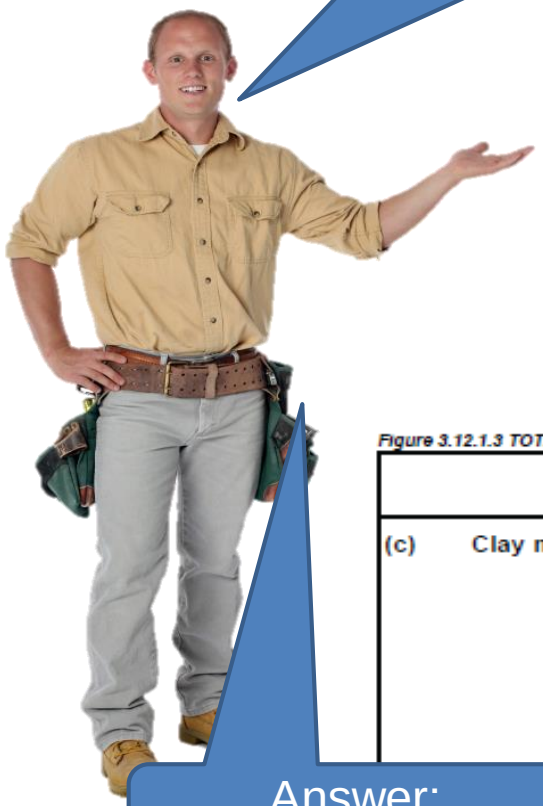
Climate Zone	Options
1, 2, 3, 4 and 5	(a) Achieve a minimum *Total R-Value* of 2.8 (b) (i) Achieve a minimum *Total R-Value* of 2.4; and (ii) shade the *external wall* of the storey with a verandah, balcony, eaves, carport or the like, which projects at a minimum angle of 15 degrees in accordance with Figure 3.12.1.2.
6 and 7	Achieve a minimum *Total R-Value* of 2.8.
8	Achieve a minimum *Total R-Value* of 3.8.

Answer:
R2.4

- Construction type
- Climate zone
- Required Total R-Value
- Wall R-Value
- Insulation R-Value

Example:
Applying NCC Volume Two

What is the R-Value of the wall without any added insulation?



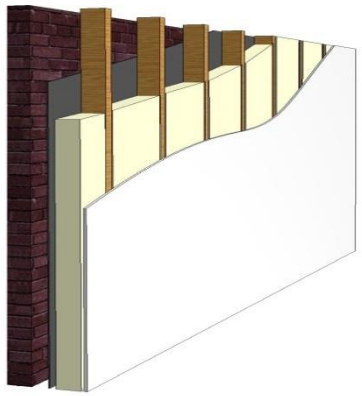
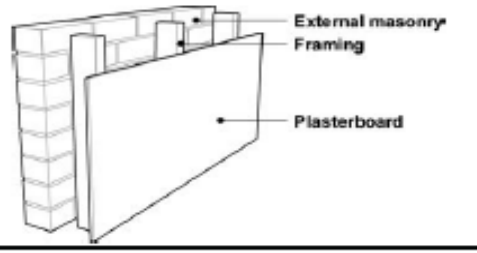


Figure 3.12.1.3 TOTAL R-VALUE FOR TYPICAL WALL CONSTRUCTION — continued

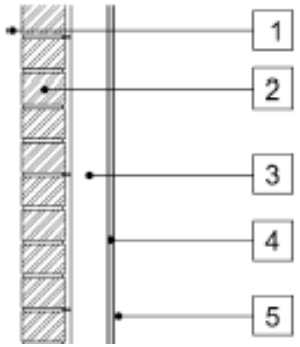
External wall construction description	*Total R-Value*
(c) Clay masonry veneer 	0.56

Answer:
R0.56

- Construction type
- Climate zone
- Required Total R-Value
- Wall R-Value
- Insulation R-Value

Example:
Applying NCC Volume Two

This image shows the R-Value of each component, which added together give a wall R-Value of R0.56.



Item	Item Description	R-Value
1	Outdoor air	0.04
2	110mm masonry	0.17
3	115mm airspace (includes 90mm stud + 25mm airspace)	0.17
4	10mm plasterboard	0.06
5	Indoor air	0.12
	Total R-Value for the wall construction =	**0.56**

Construction type

Climate zone

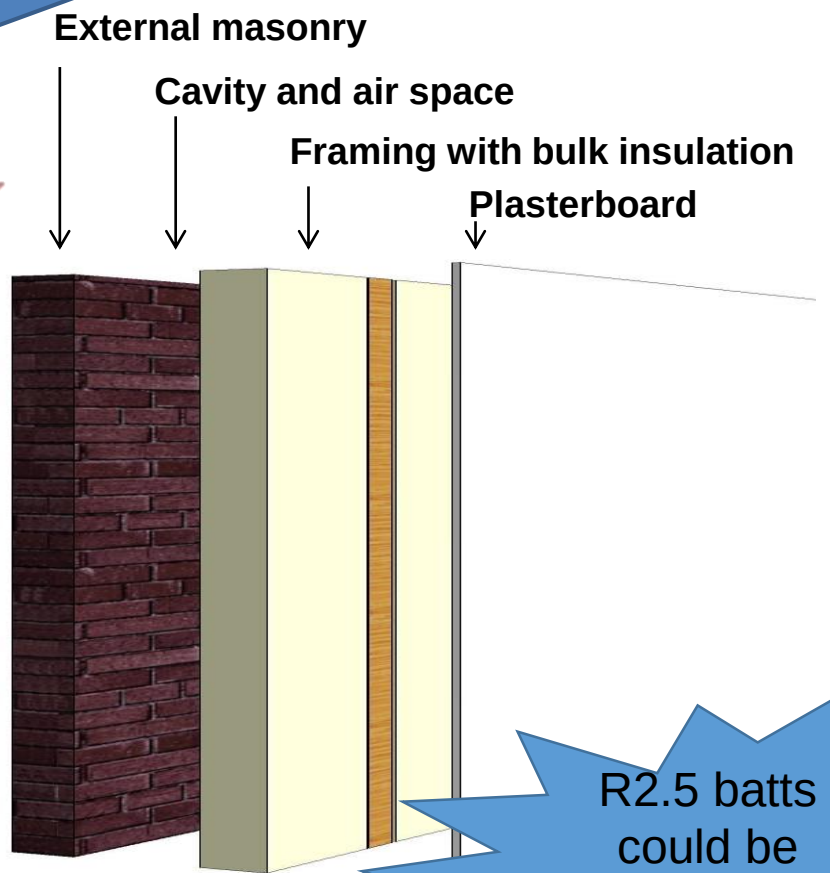
Required Total R-Value

Wall R-Value

Insulation R-Value

Example:
Applying NCC Volume Two

What is the R-Value of the insulation needed to meet the required Total R-Value for the wall?



Answer:
R2.8 – R0.56 = R2.24

R2.5 batts could be used

Construction type

Climate zone

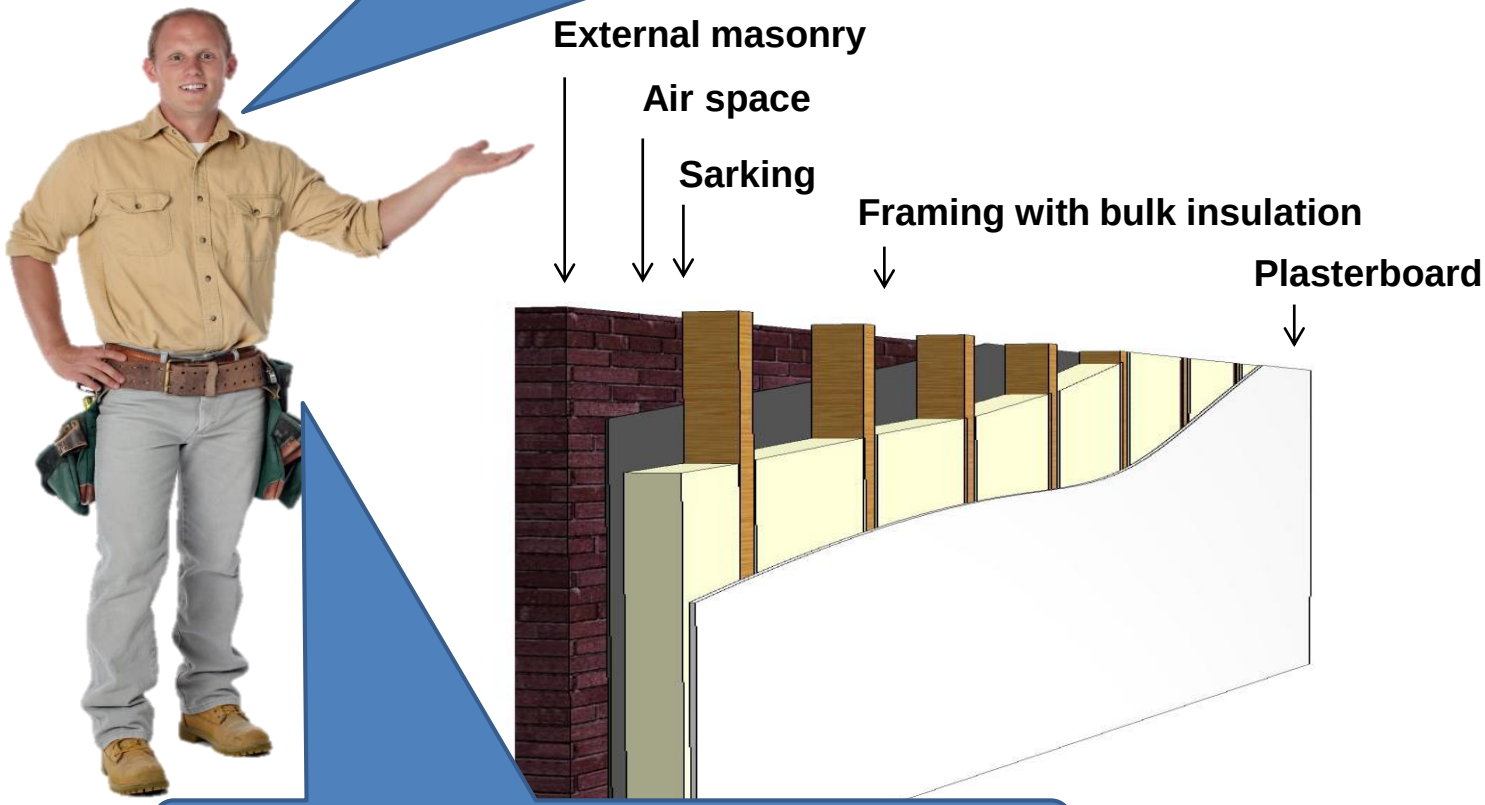
Required Total R-Value

Wall R-Value

Insulation R-Value

Example:
Applying NCC Volume Two

Can wall sarking be included when calculating the R-Value of the wall?



Answer:
Yes, if reflective sarking is used.

- Construction type
- Climate zone
- Required Total R-Value
- Wall R-Value
- Insulation R-Value

Example:
Applying NCC Volume Two

What is the of the insulation needed to meet the required Total R-Value for the wall when sarking is used?

Item	Item Description	R-Value
1	Outdoor air	0.04
2	110mm masonry	0.17
3	115mm **reflective** airspace (includes 90mm stud + 25mm airspace)	~~0.17~~ 0.65
4	Sarking (emissivity of 0.05)	0.00
5	10mm plasterboard	0.06
6	Indoor air	0.12
	Total R-Value for the wall construction =	**0.87**

Answer:
R2.8 – R0.87 = R1.93

R2.0 batts could be used

Construction type

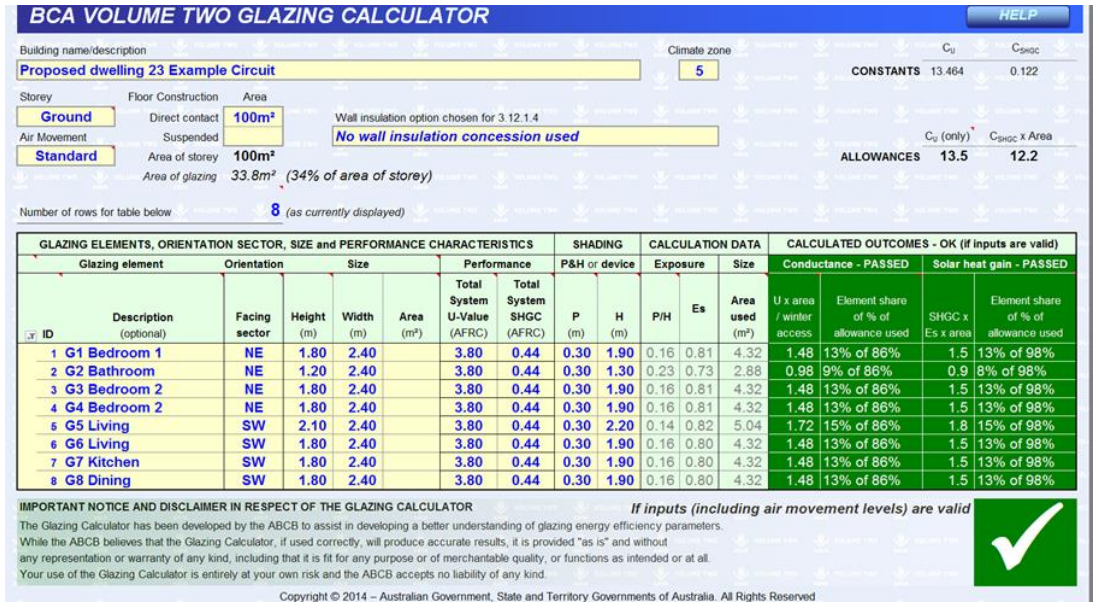
Climate zone

Required Total R-Value

Wall R-Value

Insulation R-Value

Energy Efficiency and Glazing and Lighting Calculators



BCA VOLUME TWO GLAZING CALCULATOR

HELP

Building name/description: Proposed dwelling 23 Example Circuit

Climate zone: 5

CONSTANTS: C_U 13.464, C_{SHGC} 0.122

Storey: Ground

Floor Construction: Direct contact / Suspended

Area: 100m²

Air Movement: Standard

Area of storey: 100m²

Area of glazing: 33.8m² (34% of area of storey)

Wall insulation option chosen for 3.12.1.4: No wall insulation concession used

ALLOWANCES: C_U (only) 13.5, C_{SHGC} x Area 12.2

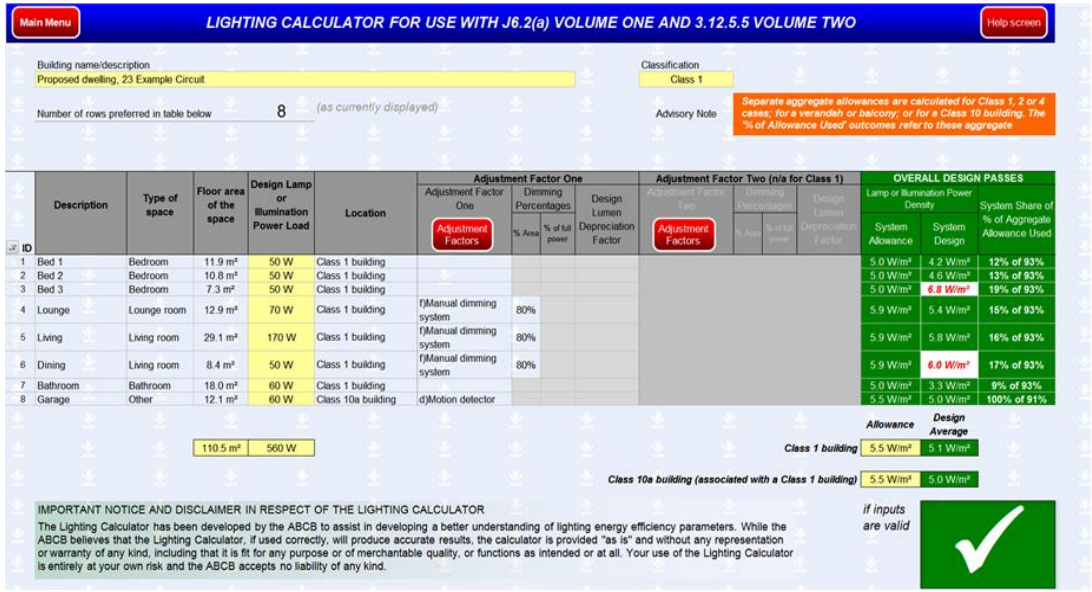
Number of rows for table below: 8 (as currently displayed)

GLAZING ELEMENTS, ORIENTATION SECTOR, SIZE and PERFORMANCE CHARACTERISTICS							SHADING		CALCULATION DATA			CALCULATED OUTCOMES - OK (if inputs are valid)			
Glazing element		Orientation	Size			Performance		P&H or device		Exposure		Size	Conductance - PASSED		Solar heat gain - PASSED	
ID	Description (optional)	Facing sector	Height (m)	Width (m)	Area (m²)	Total System U-Value (AFRC)	Total System SHGC (AFRC)	P (m)	H (m)	P/H	Es	Area used (m²)	U x area / winter access	Element share of % of allowance used	SHGC x Es x area	Element share of % of allowance used
1	G1 Bedroom 1	NE	1.80	2.40		3.80	0.44	0.30	1.90	0.16	0.81	4.32	1.48	13% of 86%	1.5	13% of 98%
2	G2 Bathroom	NE	1.20	2.40		3.80	0.44	0.30	1.30	0.23	0.73	2.88	0.98	9% of 86%	0.9	8% of 98%
3	G3 Bedroom 2	NE	1.80	2.40		3.80	0.44	0.30	1.90	0.16	0.81	4.32	1.48	13% of 86%	1.5	13% of 98%
4	G4 Bedroom 2	NE	1.80	2.40		3.80	0.44	0.30	1.90	0.16	0.81	4.32	1.48	13% of 86%	1.5	13% of 98%
5	G5 Living	SW	2.10	2.40		3.80	0.44	0.30	2.20	0.14	0.82	5.04	1.72	15% of 86%	1.8	15% of 98%
6	G6 Living	SW	1.80	2.40		3.80	0.44	0.30	1.90	0.16	0.80	4.32	1.48	13% of 86%	1.5	13% of 98%
7	G7 Kitchen	SW	1.80	2.40		3.80	0.44	0.30	1.90	0.16	0.80	4.32	1.48	13% of 86%	1.5	13% of 98%
8	G8 Dining	SW	1.80	2.40		3.80	0.44	0.30	1.90	0.16	0.80	4.32	1.48	13% of 86%	1.5	13% of 98%

IMPORTANT NOTICE AND DISCLAIMER IN RESPECT OF THE GLAZING CALCULATOR

The Glazing Calculator has been developed by the ABCB to assist in developing a better understanding of glazing energy efficiency parameters. While the ABCB believes that the Glazing Calculator, if used correctly, will produce accurate results, it is provided "as is" and without any representation or warranty of any kind, including that it is fit for any purpose or of merchantable quality, or functions as intended or at all. Your use of the Glazing Calculator is entirely at your own risk and the ABCB accepts no liability of any kind.

If inputs (including air movement levels) are valid



Main Menu

LIGHTING CALCULATOR FOR USE WITH J6.2(a) VOLUME ONE AND 3.12.5.5 VOLUME TWO

Help screen

Building name/description: Proposed dwelling, 23 Example Circuit

Classification: Class 1

Number of rows preferred in table below: 8 (as currently displayed)

Advisory Note: *Separate aggregate allowances are calculated for Class 1, 2 or 4 cases: for a verandah or balcony; or for a Class 10 building. The '% of Allowance Used' outcomes refer to these aggregate*

ID	Description	Type of space	Floor area of the space	Design Lamp or Illumination Power Load	Location	Adjustment Factor One	Dimming Percentages		Design Lumen Depreciation Factor	Adjustment Factor Two (n/a for Class 1)	Dimming Percentages		Design Lumen Depreciation Factor	OVERALL DESIGN PASSES		
						Adjustment Factors	% Area	% of full power		Adjustment Factors	% Area	% of full power		Lamp or Illumination Power Density		System Share of % of Aggregate Allowance Used
														System Allowance	System Design	
1	Bed 1	Bedroom	11.9 m²	50 W	Class 1 building									5.0 W/m²	4.2 W/m²	12% of 93%
2	Bed 2	Bedroom	10.8 m²	50 W	Class 1 building									5.0 W/m²	4.6 W/m²	13% of 93%
3	Bed 3	Bedroom	7.3 m²	50 W	Class 1 building									5.0 W/m²	*6.8 W/m²*	19% of 93%
4	Lounge	Lounge room	12.9 m²	70 W	Class 1 building	f)Manual dimming system	80%							5.9 W/m²	5.4 W/m²	15% of 93%
5	Living	Living room	29.1 m²	170 W	Class 1 building	f)Manual dimming system	80%							5.9 W/m²	5.8 W/m²	16% of 93%
6	Dining	Living room	8.4 m²	50 W	Class 1 building	f)Manual dimming system	80%							5.9 W/m²	*6.0 W/m²*	17% of 93%
7	Bathroom	Bathroom	18.0 m²	60 W	Class 1 building									5.0 W/m²	3.3 W/m²	9% of 93%
8	Garage	Other	12.1 m²	60 W	Class 10a building	d)Motion detector								5.5 W/m²	5.0 W/m²	100% of 91%
			110.5 m²	560 W												

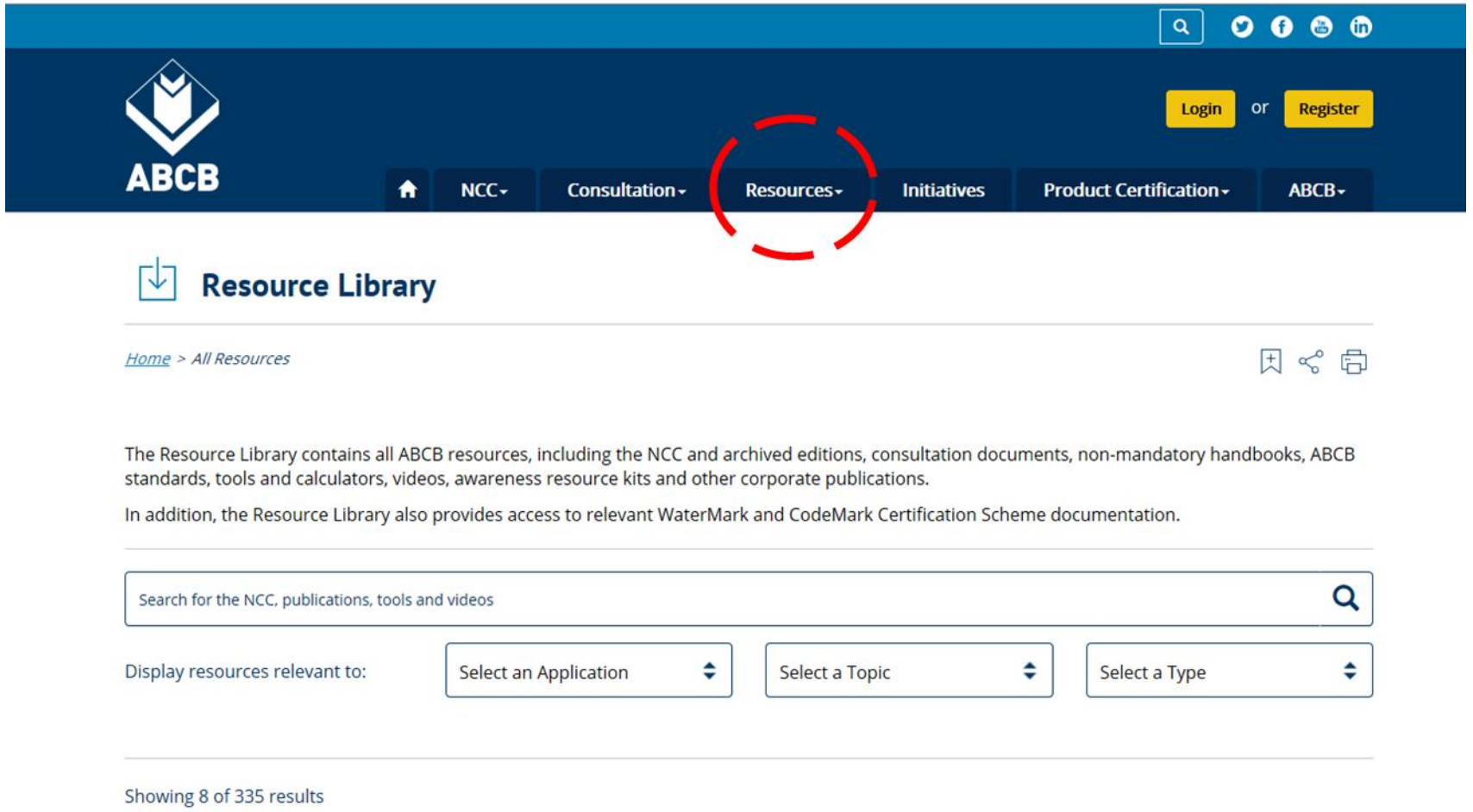
	Allowance	Design Average
Class 1 building	5.5 W/m²	5.1 W/m²
Class 10a building (associated with a Class 1 building)	5.5 W/m²	5.0 W/m²

IMPORTANT NOTICE AND DISCLAIMER IN RESPECT OF THE LIGHTING CALCULATOR

The Lighting Calculator has been developed by the ABCB to assist in developing a better understanding of lighting energy efficiency parameters. While the ABCB believes that the Lighting Calculator, if used correctly, will produce accurate results, the calculator is provided "as is" and without any representation or warranty of any kind, including that it is fit for any purpose or of merchantable quality, or functions as intended or at all. Your use of the Lighting Calculator is entirely at your own risk and the ABCB accepts no liability of any kind.

if inputs are valid

ABCB Materials



Conclusion

- Upon completion, you will have acquired a basic understanding of the energy efficiency provisions within NCC Volume Two, with emphasis on:
  - The structure of NCC Volume Two
  - A background to energy efficiency
  - Energy efficiency Performance Requirements
  - Energy efficiency Deemed-to-Satisfy Provisions
  - Applying the provisions through an example