DATAsheet

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ENERGY EFFICIENCY in Building Regulations and the Use of Concrete in Housing

INTRODUCTION

Since the early 1980's there has been steady progress towards increasing the energy efficiency of the building envelope, with a view to reducing the consumption of operational heating and cooling energy and the consequential reduction of greenhouse gas emissions.

In 2003, the Australian Building Codes Board (ABCB) published amendments to the Building Code of Australia (BCA) Volume 2 with the objective of reducing energy use and hence greenhouse gas emission.

The BCA provides a national model for building regulations. Some states have adopted the BCA model for energy efficiency measures, in some cases with modification, while others (New South Wales) have opted for alternative regulations.

This document outlines the Energy Efficiency provisions of BCA 2004 Volume 2 and the various States' Building Regulations for Class 1 and 10a buildings with a conditioned space and the use of concrete in the context of these provisions.

DEFINITIONS

Class 1 buildings are:

Class 1a is a single dwelling, being

i a detached house; or

ii one or more attached dwellings, each being a building, separated by a fire-resisting wall, including a row house, terrace house, town house or villa unit.

Class 1b is a boarding house, guest house, hostel or the like with a total floor area not exceeding 300 m^2 and in which not more than 12 persons would ordinarily be resident; which is not located above or below another dwelling or another Class of building other than a private dwelling. (BCA 2004 Volume 2 Clause 1.3.2)

Class 10a buildings are non-habitable buildings, being a private garage, carport, shed or the like.

THE BUILDING CODE OF AUSTRALIA provides a national model for building regulations.

CEMENT CONCRETE & AGGREGATES AUSTRALIA

Conditioned space is a space within a building –

a that is heated or cooled by the building's domestic services; but

b excludes a heater with a capacity of not more than 1.2 kW installed in a non-habitable room.

R-Value is the thermal resistance (m^2.K/W) of a component calculated by dividing its thickness by its thermal conductivity.

Total R-Value is the sum of the R-Values of the individual component layers in a composite element including the air space and associated surface resistance.

Climate zones are specific locations having energy efficiency provisions based on a range of similar climatic characteristics. Climate zones are defined in Figure 1.1.4 and Table 1.1.2 of the BCA 2004 Volume 2. The relevant climate zones are reproduced in this Data Sheet for all states for completeness.

THE BENEFITS OF CONCRETE CONSTRUCTION

Passive Solar Design

Passive solar design is a universally accepted method of reducing the energy demands of heating and cooling buildings. Passive solar design concepts can be applied in the relatively temperate climates experienced in Australia as follows.

In southern Australia, shaded north-facing windows with large eaves overhangs permit the entry of winter sun and restrict the entry of summer sun. Properly sealed doors and windows allow cross-ventilation in summer and restrict air and heat leakage in winter.

Conversely, in northern Australia, large eaves, verandas, sun-shades and heavy curtains prevent sunshine from entering and overheating a building. Good ventilation will assist in keeping the building cool. Good ventilation and light-coloured roofs assist the summer cooling process.

In addition using materials that lower operational energy through fabric energy storage or thermal mass, significant energy savings can be made. Concrete possesses a natural advantage in heat storage capacity or thermal mass. By harnessing this natural advantage together with the heat of the sun or solar energy more comfortable living conditions can be achieved with reduced reliance on space heating or cooling and subsequent reduced energy demands.

Thus the essential elements of passive solar design are orientation and solar access, and thermal mass augmented by sealing, ventilation and insulation.

Heat Transfer

Heat transfers through roofs, walls and floors by a combination of conduction, convection and radiation.

Conduction Heat is transferred through opaque relatively airtight barriers by conduction. The thermal resistance of a material, R, measures the attenuation of steady-state conduction. Thermal bridging occurs when heat bypasses insulating materials and passes though conductive materials such as metal window frames, metal door jambs, structural steelwork or other such items.

Convection Heat is transferred by convection through air. Air adjacent to a hot surface (eg the outside wall of a house) becomes heated in summer, flows to another location (eg an inside room) where it deposits its heat. The reverse process, also classified as convection, occurs in winter. Convection may become a particular problem if poor detailing or construction leave significant openings that permit transfer of heat by air leakage.

Radiation Heat is transferred through transparent or translucent media, such as glass, exposed to direct sunlight by radiation. Large windows exposed to direct sunlight are an advantage during the day time in winter, but a disadvantage during summer or during the night in winter.

The conduction of heat through walls may be reduced by incorporating materials with a high thermal resistance, such as insulation. However, much of this benefit could be lost if thermal bridging, radiation and convection are not controlled. There is little point in installing insulation in walls, if the heat simply transfers elsewhere by thermal bridging through window and door frames, by radiation through window openings or by convection through leakage.

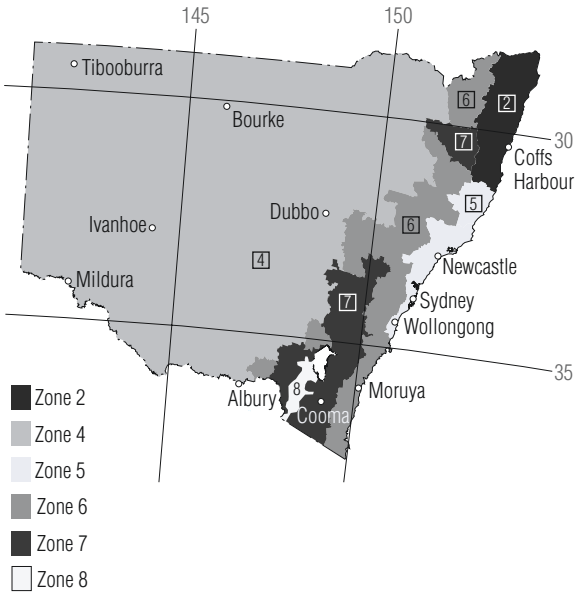
Heat Storage and Thermal Mass

Thermal mass (also known as thermal inertia or thermal capacitance) is the ability of a material to retain the quantity of heat energy when subjected to a temperature differential. Concrete roofs, walls and floors have high thermal mass. If a building incorporating these features is subject to an ambient heating and cooling cycle which crosses the comfort zone, the roof, walls and floor (as appropriate) will maintain heat energy for an extended period. In summer, these elements will remain relatively cool. In winter, the same building will remain relatively warm.

Energy Efficiency Requirements – Roofs, walls and floors

[click on page numbers for links]

New South Wales Energy Efficiency Requirements – Roofs, walls and floors



NEW SOUTH WALES Climate Zones

LOCATION	ZONE
ALBURY	4
ARMIDALE	7
BATEMANS BAY	6
BATHURST	6
BEGA	6
BOURKE	4
BROKEN HILL	4
BYRON BAY	2
COBAR	4
COFFS HARBOUR	2
DUBBO	4
GOULBURN	7
GRAFTON	2
GRIFFITH	4
IVANHOE	4
LISMORE	2
LORD HOWE ISLAND	2
MOREE	4
NEWCASTLE	5
NOWRA	6
ORANGE	7
PORT MACQUARIE	5
SYDNEY – EAST	5
SYDNEY – WEST	6
TAMWORTH	4
THREDBO	8
WAGGA WAGGA	4
WILLIAMTOWN	5
WOLLONGONG	5
YASS	6

GENERAL

New South Wales has not adopted the BCA 2004 Volume 2 energy provisions. Rather than amend the Building Regulations, it implemented Planning Legislation, which provides for a web-based approval of building designs that meet certain requirements for water saving and energy saving. This requirement commenced on 1 July 2004 in selected local government areas in Sydney, and will extend to the rest of the state within twelve months.

BUILDING SUSTAINABILITY INDEX (BASIX)

BASIX is a web-based planning tool designed to assess the potential performance of new homes against a range of sustainability indices. The first stage, implemented on 1 July 2004, focuses on reducing water and energy use. The BASIX online assessment requires information about the proposed development, such as site location, dwelling size, floor area, landscaped area and services. BASIX compares the proposal to average existing houses. The proposal is scored according to its potential to consume less mains supply water and less energy than an average existing house. Energy savings impact the reduction of greenhouse emissions from houses in NSW.

Targets to reduce the use of mains supply water and green house emissions are set in BASIX. A house must be designed and built to use 40% less drinking-quality water and produce 25% less greenhouse gas emissions than an average existing house.

A typical residential development will meet the target for energy saving and greenhouse reduction if it includes an efficient hot water system, and adopts passive solar design principles incorporating design features that make use of natural heating, cooling and lighting.

BASIX planning tool can be accessed on www.basix.nsw.gov.au

Australian Capital Territory Energy Efficiency Requirements – Roofs, walls and floors

GENERAL

Since 1992 the ACT building regulations required insulation in Class 1, 2 and 3 residential buildings to achieve 4 stars rating using NatHERS Software. The ACT has not adopted the energy provisions of BCA 2004 Volume 2. Instead provisions for energy efficiency in the ACT have been listed separately in the ACT Appendix and apply to Class 1 buildings only.

PERFORMANCE REQUIREMENT

A building must have an adequate level of thermal performance to ensure efficient use of internal heating and cooling.

ACCEPTABLE CONSTRUCTION PRACTICE

The performance requirement is satisfied by a building that achieves a house energy rating of 4 stars using NatHERS or an accredited assessment tool.

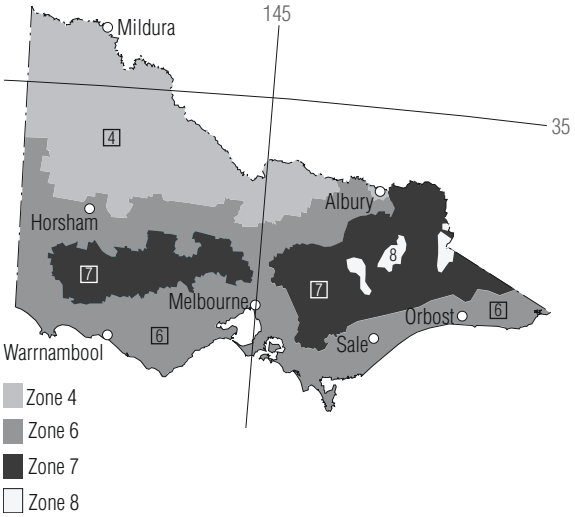
An addition to an existing building must comply with the performance requirement above or have a concrete floor and comply with the following insulation material in the roofs and walls.

Acceptable Construction Practice (Extensions only) Minimum Insulation Material

Roofs	Ceiling space OR Exposed raked ceiling	R 3.0 R 2.0
Walls	External wall space	R 1.5

Exemption Cavity brick, earth wall construction, ashlar stone, or other masonry walls of total thickness not less than 180 mm do not require wall insulation.

Victoria Energy Efficiency Requirements – Roofs, walls and floors



VICTORIA Climate Zones

LOCATION	ZONE
ANGLESEA	6
ARARAT	7
BAIRNSDALE	6
BALLARAT	7
BENALLA	6
BENDIGO	6
BRIGHT	7
COLAC	6
DANDENONG	6
ECHUCA	4
GEELONG	6
HAMILTON	7
HORSHAM	6
MELBOURNE	6
MILDURA	4
PORTLAND	6
SALE	6
SHEPPARTON	4
SWAN HILL	4
TRARALGON	6
WANGARATTA	4
WARRNAMBOOL	6
WODONGA	4

GENERAL

The Victorian government has adopted BCA Volume 2 – Clauses O2.6, F2.6 and P2.6.1, which set out the performance requirements for saving energy, together with the Victorian variation. It has not adopted the remainder of the BCA Volume 2 provisions.

The Victorian Appendix provisions effective from 1 July 2004 provide for computer simulation to demonstrate compliance with the performance requirement.

OBJECTIVE, FUNCTIONAL STATEMENT AND PERFORMANCE REQUIREMENT (BCA Clauses O2.6, F2.6 and P2.6.1)

The stated objective is "to reduce greenhouse gas emissions by efficiently using energy". This is further developed in the Functional Statement and Performance Requirement, which require consideration of:

- **a** function and use of the building
- **b** internal environment
- **c** geographic location
- **d** effects of topography and nearby buildings and structures
- **e** solar radiation effects on heating and cooling
- **f** sealing
- **g** ventilation to facilitate the efficient use of energy for artificial heating and cooling.

ACCEPTABLE CONSTRUCTION PRACTICE

A new building must achieve a home energy rating of 5 stars using FirstRate house energy rating software or the Nationwide House Energy Rating (NatHERS) software.

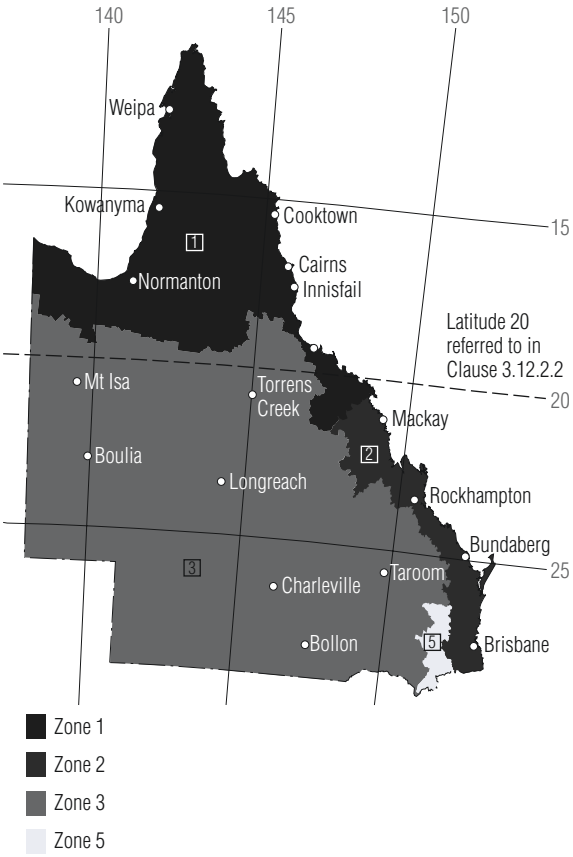
Alterations of an existing building must achieve a 3-star rating using FirstRate or NatHERS software OR Comply with all R-Values of option A or all R-Values of option B below.

Acceptable Construction Practice for Alterations Total R-Value

	Option A	Option B
Roof or ceiling	R 2.2	R 2.2
External wall (including the wall that separates a Class 1 building from a Class 10a building or from any roof space)	R 1.3	R 1.7
Ground floor	R 1.0	R 0.7

Exemption In the case of alterations the above wall requirements do not apply to concrete panels, cavity brick, earth wall construction, ashlar stone, or other masonry walls of total thickness not less than 180 mm, constructed on a concrete or masonry in contact with the ground.

Queensland Energy Efficiency Requirements – Roofs, walls and floors



QUEENSLAND Climate Zones

LOCATION	ZONE
BIRDSVILLE	3
BRISBANE	2
BUNDABERG	2
CAIRNS	1
COOKTOWN	1
CUNNAMULLA	3
LONGREACH	3
GLADSTONE	2
LABRADOR	2
MACKAY	2
MARYBOROUGH	2
MOUNT ISA	3
NORMANTON	1
ROCKHAMPTON	2
ROMA	3
TOOWOOMBA	5
TORRENS CREEK	3
TOWNSVILLE	1
WARWICK	5
WEIPA	1

GENERAL

The Queensland government has adopted the energy efficiency measures of the BCA 2004 Volume 2 into the state building regulations.

OBJECTIVE, FUNCTIONAL STATEMENT AND PERFORMANCE REQUIREMENT (BCA Clauses O2.6, F2.6 and P2.6.1)

The stated objective is "to reduce greenhouse gas emissions by efficiently using energy". This is further developed in the Functional Statement and Performance Requirement, which require consideration of:

- **a** function and use of the building
- **b** internal environment
- **c** geographic location
- **d** effects of topography and nearby buildings and structures
- **e** solar radiation effects on heating and cooling
- **f** sealing
- **g** ventilation to facilitate the efficient use of energy for artificial heating and cooling.

OPTIONS FOR DEMONSTRATING COMPLIANCE

Compliance with the performance requirement of facilitating the efficient use of energy of a building is achieved by one of the following ways:

1 Verification by calculation
2 Acceptable Construction Practice.

1 Verification by calculation

Verification using stated values

In this method the annual energy load of a building, determined using a thermal calculation, must be equal to or less than:

- In climate zones 1, 2 and 3
  - **a** the annual energy load equivalent to a 3.5 star house determined by a software complying with the ABCB Protocol for house energy rating software;
    OR
  - **b** the annual energy load value listed in the following table. (BCA 2004 Volume 2 Table V2.6.1).

- In climate zone 5, the annual energy load equivalent to a 4-star house energy rating.

Extract from Table V2.6.1
Maximum Annual Energy Load (MJ/m^2.annum)

Queensland	Birdsville	240
	Brisbane east	105
	Brisbane west	120
	Bundaberg	105
	Cairns	225
	Cooktown	450
	Cunnamulla	180
	Gladstone	130
	Labrador	105
	Longreach	300
	Mackay	130
	Maryborough	105
	Mount Isa	325
	Normanton	450
	Rockhampton	130
	Roma	180
	Torrens Creek	325
	Townsville	225
	Warwick	135
	Weipa	450

If the location is not listed in the table the value of the nearest location with similar climatic conditions should be used.
An increase of 20 MJ/m^2.annum is allowed if certain types of hot water systems are used (BCA 2004 Volume 2 Clause V2.6.2.1).

Verification using a reference building.
In this method the heating and cooling loads for the proposed building are compared with those of a reference building with the same geometry and location, but constructed of materials specified in Table V2.6.2 of the BCA. The heating and cooling loads for the proposed and reference buildings must be determined using the same thermal calculation method. When compared with a reference building, the proposed building must have:

- In climate zones 1 and 2, a cooling load equal to or less than the reference building.
- In climate zones 3 and 5, a heating load and a cooling load equal to or less than that of the reference building.

2 Acceptable Construction Practice
In this method, various building fabric components (eg roofs, walls, floors) must have certain specified levels of thermal resistance (R), taking into account the climate zone and, in some cases, thermal mass of the walls and concrete slab-on-ground.

In addition to building fabric measures, there are specified requirements for external glazing, building sealing, air movement and services (BCA Clauses 3.12.2 to 3.12.5).

The deemed-to-satisfy provisions that are considered to be acceptable forms of construction for roofs, walls and floors are described below:

ROOFS

a Achieve the minimum Total R-Value shown in the table below, extracted from Table 3.12.1.1 of the BCA.
OR

b In climate zones 1, 2 and 3 construct a pitched roof with a flat ceiling having:
- a solar absorptance value not more than 0.55; and
- reflective membrane (RBM) below the roof (emittance not more than 0.5 downwards and 0.2 upwards); and
- a roof space ventilated by:
  Gable vents, ridge vents, eaves vents or roof vents of an aggregate fixed open area of not less than 1.0% of the ceiling area, evenly distributed and located to ensure there are no dead air spaces.
  OR
  not less than two wind-driven ventilators with an aggregate opening area of not less than 0.14 m^2 in conjunction with gable vents, ridge vents, eaves vents or roof vents with an aggregate fixed open area not less than 0.2% of the ceiling area.

Extract from Table 3.12.1.1
ROOFS – Minimum Total R-Value for Climate Zones in Queensland

Climate zones	1	2		3	5
		Altitude less than 300 m	Altitude 300 m or more		
Direction of heat flow	Down	Down	Down and up	Down and up	Up
Minimum Total R-Value	2.2	2.2	2.5	2.2	2.7

EXTERNAL WALLS

In climate zones 1, 2 and 3, the external wall must achieve a Total R-Value of 1.0
OR
be shaded by a veranda, balcony, eaves, carport or the like, including any attached guttering, with a horizontal projection from the external face of the building to the outer edge of the projection of not less than 1/4 of the wall height. The wall height is measured from the internal floor level to the underside of the projection.
For a two storey house with single leaf masonry not less than 140 mm thick as the external walls the upper storey only must comply with the above requirements.

In climate zone 5, the external wall must achieve a Total R-Value of 1.4
OR
Achieve a surface density of not less than 220 kg/m^2.

Surface Density of Concrete Walls

Reinforced concrete has a density of approximately 2400 kg/m^3. Therefore, a solid concrete wall with a thickness of 100 mm will have a surface density of 240 kg/m^2 (ie greater than 220 kg/m^2). However, the BCA lists "140 mm thick or greater concrete wall panels" with the examples of ... typical wall constructions that achieve a surface density of 220 kg/m^2 in Figure 3.12.1.3. 140 mm thick, not 100 mm thick, was listed in order to achieve the appropriate combination of thermal resistance and thermal mass. It should be clearly understood that the 140 mm requirement should over-ride the 220 kg/m^2 limit if the Deemed-to-Satisfy (DTS) provisions are used. When verification by calculation is used, any wall thickness may be used provided the performance criteria are met.

FLOORS

There are no specific requirements.

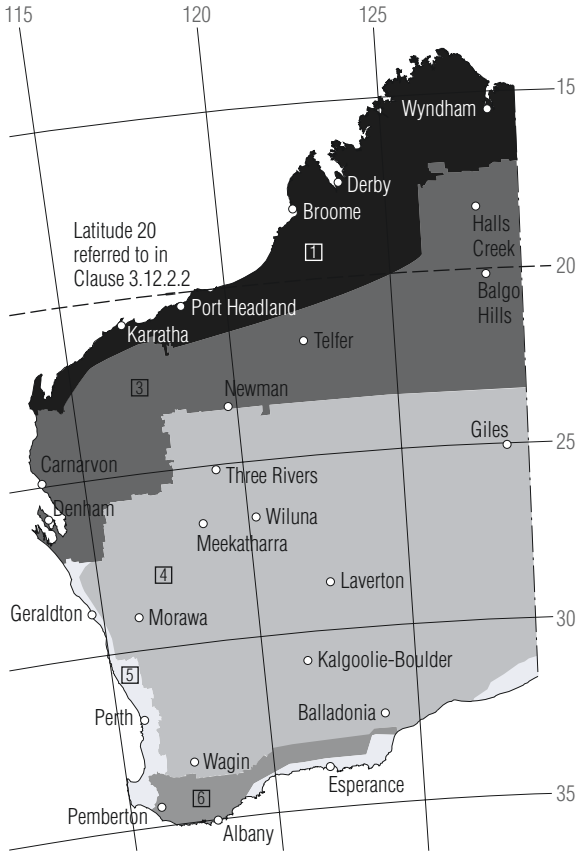
Queensland Summary

ENERGY EFFICIENT ACCEPTABLE CONSTRUCTION PRACTICE – Roofs, walls and floors

	ZONE 1	ZONE 2	ZONE 3	ZONE 5
	Locations: **CAIRNS** **COOKTOWN** **NORMANTON** **TOWNSVILLE** **WEIPA**	**Locations:** **BRISBANE** **BUNDABERG** **GLADSTONE** **LABRADOR** **MACKAY** **MARYBOROUGH** **ROCKHAMPTON**	**Locations:** **BIRDSVILLE** **CUNNAMULLA** **LONGREACH** **MOUNT ISA** **ROMA** **TORRENS CREEK**	**Locations:** **TOOWOOMBA** **WARWICK**
ROOFS	**Pitched low absorptance roof with reflective membrane, ceiling and ventilation** No additional insulation required			**All roofs** Total R-Value 2.7
	Other roofs Total R-Value 2.2	**Other roofs – Altitude over 300 m** Total R-Value 2.2 **Other roofs – Altitude under 300 m** Total R-Value 2.5	**Other roofs** Total R-Value 2.2	
WALLS	**Shaded** No insulation required Complying construction, zones 1, 2 and 3: ■ 100 mm concrete panels, ■ 140 mm concrete masonry			**Wall surface density ≥220 kg/m^2 (Solid concrete thickness ≥140 mm)** No wall insulation required Complying construction: ■ 140 mm concrete panels, ■ 140 mm concrete masonry fully grouted, ■ 190 mm concrete masonry partially grouted at 1800 mm centres
	Unshaded Total R-Value 1.0 Complying construction, zones 1, 2 and 3: ■ 100 mm concrete panels + 22 mm furring channels + 22 mm insulation + 10 mm plasterboard, ■ 140 mm hollow block concrete masonry + 22 mm furring channels + 22 mm insulation + 10 mm plasterboard, ■ 190 mm concrete masonry + internal insulation			**Wall surface density <220 kg/m^2 (Solid concrete thickness <140 mm)** Total R-Value 1.4 Complying construction: ■ 100 mm concrete panels + 30 mm furring channels + 30 mm insulation + 10 mm plasterboard, ■ 140 mm concrete masonry + 30 mm furring channels + 30 mm insulation + 10 mm plasterboard
	Walls facing south orientation in southern quadrant, south of 20°S latitude No insulation required Complying construction, zones 1, 2 and 3: ■ 100 mm concrete panels, ■ 140 mm concrete masonry			
FLOORS	No floor insulation required Complying construction, zones 1, 2, 3 and 5: ■ concrete slab-on-ground, ■ suspended concrete floor			

Note: Insulation thickness is based on material with thermal conductivity of 0.025–0.028 W/m.K. This value is typical of rigid foamed polyurethane and extruded polystyrene. For materials with different thermal conductivity the insulation thickness will vary from those given in this summary.

Western Australia Energy Efficiency Requirements – Roofs, walls and floors



Zone 1
Zone 3
Zone 4
Zone 5
Zone 6

WESTERN AUSTRALIA Climate Zones

LOCATION	ZONE
ALBANY	6
BALLADONIA	4
BROOME	1
BUNBURY	5
CARNARVON	3
CHRISTMAS ISLAND	1
COCOS ISLAND	1
DERBY	1
ESPERANCE	5
EXMOUTH	1
GERALDTON	5
HALLS CREEK	3
KALGOORLIE-BOULDER	4
KARRATHA	1
MEEKATHARRA	4
NORTHAM	4
PEMBERTON	6
PERTH	5
PORT HEDLAND	1
WAGIN	4
WYNDHAM	1

GENERAL

The Western Australia government has adopted the energy efficiency measures of the BCA 2004 Volume 2 into the state building regulations.

OBJECTIVE, FUNCTIONAL STATEMENT AND PERFORMANCE REQUIREMENT (BCA Clauses O2.6, F2.6 and P2.6.1)

The stated objective is "to reduce greenhouse gas emissions by efficiently using energy". This is further developed in the Functional Statement and Performance Requirement, which require consideration of:

- **a** function and use of the building
- **b** internal environment
- **c** geographic location
- **d** effects of topography and nearby buildings and structures
- **e** solar radiation effects on heating and cooling
- **f** sealing
- **g** ventilation to facilitate the efficient use of energy for artificial heating and cooling.

OPTIONS FOR DEMONSTRATING COMPLIANCE

Compliance with the performance requirement of facilitating the efficient use of energy of a building is achieved by one of the following ways:

1 Verification by calculation
2 Acceptable Construction Practice.

1 Verification by calculation

Verification using stated values

In this method the annual energy load of a building, determined using a thermal calculation, must be equal to or less than:

- In climate zones 1 and 3
  - **a** the annual energy load equivalent to a 3.5-star house determined by a software complying with the ABCB Protocol for house energy rating software;
    OR
  - **b** the annual energy load value listed in the following table. (BCA 2004 Volume 2 Table V2.6.1).

- In climate zones 4, 5 and 6, the annual energy load equivalent to a 4-star house energy rating.

Extract from Table V2.6.1
Maximum Annual Energy Load (MJ/m^2.annum)

Western Australia	Broome	405
	Carnarvon	183
	Derby	405
	Halls Creek	413
	Karratha	405
	Port Hedland	405
	Shark Bay	183
	Wyndham	405

If the location is not listed in the table the value of the nearest location with similar climatic conditions should be used.
An increase of 20 MJ/m^2.annum is allowed if certain types of hot water systems are used (BCA 2004 Volume 2 Clause V2.6.2.1).

Verification using a reference building.
In this method the heating and cooling loads for the proposed building are compared with those of a reference building with the same geometry and location, but constructed of materials specified in Table V2.6.2 of the BCA. The heating and cooling loads for the proposed and reference buildings must be determined using the same thermal calculation method. When compared with a reference building, the proposed building must have:

- In climate zone 1, a cooling load equal to or less than the reference building.
- In climate zones 3, 4, 5 and 6, a heating load and a cooling load equal to or less than that of the reference building.

2 Acceptable Construction Practice
In this method, various building fabric components (eg roofs, walls, floors) must have certain specified levels of thermal resistance (R), taking into account the climate zone and, in some cases, thermal mass of the walls and concrete slab-on-ground.

In addition to building fabric measures, there are specified requirements for external glazing, building sealing, air movement and services (BCA Clauses 3.12.2 to 3.12.5).

The deemed-to-satisfy provisions that are considered to be acceptable forms of construction for roofs, walls and floors are described below:

ROOFS

a Achieve the minimum Total R-Value shown in the table below, extracted from Table 3.12.1.1 of the BCA.
OR

b In climate zones 1 and 3, construct a pitched roof with a flat ceiling having:

- a solar absorptance value not more than 0.55; and
- reflective membrane (RBM) below the roof (emittance not more than 0.5 downwards and 0.2 upwards); and
- a roof space ventilated by:
  Gable vents, ridge vents, eaves vents or roof vents of an aggregate fixed open area of not less than 1.0% of the ceiling area, evenly distributed and located to ensure there are no dead air spaces.
  OR
  not less than two wind-driven ventilators with an aggregate opening area of not less than 0.14 m^2 in conjunction with gable vents, ridge vents, eaves vents or roof vents with an aggregate fixed open area not less than 0.2% of the ceiling area.

Extract from Table 3.12.1.1
ROOFS – Minimum Total R-Value for each Climate Zone

Climate zones	1	3	4	5	6
Direction of heat flow	Down	Down and up	Up	Up	Up
Minimum Total R-Value	2.2	2.2	3.0	2.7	3.2

EXTERNAL WALLS

The external wall must achieve a Total R-Value as specified in the table below, extracted from BCA Table 3.12.1.3.
OR
In climate zones 1 and 3 be shaded by a veranda, balcony, eaves, carport or the like, including any attached guttering, with a horizontal projection from the external face of the building to the outer edge of the projection of not less than 1/4 of the wall height. The wall height is measured from the internal floor level to the underside of the projection.
In climate zones 4 and 5 achieve a surface density of not less than 220 kg/m^2
In climate zone 6 achieve a surface density of not less than 220 kg/m^2 and be constructed on a concrete slab on ground; or achieve a surface density of not less than 220 kg/m^2 and incorporate insulation with an R-Value of not less than 1.0.

Surface Density of Concrete Walls
Reinforced concrete has a density of approximately 2400 kg/m^3. Therefore, a solid concrete wall with a thickness of 100 mm will have a surface density of 240 kg/m^2 (ie greater than 220 kg/m^2). However, the BCA lists "140 mm thick or greater concrete wall panels" with the examples of ... typical wall constructions that achieve a surface density of 220 kg/m^2 in Figure 3.12.1.3. 140 mm thick, not 100 mm thick, was listed in order to achieve the appropriate combination of thermal resistance and thermal mass. It should be clearly understood that the 140 mm requirement should over-ride the 220 kg/m^2 limit if the Deemed-to-Satisfy (DTS) provisions are used. When verification by calculation is used, any wall thickness may be used provided the performance criteria are met.

Extract from Table 3.12.1.3
WALLS – Minimum Total R-Value for each Climate Zone

Climate zones	1, 3, 5	4, 6
Minimum Total R-Value	1.4	1.7

FLOORS

In climate zone 6 a suspended floor with an unenclosed perimeter must have a Total R-Value of not less than 1.0.

Western Australia Summary

ENERGY EFFICIENT ACCEPTABLE CONSTRUCTION PRACTICE – Roofs, walls and floors

	ZONE 1	ZONE 3	ZONE 4	ZONE 5	ZONE 6
	Locations: **BROOME** **CHRISTMAS ISLAND** **COCOS ISLAND** **DERBY** **EXMOUTH** **KARRATHA** **WYNDHAM** **PORT HEADLAND**	**Locations:** **CARNARVON** **HALLS CREEK**	**Locations:** **BALLADONIA** **KALGOORLIE** **MEEKATHARRA** **NORTHAM** **WAGIN**	**Locations:** **BUNBURY** **ESPERANCE** **GERALDTON** **PERTH**	**Locations:** **ALBANY** **PEMBERTON**
ROOFS	**Pitched low absorptance roof with reflective membrane, ceiling and ventilation** No additional insulation required **Other roofs** Total R-Value 2.2	**All roofs** Total R-Value 3.0	**All roofs** Total R-Value 2.7	**All roofs** Total R-Value 3.2	
WALLS	**Shaded** No insulation required Complying construction, zones 1 and 3: ■ 100 mm concrete panels, ■ 140 mm concrete masonry **Unshaded** Total R-Value 1.4 Complying construction, zones 1 and 3: ■ 100 mm concrete panels + 30 mm furring channels + 30 mm insulation + 10 mm plasterboard, ■ 140 mm concrete masonry + 30 mm furring channels + 30 mm insulation + 10 mm plasterboard, ■ 190 mm concrete masonry partially grouted at 1800 mm centres **Walls facing south orientation in southern quadrant, south of 20°S latitude** No insulation required Complying construction, zones 1 and 3: ■ 100 mm concrete panels, ■ 140 mm concrete masonry	**Wall surface density ≥220 kg/m² (Solid concrete thickness ≥140 mm)** No wall insulation required Complying construction: ■ 140 mm concrete panels, ■ 140 mm concrete masonry fully grouted, ■ 190 mm concrete masonry partially grouted at 1800 mm centres **Wall surface density <220 kg/m² (Solid concrete thickness <140 mm)** Total R-Value 1.7 Complying construction: ■ 100 mm concrete panels + 40 mm furring channels + 40 mm insulation + 10 mm plasterboard, ■ 140 mm concrete masonry + 40 mm furring channels + 40 mm insulation + 10 mm plasterboard	**Wall surface density ≥220 kg/m² (Solid concrete thickness ≥140 mm)** No wall insulation required Complying construction: ■ 140 mm concrete panels, ■ 140 mm concrete masonry fully grouted, ■ 190 mm concrete masonry partially grouted at 1800 mm centres **Wall surface density <220 kg/m² (Solid concrete thickness <140 mm)** Total R-Value 1.4 Complying construction: ■ 100 mm concrete panels + 30 mm furring channels + 30 mm insulation + 10 mm plasterboard, ■ 140 mm concrete masonry + 30 mm furring channels + 30 mm insulation + 10 mm plasterboard	**Wall surface density ≥220 kg/m² (Solid concrete thickness ≥140 mm)** If built on slab-on-ground no wall insulation required Complying construction: ■ 140 mm concrete panels, ■ 140 mm concrete masonry fully grouted ■ 190 mm concrete masonry partially grouted at 1800 mm centres **If not built on slab or if wall surface density <220 kg/m²** Total R-Value 1.7 Complying construction: ■ 100 mm concrete panels + 40 mm furring channels + 40 mm insulation + 10 mm plasterboard, ■ 140 mm concrete masonry+ 40 mm furring channels + 40 mm insulation + 10 mm plasterboard
FLOORS	No floor insulation required Complying construction, zones 1, 3, 4 and 5: ■ concrete slab-on-ground, ■ suspended concrete floor				**Enclosed suspended floors without heating** No insulation required Complying construction: ■ suspended concrete floor

Continues next page

Western Australia Summary *continued*

ENERGY EFFICIENT ACCEPTABLE CONSTRUCTION PRACTICE – Roofs, walls and floors

ZONE 1	ZONE 3	ZONE 4	ZONE 5	ZONE 6
				Locations: **ALBANY** **PEMBERTON**

FLOORS

Continued from previous page

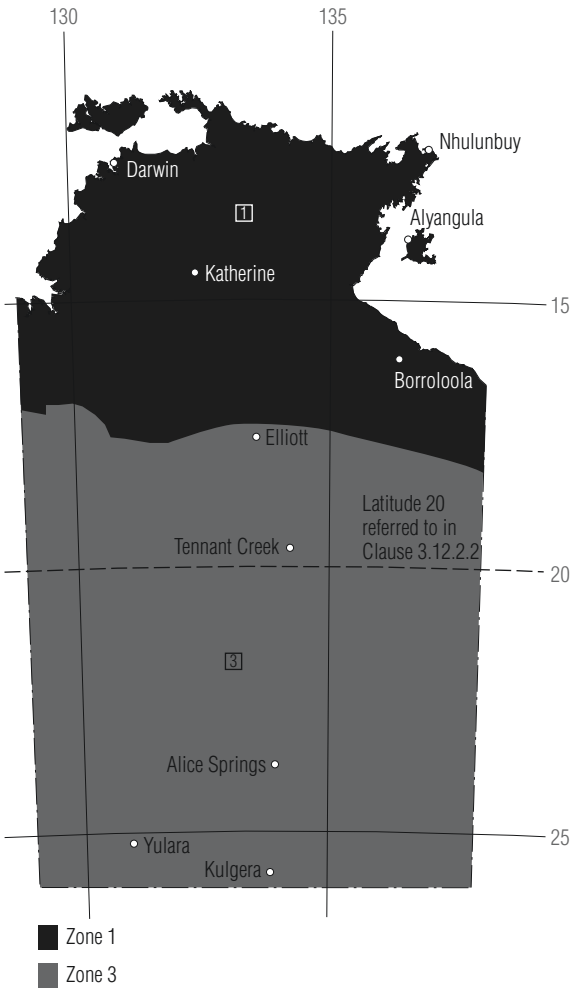
Unenclosed suspended floors
Total R-Value 1.0
Complying construction:
- 150 mm suspended concrete floor + 10 mm insulation + carpet or similar

Heated suspended floors
Added R-Value of 1.0 underneath and at the perimeter
Complying construction:
- 150 mm suspended concrete floor + 40 mm insulation

Other applications
No floor insulation required
Complying construction:
- concrete slab-on-ground

Note: Insulation thickness is based on material with thermal conductivity of 0.025–0.028 W/m.K. This value is typical of rigid foamed polyurethane and extruded polystyrene. For materials with different thermal conductivity the insulation thickness will vary from those given in this summary.

Northern Territory Energy Efficiency Requirements – Roofs, walls and floors



NORTHERN TERRITORY Climate Zones

LOCATION	ZONE
ALICE SPRINGS	3
DARWIN	1
ELLIOT	3
KATHERINE	1
RENNER SPRINGS	3
TENNANT CREEK	3

GENERAL

The Northern Territory government has adopted the energy efficiency measures of the BCA 2004 Volume 2 into the state building regulations.

OBJECTIVE, FUNCTIONAL STATEMENT AND PERFORMANCE REQUIREMENT (BCA Clauses O2.6, F2.6 and P2.6.1)

The stated objective is "to reduce greenhouse gas emissions by efficiently using energy". This is further developed in the Functional Statement and Performance Requirement, which require consideration of:

- **a** function and use of the building
- **b** internal environment
- **c** geographic location
- **d** effects of topography and nearby buildings and structures
- **e** solar radiation effects on heating and cooling
- **f** sealing
- **g** ventilation to facilitate the efficient use of energy for artificial heating and cooling.

OPTIONS FOR DEMONSTRATING COMPLIANCE

Compliance with the performance requirement of facilitating the efficient use of energy of a building is achieved by one of the following ways:

1 Verification by calculation
2 Acceptable Construction Practice.

1 Verification by calculation

Verification using stated values

In this method the annual energy load of a building, determined using a thermal calculation, must be equal to or less than:

- In climate zones 1 and 3, the annual energy load equivalent to a 3.5-star house determined by a software complying with the ABCB Protocol for house energy rating software;

Verification using a reference building.

In this method the heating and cooling loads for the proposed building are compared with those of a reference building with the same geometry and location, but constructed of materials specified in Table V2.6.2 of the BCA. The heating and cooling loads for the proposed and reference buildings must be determined using the same thermal calculation method. When compared with a reference building, the proposed building must have:

- In climate zone 1, a cooling load equal to or less than the reference building.
- In climate zone 3, a heating load and a cooling load equal to or less than that of the reference building.

2 Acceptable Construction Practice

In this method, various building fabric components (eg roofs, walls, floors) must have certain specified levels of thermal resistance (R), taking into account the climate zone and, in some cases, thermal mass of the walls and concrete slab-on-ground.

In addition to building fabric measures, there are specified requirements for external glazing, building sealing, air movement and services (BCA Clauses 3.12.2 to 3.12.5).

The deemed-to-satisfy provisions that are considered to be acceptable forms of construction for roofs, walls and floors are described below:

ROOFS

a Achieve the minimum Total R-Value shown in the table below, extracted from Table 3.12.1.1 of the BCA.
OR

b In climate zones 1 and 3, construct a pitched roof with a flat ceiling having:
- a solar absorptance value not more than 0.55; and
- reflective membrane (RBM) below the roof (emittance not more than 0.5 downwards and 0.2 upwards); and
- a roof space ventilated by:
  Gable vents, ridge vents, eaves vents or roof vents of an aggregate fixed open area of not less than 1.0% of the ceiling area, evenly distributed and located to ensure there are no dead air spaces.
  OR
  not less than two wind-driven ventilators with an aggregate opening area of not less than 0.14 m^2 in conjunction with gable vents, ridge vents, eaves vents or roof vents with an aggregate fixed open area not less than 0.2% of the ceiling area.

Extract from Table 3.12.1.1
ROOFS – Minimum Total R-Value for each Climate Zone

Climate zones	1	3
Direction of heat flow	Down	Down and up
Minimum Total R-Value	2.2	2.2

EXTERNAL WALLS

In climate zones 1 and 3 the external wall must achieve a Total R-Value of 1.4
OR
be shaded by a veranda, balcony, eaves, carport or the like, including any attached guttering, with a horizontal projection from the external face of the building to the outer edge of the projection of not less than 1/4 of the wall height. The wall height is measured from the internal floor level to the underside of the projection.

FLOORS

There are no specific requirements.

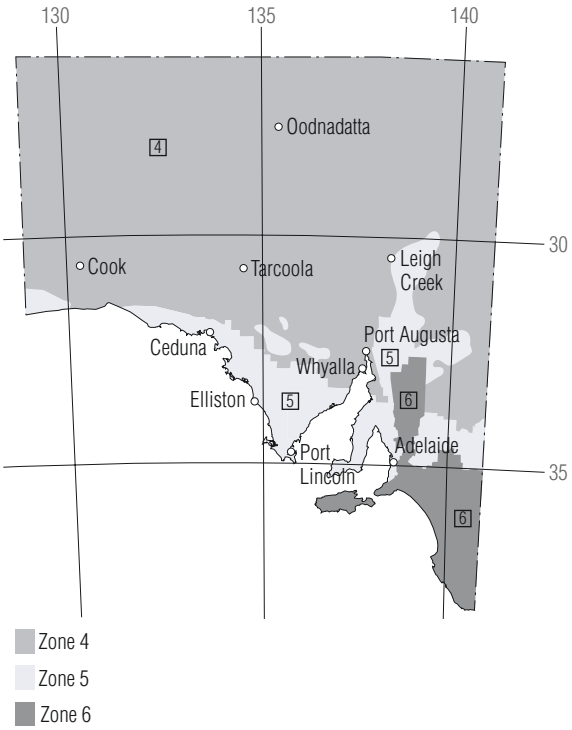
Northern Territory Summary

ENERGY EFFICIENT ACCEPTABLE CONSTRUCTION PRACTICE – Roofs, walls and floors

	ZONE 1	ZONE 3
	Locations: **DARWIN** **KATHERINE**	**Locations:** **ALICE SPRINGS** **ELLIOT** **RENNER SPRINGS** **TENNANT CREEK**
ROOFS	**Pitched low absorptance roof with reflective membrane, ceiling and ventilation** No additional insulation required	
	Other roofs Total R-Value 2.2	
WALLS	**Shaded** No insulation required Complying construction, zones 1 and 3: ■ 100 mm concrete panels, ■ 140 mm concrete masonry	
	Unshaded Total R-Value 1.4 Complying construction, zones 1 and 3: ■ 100 mm concrete panels + 30 mm furring channels + 30 mm insulation + 10 mm plasterboard, ■ 140 mm concrete masonry + 30 mm furring channels + 30 mm insulation + 10 mm plasterboard	
	Walls facing south orientation in southern quadrant, south of 20°S latitude No insulation required Complying construction, zones 1 and 3: ■ 100 mm concrete panels, ■ 140 mm concrete masonry	
FLOORS	No floor insulation required Complying construction, zones 1 and 3: ■ concrete slab-on-ground, ■ suspended concrete floor	

Note: Insulation thickness is based on material with thermal conductivity of 0.025–0.028 W/m.K. This value is typical of rigid foamed polyurethane and extruded polystyrene. For materials with different thermal conductivity the insulation thickness will vary from those given in this summary.

South Australia Energy Efficiency Requirements – Roofs, walls and floors



SOUTH AUSTRALIA Climate Zones

LOCATION	ZONE
ADELAIDE	5
BORDERTOWN	6
CEDUNA	5
COOK	4
ELLISTON	5
KINGSCOTE	6
LEIGH CREEK	5
LOBETHAL	6
LOXTON	5
NARACOORTE	6
MARREE	4
MOUNT GAMBIER	6
MURRAY BRIDGE	6
OODNADATTA	4
PORT AUGUSTA	4
PORT LINCOLN	5
RENMARK	5
TARCOOLA	4
VICTOR HARBOUR	6
WHYALLA	4

GENERAL

The South Australian government has adopted the energy efficiency measures of the BCA 2004 Volume 2 into the state building regulations.

OBJECTIVE, FUNCTIONAL STATEMENT AND PERFORMANCE REQUIREMENT (BCA Clauses O2.6, F2.6 and P2.6.1)

The stated objective is "to reduce greenhouse gas emissions by efficiently using energy". This is further developed in the Functional Statement and Performance Requirement, which require consideration of:

- **a** function and use of the building
- **b** internal environment
- **c** geographic location
- **d** effects of topography and nearby buildings and structures
- **e** solar radiation effects on heating and cooling
- **f** sealing
- **g** ventilation to facilitate the efficient use of energy for artificial heating and cooling.

OPTIONS FOR DEMONSTRATING COMPLIANCE

Compliance with the performance requirement of facilitating the efficient use of energy of a building is achieved by one of the following ways:

1 Verification by calculation
2 Acceptable Construction Practice.

1 Verification by calculation

Verification using stated values

In this method the annual energy load of a building, determined using a thermal calculation, must be equal to or less than:

- In climate zones 4, 5 and 6, the annual energy load equivalent to a 4-star house energy rating.

Verification using a reference building.

In this method the heating and cooling loads for the proposed building are compared with those of a reference building with the same geometry and location, but constructed of materials specified in Table V2.6.2 of the BCA. The heating and cooling loads for the proposed and reference buildings must be determined using the same thermal calculation method. When compared with a reference building, the proposed building must have:

- In climate zones 4, 5 and 6, a heating load and a cooling load equal to or less than that of the reference building.

2 Acceptable Construction Practice

In this method, various building fabric components (eg roofs, walls, floors) must have certain specified levels of thermal resistance (R), taking into account the climate zone and, in some cases, thermal mass of the walls and concrete slab-on-ground.

In addition to building fabric measures, there are specified requirements for external glazing, building sealing, air movement and services (BCA Clauses 3.12.2 to 3.12.5).

The deemed-to-satisfy provisions that are considered to be acceptable forms of construction for roofs, walls and floors are described below:

ROOFS

The roof must achieve the minimum Total R-Value shown in the table below, extracted from Table 3.12.1.1 of the BCA.

Extract from Table 3.12.1.1
ROOFS – Minimum Total R-Value for each Climate Zone

Climate zones	4	5	6
Direction of heat flow	Up	Up	Up
Minimum Total R-Value	3.0	2.7	3.2

EXTERNAL WALLS

The external wall must achieve a Total R-Value as specified in the table below, extracted from BCA Table 3.12.1.3.
OR
In climate zones 4 and 5 achieve a surface density of not less than 220 kg/m^2
In climate zone 6 achieve a surface density of not less than 220 kg/m^2 and be constructed on a concrete slab on ground; or achieve a surface density of not less than 220 kg/m^2 and incorporate insulation with an R-Value of not less than 1.0.

Surface Density of Concrete Walls

Reinforced concrete has a density of approximately 2400 kg/m^3. Therefore, a solid concrete wall with a thickness of 100 mm will have a surface density of 240 kg/m^2 (ie greater than 220 kg/m^2). However, the BCA lists "140 mm thick or greater concrete wall panels" with the examples of ... typical wall constructions that achieve a surface density of 220 kg/m^2 in Figure 3.12.1.3. 140 mm thick, not 100 mm thick, was listed in order to achieve the appropriate combination of thermal resistance and thermal mass. It should be clearly understood that the 140 mm requirement should over-ride the 220 kg/m^2 limit if the Deemed-to-Satisfy (DTS) provisions are used. When verification by calculation is used, any wall thickness may be used provided the performance criteria are met.

Extract from Table 3.12.1.3
WALLS – Minimum Total R-Value for each Climate Zone

Climate zones	5	4, 6
Minimum Total R-Value	1.4	1.7

FLOORS

In climate zone 6 a suspended floor with an unenclosed perimeter must have a Total R-Value of not less than 1.0.

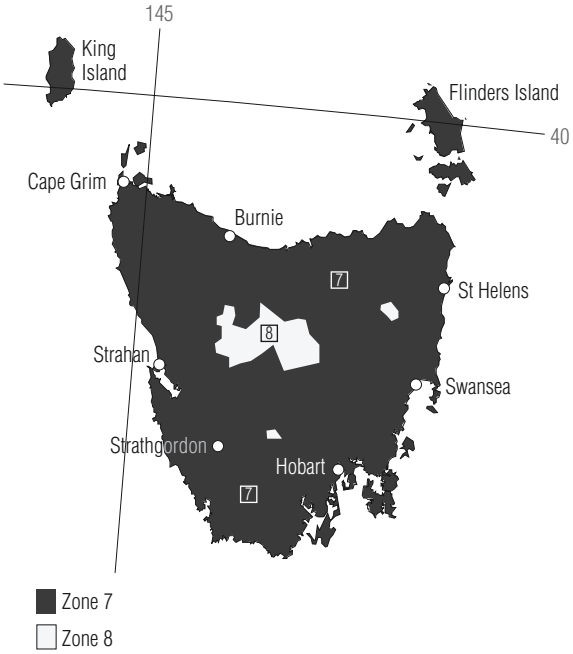
South Australia Summary

ENERGY EFFICIENT ACCEPTABLE CONSTRUCTION PRACTICE – Roofs, walls and floors

	ZONE 4	ZONE 5	ZONE 6
	Locations: **COOK** **MARREE** **OODNADATTA** **PORT AUGUSTA** **TARCOOLA** **WHYALLA**	**Locations:** **ADELAIDE** **CEDUNA** **ELLISTON** **LEIGH CREEK** **LOXTON** **PORT LINCOLN** **RENMARK**	**Locations:** **KINGSCOTE** **LOBETHAL** **NARACOORTE** **MT GAMBIER** **MURRAY BRIDGE** **VICTOR HARBOUR**
ROOFS	**All roofs** Total R-Value 3.0	**All roofs** Total R-Value 2.7	**All roofs** Total R-Value 3.2
WALLS	**Wall surface density ≥220 kg/m^2 (Solid concrete thickness ≥140 mm)** No wall insulation required Complying construction, zones 4 and 5: ■ 140 mm concrete panels, ■ 140 mm concrete masonry fully grouted, ■ 190 mm concrete masonry partially grouted at 1800 mm centres		**Wall surface density ≥220 kg/m^2 (Solid concrete thickness ≥140 mm)** If built on slab-on-ground no wall insulation required Complying construction: ■ 140 mm concrete panels, ■ 140 mm concrete masonry fully grouted
	Wall surface density <220 kg/m^2 (Solid concrete thickness <140 mm) Total R-Value 1.7 Complying construction: ■ 100 mm concrete panels + 40 mm furring channels + 40 mm insulation + 10 mm plasterboard, ■ 140 mm concrete masonry + 40 mm furring channels + 40 mm insulation + 10 mm plasterboard	**Wall surface density <220 kg/m^2 (Solid concrete thickness <140 mm)** Total R-Value 1.4 Complying construction: ■ 100 mm concrete panels + 30 mm furring channels + 30 mm insulation + 10 mm plasterboard, ■ 140 mm concrete masonry + 30 mm furring channels + 30 mm insulation + 10 mm plasterboard	**If not built on slab-on-ground or if wall surface density <220 kg/m^2** Total R-Value 1.7 Complying construction: ■ 100 mm concrete panels + 40 mm furring channels + 40 mm insulation + 10 mm plasterboard, ■ 140 mm concrete masonry + 40 mm furring channels + 40 mm insulation + 10 mm plasterboard
FLOORS	No floor insulation required Complying construction, zones 4 and 5: ■ concrete slab-on-ground, ■ suspended concrete floor		**Enclosed suspended floors without heating** No insulation required Complying construction: ■ suspended concrete floor
			Unenclosed suspended floors Total R-Value 1.0 Complying construction: ■ 150 mm concrete floor + 10 mm insulation + carpet or similar
			Heated suspended floors ***Added*** R-Value of 1.0 underneath and at the perimeter Complying construction: ■ 150 mm suspended concrete floor + 40 mm insulation
			Other applications No floor insulation required Complying construction: ■ concrete slab-on-ground

Note: Insulation thickness is based on material with thermal conductivity of 0.025–0.028 W/m.K. This value is typical of rigid foamed polyurethane and extruded polystyrene. For materials with different thermal conductivity the insulation thickness will vary from those given in this summary.

Tasmania Energy Efficiency Requirements – Roofs, walls and floors



TASMANIA Climate Zones

LOCATION	ZONE
BURNIE	7
BICHENO	7
DELORAINE	7
DEVONPORT	7
FLINDERS ISLAND	7
HOBART	7
HUONVILLE	7
KING ISLAND	7
LAUNCESTON	7
NEW NORFOLK	7
OATLANDS	7
ORFORD	7
SMITHTON	7
ST MARYS	7
ZEEHAN	7

GENERAL

The Tasmanian government has adopted the energy efficiency measures of the BCA 2004 Volume 2 into the state building regulations.

OBJECTIVE, FUNCTIONAL STATEMENT AND PERFORMANCE REQUIREMENT (BCA Clauses O2.6, F2.6 and P2.6.1)

The stated objective is "to reduce greenhouse gas emissions by efficiently using energy". This is further developed in the Functional Statement and Performance Requirement, which require consideration of:

- **a** function and use of the building
- **b** internal environment
- **c** geographic location
- **d** effects of topography and nearby buildings and structures
- **e** solar radiation effects on heating and cooling
- **f** sealing
- **g** ventilation to facilitate the efficient use of energy for artificial heating and cooling.

OPTIONS FOR DEMONSTRATING COMPLIANCE

Compliance with the performance requirement of facilitating the efficient use of energy of a building is achieved by one of the following ways:

1 Verification by calculation
2 Acceptable Construction Practice.

1 Verification by calculation

Verification using stated values

In this method the annual energy load of a building, determined using a thermal calculation, must be equal to or less than:

- In climate zones 7 and 8, the annual energy load equivalent to a 4-star house energy rating.

Verification using a reference building.

In this method the heating and cooling loads for the proposed building are compared with those of a reference building with the same geometry and location, but constructed of materials specified in Table V2.6.2 of the BCA. The heating and cooling loads for the proposed and reference buildings must be determined using the same thermal calculation method. When compared with a reference building, the proposed building must have:

- In climate zones 7 and 8, a heating load equal to or less than that of the reference building.

2 Acceptable Construction Practice

In this method, various building fabric components (eg roofs, walls, floors) must have certain specified levels of thermal resistance (R), taking into account the climate zone and, in some cases, thermal mass of the walls and concrete slab-on-ground.

In addition to building fabric measures, there are specified requirements for external glazing, building sealing, air movement and services (BCA Clauses 3.12.2 to 3.12.5).

The deemed-to-satisfy provisions that are considered to be acceptable forms of construction for roofs, walls and floors are described below:

ROOFS

The roof must achieve the minimum Total R-Value shown in the table below, extracted from Table 3.12.1.1 of the BCA.

Extract from Table 3.12.1.1
ROOFS – Minimum Total R-Value for each Climate Zone

Climate zones	7	8
Direction of heat flow	Up	Up
Minimum Total R-Value	3.8	4.3

EXTERNAL WALLS

The external wall must achieve a Total R-Value as specified in the table below, extracted from BCA Table 3.12.1.3.
OR
In climate zones 7 and 8 achieve a surface density of not less than 220 kg/m^2 and incorporate insulation with an R-Value of not less than 1.0.

Surface Density of Concrete Walls

Reinforced concrete has a density of approximately 2400 kg/m^3. Therefore, a solid concrete wall with a thickness of 100 mm will have a surface density of 240 kg/m^2 (ie greater than 220 kg/m^2). However, the BCA lists "140 mm thick or greater concrete wall panels" with the examples of ... typical wall constructions that achieve a surface density of 220 kg/m^2 in Figure 3.12.1.3. 140 mm thick, not 100 mm thick, was listed in order to achieve the appropriate combination of thermal resistance and thermal mass. It should be clearly understood that the 140 mm requirement should over-ride the 220 kg/m^2 limit if the Deemed-to-Satisfy (DTS) provisions are used. When verification by calculation is used, any wall thickness may be used provided the performance criteria are met.

Extract from Table 3.12.1.3
WALLS – Minimum Total R-Value for each Climate Zone

Climate zones	7	8
Minimum Total R-Value	1.9	2.8

FLOORS

A suspended floor with an unenclosed perimeter must have a Total R-Value:

- in climate zone 7 of not less than 1.0
- in climate zone 8 of not less than 2.5.

Tasmania Summary

ENERGY EFFICIENT ACCEPTABLE CONSTRUCTION PRACTICE – Roofs, walls and floors

	ZONE 7	ZONE 8
	Locations: **BURNIE** **BICHENO** **DELORAINE** **DEVONPORT** **FLINDERS IS** **HOBART** **HUONVILLE** **KING IS** **LAUNCESTON** **NEW NORFOLK** **OATLANDS** **ORFORD** **ROSSARDEN** **SMITHTON** **ST MARYS** **ZEEHAN**	**Locations:** **ALPINE REGIONS**
ROOFS	**All roofs** Total R-Value 3.8	**All roofs** Total R-Value 4.3
WALLS	**Wall surface density ≥220 kg/m^2 (Solid concrete thickness ≥140 mm)** ***Added*** R-Value 1.0 Complying construction, zones 7 and 8: ■ 140 mm concrete panels + 40 mm furring channels + 40 mm insulation + 10 mm plasterboard, ■ 140 mm concrete masonry fully grouted + 40 mm furring channels + 40 mm insulation + 10 mm plasterboard, ■ 190 mm concrete masonry partially grouted at 1800 mm centres	
	Wall surface density <220 kg/m^2 **(Solid concrete thickness <140 mm)** Total R-Value 1.9 Complying construction: ■ 100 mm concrete panels + 50 mm furring channels + 50 mm insulation + 10 mm plasterboard, ■ 140 mm concrete masonry + 50 mm furring channels + 50 mm insulation + 10 mm plasterboard	**Wall surface density <220 kg/m^2** **(Solid concrete thickness <140 mm)** Total R-Value 2.8 Complying construction: ■ 100 mm concrete panels + 70 mm furring channels + 70 mm insulation + 10 mm plasterboard, ■ 140 mm concrete masonry + 70 mm furring channels + 70 mm insulation + 10 mm plasterboard
FLOORS	**Enclosed suspended floors without heating** No floor insulation required Complying construction, zones 7 and 8: ■ suspended concrete floor	
	Unenclosed suspended floors Total R-Value 1.0 Complying construction, zones 7 and 8: ■ 150 mm concrete floor + 10 mm insulation + carpet or similar	
	Heated suspended floors ***Added*** R-Value of 1.0 underneath and at the perimeter Complying construction, zones 7 and 8: ■ suspended concrete floor + 40 mm insulation	
	Other applications No floor insulation required Complying construction, zones 7 and 8: ■ concrete slab-on-ground	

Note: Insulation thickness is based on material with thermal conductivity of 0.025–0.028 W/m.K. This value is typical of rigid foamed polyurethane and extruded polystyrene. For materials with different thermal conductivity the insulation thickness will vary from those given in this summary.

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CCAA OFFICES

SYDNEY OFFICE:
Level 6, 504 Pacific Highway
St Leonards NSW Australia 2065
POSTAL ADDRESS:
Locked Bag 2010
St Leonards NSW 1590
TELEPHONE: (61 2) 9437 9711
FACSIMILE: (61 2) 9437 9470

BRISBANE OFFICE:
Level 14, IBM Building
348 Edward Street
Brisbane QLD 4000
TELEPHONE: (61 7) 3831 3288
FACSIMILE: (61 7) 3839 6005

EXTRACTIVE INDUSTRIES OFFICE
375 Wickham Terrace
Brisbane QLD 4000
TELEPHONE: (61 7) 3886 1543
FACSIMILE: (61 7) 3832 3195

MELBOURNE OFFICE:
2nd Floor, 1 Hobson Street
South Yarra VIC 3141
TELEPHONE: (61 3) 9825 0200
FACSIMILE: (61 3) 9825 0222

EXTRACTIVE INDUSTRIES OFFICE
486 Albert Street
Melbourne VIC 3002
POSTAL ADDRESS:
GPO Box 4352QQ
Melbourne VIC 3001
TELEPHONE: (61 3) 8662 5333
FACSIMILE: (61 3) 8662 5358

PERTH OFFICE:
45 Ventnor Avenue
West Perth WA 6005
TELEPHONE: (61 8) 9389 4452
FACSIMILE: (61 8) 9389 4451

ADELAIDE OFFICE:
Greenhill Executive Suites
213 Greenhill Road
Eastwood SA 5063
POSTAL ADDRESS:
PO Box 229
Fullarton SA 5063
TELEPHONE: (61 8) 8274 3758
FACSIMILE: (61 8) 8373 7210

EXTRACTIVE INDUSTRIES OFFICE
Enterprise House
136 Greenhill Road
Unley SA 5061
TELEPHONE: (61 8) 8300 0180
FACSIMILE: (61 8) 8300 0001

TASMANIAN OFFICE:
EXTRACTIVE INDUSTRIES OFFICE
PO Box 59
Riverside TAS 7250
TELEPHONE: (61 3) 6330 2476
FACSIMILE: (61 3) 6330 2179

WEBSITE: www.concrete.net.au

EMAIL: info@ccaa.com.au

DESIGN: Helen Rix Design