

### Introduction

Energy efficiency requirements for housing were introduced into the Building Code of Australia (BCA) on 1<sup>st</sup> January 2003. Queensland energy efficiency variations to the BCA were introduced in Amendment 13 on 1<sup>st</sup> July 2003 and were implemented on 1<sup>st</sup> September 2003. The provisions apply statewide with some variations depending upon climatic zone.

This data sheet provides a brief outline of the energy efficiency requirements of the BCA with respect to Queensland and explains how timber framed wall and roof systems can be used to achieve the thermal insulation ('R' value) requirements. There are no insulation requirements for floors for the climatic zones applicable in Queensland.

### BCA Energy Efficiency Requirements

The energy requirements for Queensland apply to four Climate Zones (Zones 1, 2, 3 and 5) which are separated by local government boundaries. See Table 1. Other Zones (4, 6, 7 and 8) are not applicable in Queensland.

Compliance with the energy efficiency provisions can be achieved either by a 'deemed to comply' solution or by thermal simulation. Thermal simulation requires use of computer software such as 'NatHERS' or 'BERS' and is beyond the scope of this data sheet.

The provisions of the BCA relating to energy efficiency include minimum requirements for insulation of the building fabric (roofs, walls, and floors), shading of external glazing, sealing of the building and air movement.

This datasheet is primarily concerned with acceptable 'deemed to comply' solutions relating to insulation of the building fabric. For all other requirements refer to the BCA.

### Insulation

The **total** thermal resistance ('R') value of a roof or wall system required by the BCA is given in Table 2. The 'R' values given are directional, depending upon the need to either keep in heat, or exclude heat from the building.

**Table 1 Climate Zones** (For a detailed map of these zones refer to [www.abcb.gov.au/content/energy](http://www.abcb.gov.au/content/energy))

Climate Zone	Local Government Areas included in Zone
Zone 1	Atherton, Aurukun, Bowen, Burdekin, Burke, Cairns, Cardwell, Carpentaria, Cook, Croydon, Douglas, Eacham, Etheridge, Herberton, Hinchinbrook, Johnstone, Mareeba, Mornington, Sweets Isl, Thuringowa, Torres, Townsville, Whitsunday
Zone 2	Beaudesert, Biggenden, Boonah, Brisbane, Broadsound, Bundaberg, Burnett, Caboolture, Calliope, Caloundra, Cooloola, Esk, Fitzroy, Gatton, Gladstone, Gold Coast, Hervey Bay, Ipswich, Isis, Kilcoy, Kilkivan, Kolan, Laidley, Livingstone, Logan, Mackay, Maroochy, Maryborough, Mirani, Miriam Vale, Nebo, Noosa, Pine Rivers, Redcliffe, Redland, Rockhampton, Sarina, Tiara, Woocoo
Zone 3	Aramac, Balonne, Banana, Barcardine, Barcoo, Bauhinia, Belyando, Bendemere, Blackall, Booringa, Boulia, Bulloo, Bungil, Charters Towers, Chinchilla, Cloncurry, Dalby, Dalrymple, Diamantina, Duaringa, Eidsvold, Emerald, Flinders, Gayndah, Goondiwindi, Ilfracombe, Inglewood, Isisford, Jericho, Longreach, McKinlay, Millmerran, Monto, Mount Isa, Mount Morgan, Mundubbera, Murgon, Murilla, Murweh, Paroo, Peak Downs, Perry, Quilpie, Richmond, Roma, Tambo, Tara, Taroom, Waggamba, Wambo, Warroo, Winton, Wondai
Zone 5	Cambooya, Clifton, Crow's Nest, Jondaryan, Kingaroy, Nanango, Pittsworth, Rosalie, Stanthorpe, Toowoomba, Warwick

**Table 2 Insulation**

Element	Climate Zone				
	1 ( Hot wet tropics)	2 (Sub-tropical)		3 (Hot dry inland)	5 (Temperate)
		Less than 300 m AHD(1)	Equal or > 300 m AHD(1)		
<b>Timber Framed Roof/ceiling system</b>	R 2.2 inward or roofing to have solar absorptance value not > 0.55 + RBM + ventilation	R 2.2 inward	R 2.5 inward or outward	R 2.2 inward or outward or roofing to have solar absorptance value not > 0.55 + RBM + ventilation	R 2.7 outward
<b>Timber Framed External wall system</b>	R 1.0 or eaves shading to ¼ wall height	R 1.0 or eaves shading to ¼ wall height	R 1.0 or eaves shading to ¼ wall height	R 1.0 or eaves shading to ¼ wall height	R 1.4 or wall density 220 kg/m <sup>2</sup>
<b>Floors</b>	NR	NR	NR	NR	NR

Notes:

- 'R' values given above are total 'R' values required for the roof or wall system
- AHD is Australian Height Datum. Height above AHD is measured from mean sea level.
- NR = No requirement.
- RBM = Reflective building membrane.
- Specific requirements apply to skylights.
- Solar absorptance value relates to the colour of the roofing. Pale colours have lower values.

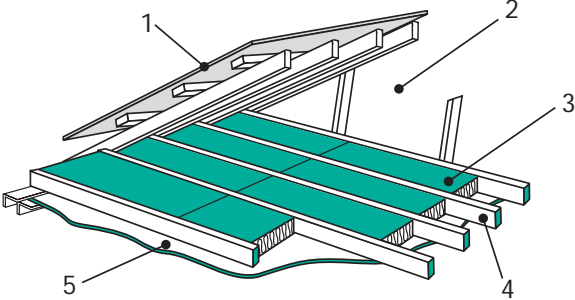
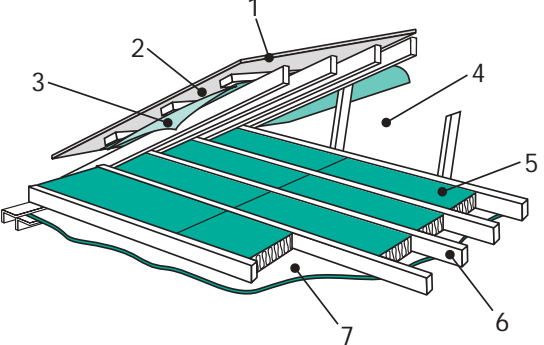
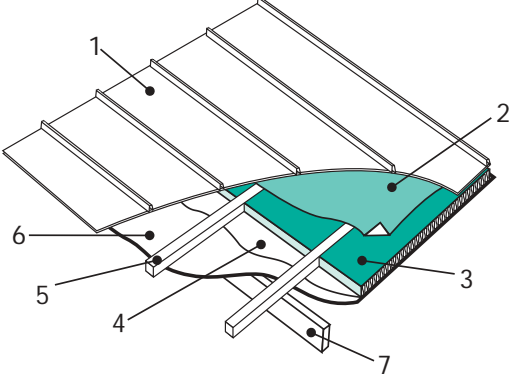
## 'R' Rated Timber Systems

Tables 3 and 4 give a summary of some 'R' ratings for typical timber framed roof and wall systems.

The 'R' rating is a measure of the thermal resistance ( $m^2.K/W$ ) of the total system, that is, the summation of the 'R' values of all the components of the system including any insulation and reflective air spaces that may be present.

Comprehensive 'R' ratings for a wider range of timber framed roof, wall and floor systems are available at [www.timber.org.au](http://www.timber.org.au) under the 'ENERGY' page. The numbering system used in this data sheet for roofs and walls, corresponds to that in the details at the above web address.

Table 3 'R' Ratings for timber framed roof assemblies

Description	Item	Total 'R' Value	
		Inward	Outward
<b>R1 Pitched/truss roof, flat ceiling, bulk insulation between joists</b>  <ol style="list-style-type: none"> <li>1. Roof cladding</li> <li>2. Attic space (non-reflective)</li> <li>3. Bulk insulation</li> <li>4. Timber ceiling joists</li> <li>5. Plasterboard</li> </ol>	R 1.5 bulk insulation Tiles Sheet	2.3 2.1	1.9 1.9
	R 2.0 bulk insulation Tiles Sheet	2.7 2.5	2.3 2.3
	R 2.5 bulk insulation Tiles Sheet	3.0 2.8	2.8 2.8
	R 3.0 bulk insulation Tiles Sheet	3.4 3.2	3.2 3.2
<b>R2 Pitched/truss roof, flat ceiling, reflective foil with/without bulk insulation between joists</b>  <ol style="list-style-type: none"> <li>1. Roof cladding</li> <li>2. Airspace (non-reflective)</li> <li>3. RFL</li> <li>4. Attic space (reflective)</li> <li>5. Bulk insulation</li> <li>6. Timber ceiling joists</li> <li>7. Plasterboard</li> </ol>	No bulk insulation Tiles Sheet	1.4 1.4	0.6 0.6
	R 1.5 bulk insulation Tiles Sheet	2.9 2.9	2.1 2.1
	R 2.0 bulk insulation Tiles Sheet	3.3 3.3	2.5 2.5
	R 2.5 bulk insulation Tiles Sheet	3.6 3.6	3.0 3.0
<b>R6 Metal roof, exposed rafters, bulk insulation and RFL</b>  <ol style="list-style-type: none"> <li>1. Metal decking</li> <li>2. Sarking</li> <li>3. Bulk insulation</li> <li>4. Vapour barrier</li> <li>5. Timber batten</li> <li>6. Ceiling lining</li> <li>7. Exposed rafter</li> </ol> <p>slope: 15° to 35°</p>	R 2.5 bulk insulation	2.3	2.6
	R 3.0 bulk insulation	2.7	3.1

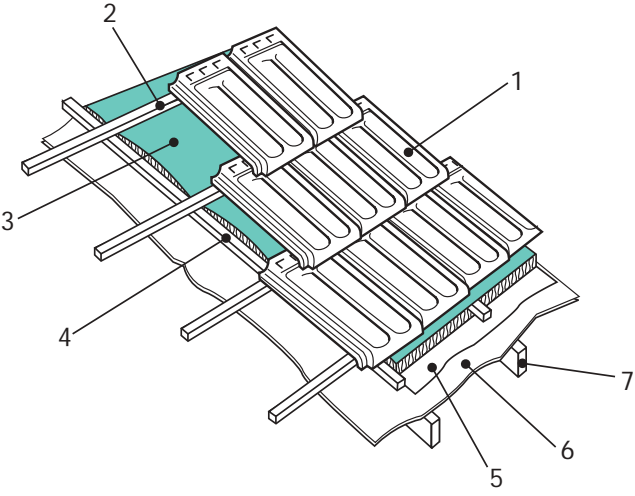
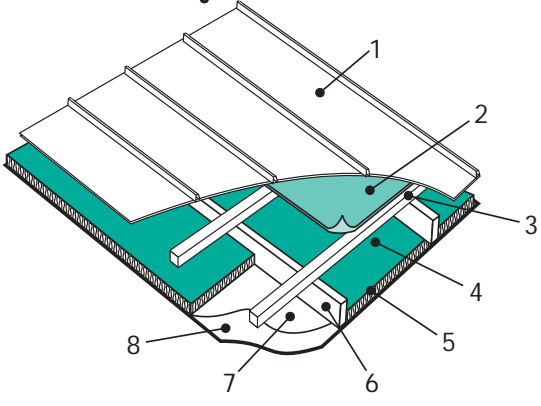
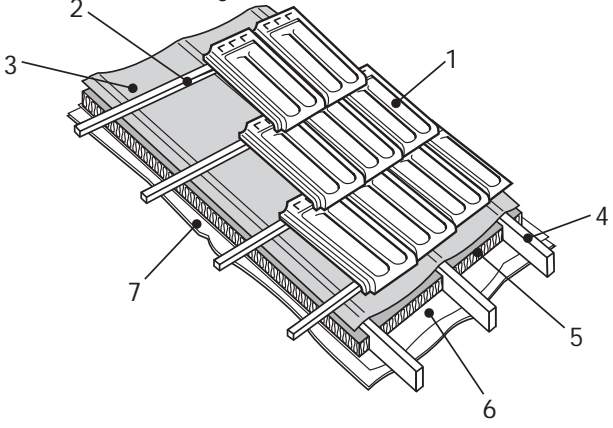
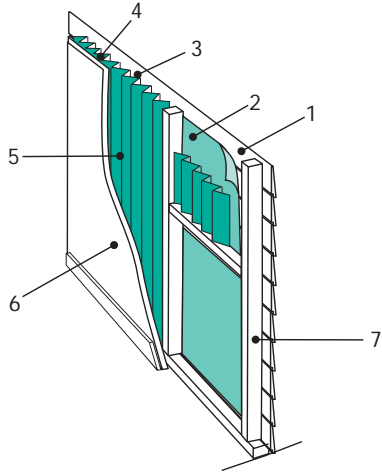
Description	Item	Total 'R' Value		
		Inward	Outward	
<b>R7 Tile roof, exposed rafters and bulk insulation</b> Inward    Outward 	1. Tiles 2. Timber tile batten 3. Bulk insulation 4. Counter battens 5. Vapour barrier 6. Plasterboard 7. Exposed rafter  slope: 15° to 35°	R 2.5 bulk insulation	2.5	2.7
		R 3.0 bulk insulation	2.8	3.1
<b>R9 Metal roof, raked ceiling lined on underside and bulk insulation</b> 	1. Metal roofing 2. Sarking RFL 3. Timber roofing batten 4. Airspace (reflective) 5. Bulk insulation 6. Timber rafter 7. Vapour barrier 8. Plasterboard  slope: 15° to 35°	R 2.0 bulk insulation	2.6	2.7
		R 2.5 bulk insulation	3.0	3.2
		R 3.0 bulk insulation	3.4	3.6
<b>R10 Tile roof, raked ceiling lined on underside and bulk insulation</b> 	1. Tiles 2. Timber tile batten 3. Sarking RFL 4. Timber rafter 5. Bulk insulation 6. Vapour barrier 7. Plasterboard  slope: 15° to 35°	R 2.0 bulk insulation	2.7	2.8
		R 2.5 bulk insulation	3.0	3.2
		R 3.0 bulk insulation	3.4	3.6

Table 4 'R' Ratings for timber framed wall assemblies

Description	Item	Total 'R' Value		
		Inward	Outward	
<b>W1 Timber framed wall, brick veneer, reflective foil laminate (RFL)</b>  <ol style="list-style-type: none"> <li>1. External cladding</li> <li>2. Airspace (anti-glare)</li> <li>3. RFL</li> <li>4. Airspace (reflective)</li> <li>5. Timber studs</li> <li>6. Plasterboard 10 mm</li> </ol>	Clay Brick 110mm 70mm frame 90mm frame	1.4 1.5	1.3 1.3	
	Concrete brick 90mm 70mm frame 90mm frame	1.4 1.4	1.3 1.3	
<b>W2 Timber framed wall, weatherboard or sheet cladding, concertina RFL between studs</b>  <ol style="list-style-type: none"> <li>1. External cladding</li> <li>2. Airspace (reflective)</li> <li>3. Concertina RFL</li> <li>4. Airspace (reflective)</li> <li>5. Timber studs</li> <li>6. Plasterboard 10 mm</li> </ol> Note: Noggings omitted for clarity	Weatherboard  Plywood cladding  Fibre cement cladding	1.8  1.7  1.7	1.5  1.4  1.4	
<b>W5 Timber framed wall, weatherboard or sheet cladding, R 1.5 bulk insulation and RFL</b>  <ol style="list-style-type: none"> <li>1. External cladding</li> <li>2. Vapour permeable RFL Airspace (reflective)</li> <li>3. R 1.5 bulk insulation</li> <li>4. Timber studs</li> <li>5. Plasterboard 10 mm</li> </ol> Note: Noggings omitted for clarity	Weatherboard  Plywood cladding  Fibre cement cladding	1.6  1.6  1.5	1.5  1.5  1.4	

Description	Item	Total 'R' Value	
		Inward	Outward
<p><b>W9 Timber framed wall, weatherboard or sheet cladding, 10 mm foil-backed insulation board</b></p> <ol style="list-style-type: none"> <li>External cladding</li> <li>Insulation board 10 mm</li> <li>Airspace (reflective)</li> <li>Timber studs</li> <li>Plasterboard 10 mm</li> </ol>	<p>Weatherboard</p> <p>Plywood cladding</p> <p>Fibre cement cladding</p>	<p>1.2</p> <p>1.2</p> <p>1.1</p>	<p>1.2</p> <p>1.1</p> <p>1.1</p>
<p><b>W10 Timber framed wall, weatherboard or sheet cladding, 15 mm foil-backed insulation board</b></p> <ol style="list-style-type: none"> <li>External cladding</li> <li>Insulation board 15 mm</li> <li>Airspace (reflective)</li> <li>Timber studs</li> <li>Plasterboard 10 mm</li> </ol>	<p>Weatherboard</p> <p>Plywood cladding</p> <p>Fibre cement cladding</p>	<p>1.4</p> <p>1.3</p> <p>1.3</p>	<p>1.4</p> <p>1.3</p> <p>1.3</p>
<p><b>W11 Timber framed wall, weatherboard or sheet cladding, RFL</b></p> <ol style="list-style-type: none"> <li>External cladding</li> <li>Vapour permeable RFL</li> <li>Airspace (reflective)</li> <li>Timber studs</li> <li>Plasterboard 10 mm</li> </ol>	<p>Weatherboard</p> <p>Plywood cladding</p> <p>Fibre cement cladding</p>	<p>1.2</p> <p>1.1</p> <p>1.1</p>	<p>1.1</p> <p>1.0</p> <p>1.0</p>

Description	Item	Total 'R' Value	
		Inward	Outward
<b>W14 Timber framed wall, weatherboard or sheet cladding, concertina RFL between studs</b>   <ol style="list-style-type: none"> <li>1. External cladding</li> <li>2. Vapour permeable RFL</li> <li>3. Airspace (reflective)</li> <li>4. Concertina RFL</li> <li>5. Airspace (reflective)</li> <li>6. Plasterboard</li> <li>7. Timber studs</li> </ol>	Weatherboard	1.9	1.8
	Plywood cladding	1.9	1.7
	Fibre cement cladding	1.8	1.7

## Other Considerations

### Substitution of lining/sheeting materials

It can be noted from Tables 3 and 4, that the total 'R' rating for the various assemblies is not very sensitive to the type of lining or sheeting materials used. Table 5 provides 'R' ratings for individual lining/sheeting materials and this can be used to determine if one product can be substituted for another in any of the assemblies given in Tables 3 and 4.

**Table 5 'R' Ratings for some common lining/sheeting materials**

Material	Thickness (mm)	'R' Rating (m <sup>2</sup> K/W)
Softwood	12	0.09
	19	0.14
Hardwood	12	0.06
	19	0.10
Plywood	6	0.05
	12	0.09
	15	0.11
Hardboard	4.5	0.02
	6	0.03
Particleboard	19	0.17
	22	0.20
Medium Density Fibreboard	9	0.07
	12	0.09
	18	0.14
Fibre cement	6	0.02
Plasterboard	10	0.06
	13	0.08
	18	0.11
Brick	90	0.06
	110	0.07

 Standard plasterboard thickness used for wall and ceiling lining in Tables 3 and 4

## Fixed shading for windows and doors (Screens, awnings etc)

The code requires control of solar radiation through external glazing. This can be achieved by either using roof overhangs or fixed screens that have blades, slats or battens covering a minimum of 75% of the area of the screen.

Note: Overhang requirements vary with orientation of glazing and height from overhang to bottom of glazing.

Timber used for the construction of screens should be of an appropriate quality and durability to achieve the performance required. Information on durability and preservative treatment for timber used in these applications can be obtained from Technical Data Sheet No 25 'Outdoor Timber Performance'

## Thermal Bridging

The thermal conductivity of building elements plays an important role in the overall thermal efficiency of building assemblies. Timber, which has a relatively low coefficient of thermal conductivity is ideal for framing systems and window and door joinery as it does not result in any significant thermal bridging between the inside and outside of the building envelope.

Extensive studies in North America have shown that the thermal bridging that occurs with steel stud wall assemblies reduces the effective 'R' rating of walls by as much as 50% compared to the same timber framed wall assembly. Steel stud wall systems have been shown to require an additional 38 to 50 mm of bulk insulation to achieve the same 'R' ratings as timber stud systems.

## References

1. Building Code of Australia – Amendment 13. July 2003.
2. R-Values for Timber Framed Building Elements. Forest and Wood Products Research and Development Corporation. April 2002.
3. Building Insulation Design Guide. CSR Bradford Insulation. Dec 1992.
4. Comparison of the Thermal Performance of Wood Stud and Metal Frame Wall Systems. Kosny, Jan, Oak Ridge National Laboratory. Journal Thermal Insul. and Bldg. Envs., Volume 19 - July 1995.



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