

**CSR**<sup>™</sup>  
**Bradford**  
**Insulation**

# BUILDING

Residential & Commercial

## Contents.

<b>Introduction</b>	2
<b>The Benefits of Insulation in Buildings</b>	3
<b>Application Guide for Home Insulation</b>	4 – 5
Selection Guide for homes	6
<b>Application Guide for Commercial Insulation</b>	7 – 8
Selection Guide for Commercial Buildings	9
<b>Design Considerations</b>	
Design Considerations Summary	10
Comfort for Building Occupants	10
Heat Flow Into and Out of a Building	11
Added vs Overall 'R-Value'	15
Energy Conservation	15
Solar Radiation	17
Condensation Control	18
Sound Control	20
Fire Protection	21
Building Sarking	22
Environmental Design	23
Durability	23
Installation	23
Health and safety	23
<b>Design Calculations</b>	
Thermal & Condensation Control	24
<b>System Specification</b>	
Metal Deck Roof	25
External Wall - Commercial & Industrial Buildings	27
Internal Partitions – Framed Construction	28
Suspended Concrete Slab	28
Commercial Ceilings	29
Curtain Walls	30
Party Wall Fire Protection	30
Timber Flooring Systems	30
External Wall (Brick Veneer/Weatherboard)	31
Pitched Roof/Raked Ceiling	32
Pitched Roof/Horizontal Ceiling	34
Thermofoil Fixing to Timber Studs	35
Thermofoil Under Tiled Roof	35
Thermofoil Under Metal Roof	36
<b>Appendix A</b> Design Data	37 – 41
<b>Appendix B</b> Thermal Performance of Typical Building Elements	42 – 44
<b>Appendix C</b> Frequently Asked Questions and Answers	45 – 46
<b>Appendix D</b> Terminology	47
<b>CSR Bradford Insulation Regional Contact Details</b>	48

## Introduction.

The Bradford Insulation Group forms part of the Building Materials Division of CSR Limited. Bradford manufactures and markets an extensive range of insulation products offering outstanding thermal, acoustic and fire protection properties for use in all types of domestic and commercial buildings.

Two bulk insulation materials are available; 'Bradford Glasswool', which is manufactured by controlled felting of glass wool bonded with a thermosetting resin; and 'Bradford Fibertex™ Rockwool' which is spun from natural rock and bonded with a thermosetting resin. Both are available in sheet or roll form and as moulded pipe insulation.

Bradford Thermofoil™ and Thermotuff™ are a range of aluminium foil laminates available in various grades.

All Bradford Insulation products are tested to meet stringent quality control standards incorporating quality management systems such as AS3902/ISO9002.

### TECHNICAL ASSISTANCE.

The purpose of this guide is to provide information on the technical benefits obtained with the inclusion of insulation materials in the construction of buildings, whether they are houses, apartments, offices, shopping centres, warehouses or other commercial buildings.

The range of Bradford products and their applications is presented along with data and worked examples to illustrate design considerations. System specifications for typical applications are also included. In order that the benefits of insulation may be realised most cost effectively, its inclusion in the building should be considered right from the initial design stage.

This guide deals primarily with thermal performance of building insulation products and systems. Additional specific information is available in the Bradford Insulation Acoustic Design Guide, and the Bradford Insulation Fire Protection Design Guide.

To assist designers, a free and comprehensive technical service, as well as advice and assistance in specifying and using Bradford products is available from Bradford Insulation offices in your region. Further technical data and product updates are also available on the CSR Building Solutions Website: [www.csr.com.au/bradford](http://www.csr.com.au/bradford)

Information included in this Design Guide relates to products as manufactured at the date of publication. As the Bradford Insulation policy is one of continual product improvement, technical details as published are subject to change without notice.

# The Benefits of Insulation in Buildings.

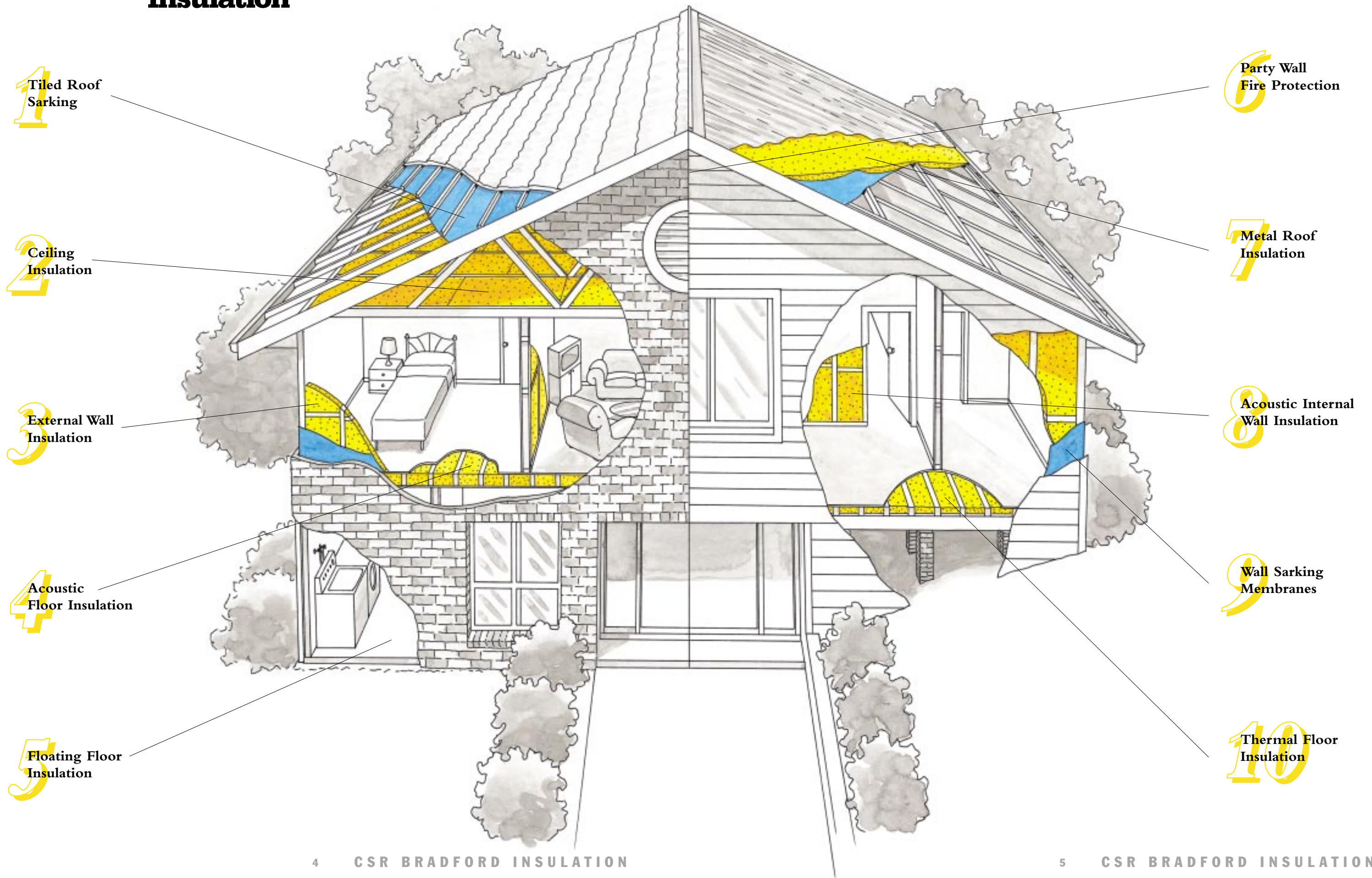
Given the limited nature of world resources and the rising costs of energy, there is an increasing focus on the use of insulation in homes and commercial buildings. By incorporating thermal insulation in the building structure, the occupants experience increased comfort, and at the same time the amount of energy used is minimised. Reduced energy usage preserves scarce resources and also decreases the amount of carbon dioxide produced during the burning of fossil fuels to supply energy.

Improved Thermal Comfort all year round	Insulation assists greatly in keeping heat within a building in winter and slowing the flow of heat into the building in summer. An insulated building will therefore be warmer in winter and cooler in summer, creating a more comfortable environment all year round.
Reduced Noise Levels	<p>Glasswool and rockwool are excellent sound absorbers and can assist in reducing noise transmission through walls, ceilings and floors, making the home or work environment quieter.</p> <p>Sound transmission through roofs with metal decking is significantly reduced by installation of glasswool or rockwool blanket as part of the roof system.</p>
Saving on Energy Costs	<p>Insulation can cut the cost of heating and cooling by over 40%. Insulating the ceiling of a house has the potential to saving 20–30% on heating and cooling bills. Adding R1.5 insulation to external walls gives an additional 10–20% saving.</p> <p>Air conditioning system capital and running costs can be minimised by using adequate insulation in the building envelope.</p>
Helping the Environment	Insulation is an acknowledged way to reduce consumption of fossil fuels which add to the greenhouse effect. Bradford Insulation products are environmentally friendly, they contain no asbestos or CFC's, and are made from highly abundant raw and recycled materials. Using insulation can help reduce greenhouse gas emissions by approximately 2 tonnes per year, per household.
Condensation Control	Condensation can occur on the inside surface of a roof or ceiling at any time when the temperature of the surface is at or below the dew-point of the air in contact with it. Bradford Glasswool and Fibertex Rockwool bulk insulation raises the temperature on the insulated surface above the dew point temperature. Bradford Thermofoil products act as a vapour barrier to prevent condensation when faced onto glasswool or rockwool insulation.





# Application Guide for Home Insulation.



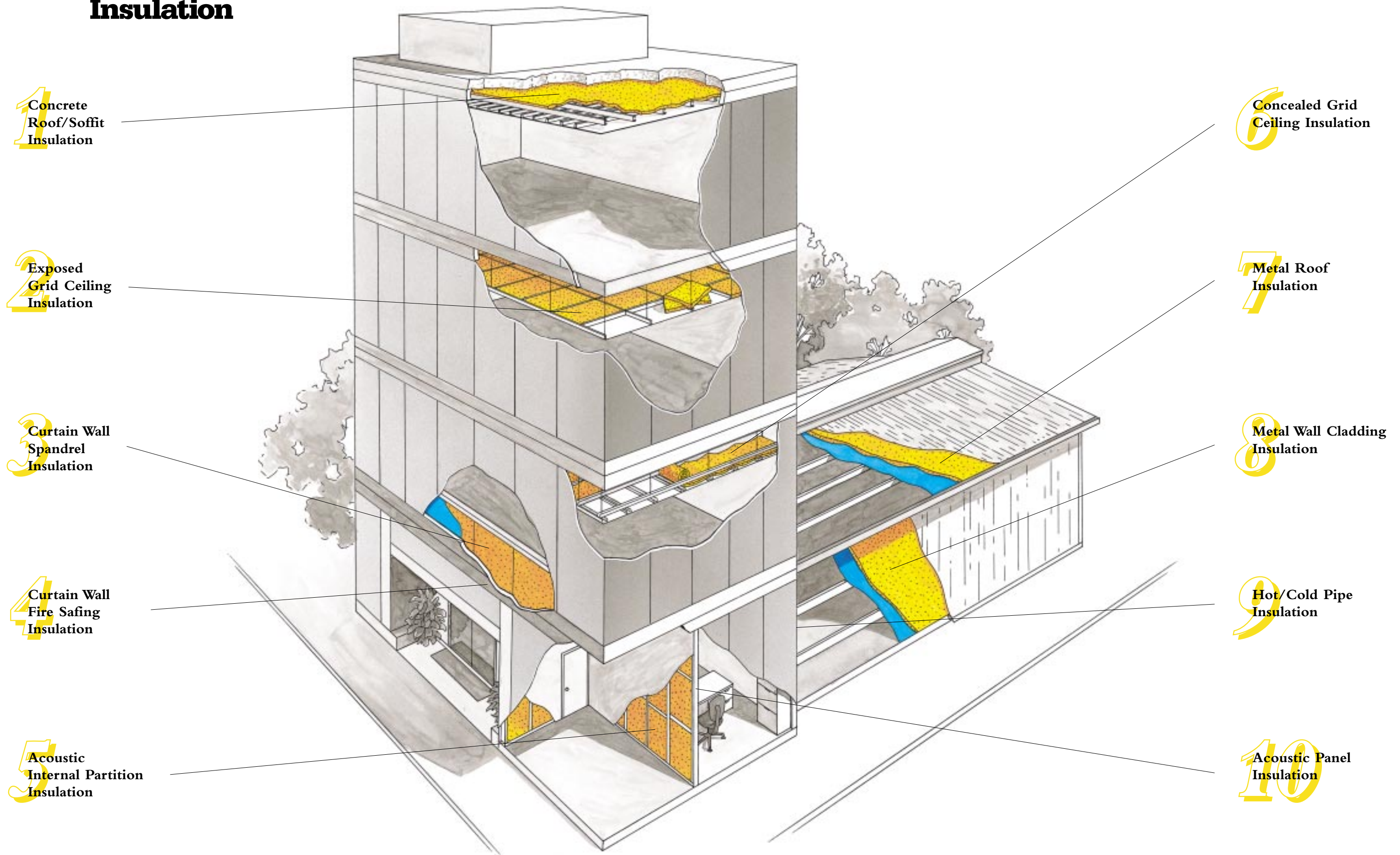
## Bradford Insulation Application & Selection Guide for Homes.

Insulation Application	Product Type	Product Range/Facings
<b>1</b> Tiled Roof Sarking	Bradford THERMOFOIL™ Sarking	Medium, Heavy Duty, ANTIGLARE
	Bradford THERMOTUFF™ Sarking	Medium, Extra Heavy Duty, Safety
<b>2</b> Ceiling	Bradford Glasswool Gold Ceiling Batts	R2.0, R2.5, R3.0, R3.5, R4.0
	Bradford FIBERTEX™ Rockwool Ceiling Batts	R2.0, R2.5, R3.0
	Bradford FIBERTEX™ Rockwool Granulated	Loose Fill Bags
<b>3</b> External Wall	Bradford Glasswool Gold Wall Batts	R1.5, R2.0
	Bradford FIBERTEX™ Rockwool Wall Batts	R1.5, R2.0
	Bradford FIBERTEX™ Rockwool Cavity Wall Granulated	Loose Fill Bags
	Bradford THERMOFOIL™ Board	10 - 30mm
<b>4</b> Acoustic Floors	Bradford Glasswool Gold Ceiling Batts	R2.0, R2.5
	Bradford FIBERTEX™ Rockwool Ceiling Batts	R2.0, R2.5
<b>5</b> Floating Floors	Bradford Glasswool QUIETEL™	Refer to the Bradford Insulation Acoustic Design Guide
<b>6</b> Party Wall Fire Protection	Bradford Rockwool FIRESEAL™ Party Wall Batts	Standard 100mm thick
<b>7</b> Metal Roofing	Bradford Glasswool ANTICON™ Blanket	R1.5, R2.0, R2.5 Faced Light, Medium, Heavy Duty or Specialty THERMOFOIL™
	Bradford FIBERTEX™ Rockwool ANTICON™ Blanket	R1.5, R2.0, R2.0 Faced Light, Medium, Heavy Duty or Specialty THERMOFOIL™
	Bradford ACOUSTICON™ Blanket	THERMOFOIL™ Facing
<b>8</b> Acoustic Internal Walls	Bradford Glasswool Gold Wall Batts	R1.5, R2.0
	Bradford FIBERTEX™ Rockwool Wall Batts	R1.5, R2.0
	Bradford Rockwool SoundScreen™	80mm thick
<b>9</b> Wall Sarking	Bradford THERMOFOIL™	Light Duty, ANTIGLARE, Breather
	Bradford THERMOTUFF™	Light Duty, Light Duty Breather
<b>10</b> Timber Floors	Bradford Glasswool Wall/Floor Batts	R1.5 - R2.0
	Bradford FIBERTEX™ Rockwool Wall/Floor Batts	R1.5 - R2.0
	Bradford THERMOTUFF™ Draught Barrier	Light Duty, Light Duty Breather
	Bradford Rockwool SoundScreen™	80mm thick





# Application Guide for Commercial Building Insulation.



## Bradford Insulation Application & Selection Guide for Commercial Buildings.

Insulation Application	Product Type	Product Range/Facings
<b>1</b> Concrete Roof/Soffit	Bradford Glasswool ANTICON™ Blanket	R1.5, R2.0, R2.5 Faced Light, Medium, Heavy Duty or Specialty THERMOFOIL™
	Bradford FIBERTEX™ Rockwool ANTICON™ Blanket	R1.5, R2.0 Faced Light, Medium, Heavy Duty or Specialty THERMOFOIL™
	Bradford Glasswool SUPERTEL™	25 – 75mm THERMOFOIL™ Facing
	Bradford FIBERTEX™ 350 Rockwool	50 – 100mm THERMOFOIL™ Facing
<b>2</b> Exposed Grid Ceiling	Bradford Glasswool Ceiling Panel Overlays	Factory Applied Acoustic Facings
	Bradford FIBERTEX™ Rockwool Ceiling Panel Overlays	Factory Applied Acoustic Facings
<b>3</b> Curtain Wall Spandrel Panels	Bradford SPANSEAL™ Rockwool Boards	THERMOFOIL™, BMF Facing
	Bradford Glasswool SUPERTEL™ Boards	THERMOFOIL™, BMF Facing
<b>4</b> Curtain Wall Fire Safing	Bradford FIRESEAL™ Curtain Wall Batts	Standard 100mm thick
<b>5</b> Acoustic Internal Partitions	Bradford Glasswool Partition Batts	50, 75mm
	Bradford FIBERTEX™ Rockwool Partition Batts	45mm
	Bradford FIBERTEX™ Acoustic Grade Rockwool	50, 75mm
<b>6</b> Concealed Grid Ceilings	Bradford Glasswool Building Blanket	R1.2, R1.5, R1.8, R2.0, R2.5
	Bradford FIBERTEX™ Rockwool Building Blanket	50, 75mm, R1.5, R2.0
<b>7</b> Metal Roofing	Bradford Glasswool ANTICON™ Blanket	R1.5, R2.0, R2.5 Faced Light, Medium, Heavy Duty or Specialty THERMOFOIL™
	Bradford FIBERTEX™ Rockwool ANTICON™ Blanket	R1.5, R2.0 Faced Light, Medium, Heavy Duty or Specialty THERMOFOIL™
	Bradford ACOUSTICON™ Blanket	THERMOFOIL™ Facing
<b>8</b> Metal Wall Cladding	Bradford Glasswool ANTICON™ Blanket	R1.5, R2.0, R2.5 Faced Light, Medium, Heavy Duty or Specialty THERMOFOIL™
	Bradford FIBERTEX™ Rockwool ANTICON™ Blanket	R1.5, R2.0 Faced Light, Medium, Heavy Duty or Specialty THERMOFOIL™
<b>9</b> Pipe Insulation	Bradford Glasswool Pipe Insulation	<219mm pipe O.D., <100mm wall thick
	Bradford FIBERTEX™ Pipe Insulation	<710mm pipe O.D., <100mm wall thick
	Bradford ACOUSTILAG™ Pipe Insulation	ACOUSTILAG™ 20, 23 and 26
<b>10</b> Acoustic Panels	Bradford Glasswool ULTRATEL™ Board	25-100mm, Factory Applied Facings
	Bradford FIBERTEX™ 450 Rockwool	25-100mm, Factory Applied Facings

## Design Considerations.

In the selection and design of the optimum type of insulation for residential and commercial buildings, there are several factors which need to be taken into account to ensure total performance requirements are met.

CONSIDERATION	ACTION
Comfort for building occupants	Ensure conditions in the building's occupied spaces are suitable for intended use.
Rate of heat flow into and out of a building	Calculate the required thermal resistance (R-Value) of insulation to act as sufficient barrier to heat flow.
Added vs Overall R-Value	Understand the individual and cumulative thermal rating of elements in the building envelope.
Energy conservation	Design optimum insulation for minimal energy usage.
Solar radiation	Understand the effects of solar radiation on different building surfaces.
Condensation control	Design with respect to dew point at expected atmospheric conditions.
Sound control	Choose insulation of sufficient density and thickness for control of noise from prevailing or likely sources.
Fire protection	Select material with suitable fire resistance for protection of people, the building structure and contents.
Building Sarking	Select suitable membranes to protect the building envelope.
Environmental	Choose environmentally friendly insulation products for ecologically sustainable development.
Durability	Choose products guaranteed to last the life of the building.
Installation	Ensure sufficient space is allowed for insulation.
Health & Safety	Observe MSDS recommendations.

### Comfort for Building Occupants.

A principal objective in the design of a building is that conditions in the occupied space should permit occupants to pursue their normal activities in comfort. Numerous studies have demonstrated that a comfortable environment in a building will (depending upon its use) contribute to:

- Increased productivity
- Reduced accidents
- Reduced staff absenteeism/turnover
- Improved occupancy rates

In the assessment of comfort, thermal, acoustic and visual factors all play a part, and all three of these factors must be considered together. The solution to a

lighting problem, for example, may affect the efficiency of the ventilation system or air conditioning plant. On the other hand, it may be possible to achieve both thermal and acoustic objectives by selecting one material which performs acceptably in both respects.

Environmental factors which largely determine whether people will be comfortable or not include:

- Air temperature
- Radiation temperature
- Air movement
- Humidity

The thermal performance of materials used in the construction of a building's exterior or envelope has a significant influence on the first two of these, i.e. air temperature and radiation temperature, particularly if the temperature of the enclosed space is not otherwise controlled.



If the air temperature is controlled by air conditioning, then the thermal performance of the envelope will have a significant influence on the cost of achieving temperature control.

For a variety of important and valid reasons the use of lightweight materials has become almost universal in modern construction. Commercial buildings in particular favour the use of lightweight materials in the construction of external walls and roofs and internal walls and ceilings. Yet these materials characteristically have a poor thermal performance and this has complicated the achievement of comfort for a building's occupants.

The use of thermal insulation can overcome this problem. Indeed, it has long been accepted as good practice to include thermal insulation while cladding, such as roll formed metal or fibrous cement, is being installed. Yet it is the level of insulation used that will dictate the building envelope's thermal performance. This is significant in an age where community expectations of internal comfort are rising almost as fast as the energy costs needed to achieve this comfort. The designer therefore must find a balance which optimises the level of insulation to be installed with the initial and on-going costs which insulation minimises.

## The Effect of Insulation on the Rate of Heat Flow Into and Out of a Building.

Thermal insulation reduces the flow of heat through elements of the building envelope, such as walls, roofs or ceilings and floors. The amount of thermal insulation which can be economically justified may be determined from an analysis of life-cycle costs. These costs include: capital, maintenance and operating or running costs. The economic level of thermal resistance is that for which the lifetime cost of the next available increment of insulation exceeds the lifetime saving in energy cost.

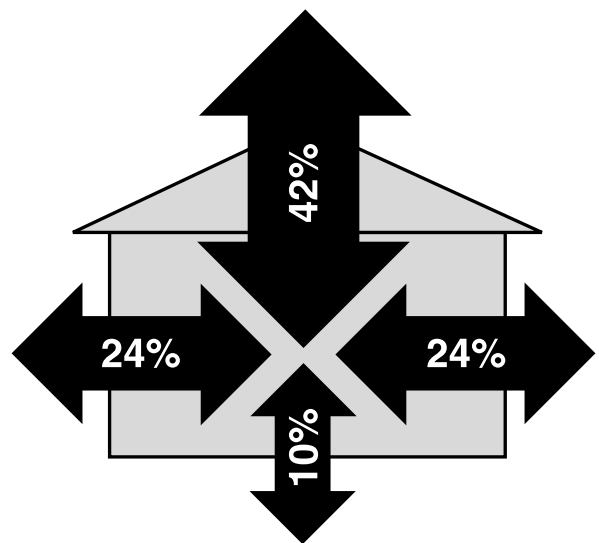
It is therefore necessary to be able to calculate the thermal resistance of uninsulated building elements, and subsequently the thermal resistance with the addition of thermal insulation.

Comprehensive information is given in this design guide on the determination of the thermal resistance of building elements, surfaces and air spaces. Worked examples are also provided. In addition, computer programmes are available to model any particular design to predict heat load for the sizing of air conditioning equipment, capital and running costs. For buildings that are not air conditioned the internal temperatures may be profiled.

Bradford Glasswool and Bradford Rockwool are supplied in preformed batts or in flexible rolls and Bradford Thermofoil is supplied in rolls with optional anti-glare coating to one side. They provide a thermal barrier to heat flow into and out of the structure. Bulk insulation such as glasswool and rockwool work primarily by trapping still air between the fibres, these air cells are very effective insulators. Thermofoil reflective foil laminates act as radiant barriers, utilising the low emissivity properties of foil to create reflective air spaces.

In winter, 42% of a home's warmth is lost through the ceilings and 24% is lost through the walls. In summer, the heat flow is reversed with heat flowing in through the ceilings and walls. Refer to FIG 1.

**FIG 1.**  
**HEAT TRANSFER TO AND FROM A BUILDING.**



Adequate levels of insulation will maintain inner surfaces at a temperature closer to that of the air within the house, and the differential between the inside and outside temperature will be greater.

Insulation materials are rated according to their ability to restrict heat transfer by the R-value which is a measure of the materials resistance to heat transfer. The higher the R-value, the higher will be the performance of the insulation.

By increasing the thermal resistance of a ceiling or wall up to 70% of heat flowing in through bricks, timber or cement sheet is reduced. This translates into a well insulated home being up to 7°C cooler in summer and up to 10°C warmer in winter.

All building materials have a thermal resistance, known as an R-value. Very dense products have low R-values while glasswool and rockwool and other insulation products have high R-values. Some typical R-values for various building materials and insulating products are shown below.

**TABLE 1. R-VALUES OF COMMON BUILDING MATERIALS.**

Material Type	R-Value (m <sup>2</sup> K/W)
Weatherboard 12mm	0.09
Bricks 110mm	0.08
Concrete 100mm	0.07
Gyprock® Plasterboard 10mm	0.06
Hardwood Rafter 100mm	0.53
Softwood 90mm	0.81
Rockwool Batts 100mm	2.5
Glasswool Batts 130mm	2.5
Glasswool Blanket 65mm	1.5
Polystyrene (SL) 25mm	0.6

## THERMAL RESISTANCE AND HEAT TRANSFER CALCULATIONS.

The heat transfer rate per unit area through a uniform flat insulation or building material is given by:

$$Q = \frac{t_h - t_c}{\frac{L_1}{k_1}} = \frac{t_h - t_c}{R_1}$$

where:

Q = heat flow per square metre per second (W/m<sup>2</sup>)

t<sub>h</sub> = hot side surface temperature (°C)

t<sub>c</sub> = cold side surface temperature (°C)

L<sub>1</sub> = thickness of the material (m)

k<sub>1</sub> = thermal conductivity of the material (W/mK)

R<sub>1</sub> =  $\frac{L_1}{k_1}$  thermal resistance of the material (m<sup>2</sup>K/W)

Where there are several layers of insulating or building materials in series, the heat transfer rate is the same for each layer and the formula now becomes:

$$Q = \frac{t_h - t_c}{R_1 + R_2 + R_3 + \dots R_n}$$

where R<sub>1</sub>, R<sub>2</sub>, ..., R<sub>n</sub> are the thermal resistances of each material within the building element.

Often, when considering the heat transfer through a section of a building, the temperatures of the boundary surfaces are not known; however, the air temperatures on both sides of the section are usually available. To use the air temperature data, the resistance to heat transfer of the surface air films must be brought into consideration and the formula adjusted to:

$$Q = \frac{t_i - t_o}{R_{si} + R_1 + R_2 + \dots R_n + R_{so}}$$

$$= \frac{t_i - t_o}{R}$$

Where:

t<sub>i</sub> = inside air temperature (°C)

t<sub>o</sub> = outside air temperature (°C)

R<sub>si</sub> = resistance of inside air film

R<sub>so</sub> = resistance of outside air film (m<sup>2</sup>.K/W)

R = overall resistance; air to air (m<sup>2</sup>.K/W)

Note: In using these formulae, the insulation thicknesses must be expressed in metres, not millimetres.

The overall coefficient of heat transfer, or thermal transmittance, is often referred to as the U value; it is the reciprocal of R, the overall thermal resistance, i.e.

$$U = \frac{1}{R}$$

$$= \frac{1}{R_{si} + R_1 + R_2 + \dots R_n + R_{so}}$$

and the above formula for heat transfer rate can be expressed as:

$$Q = U(t_i - t_o)$$

Note that for calculations involving winter conditions, t<sub>i</sub> will be greater than t<sub>o</sub>, and Q will be positive. For summer conditions t<sub>i</sub> will be less than t<sub>o</sub> and Q will be negative indicating a reversal in the direction of heat flow.

## SURFACE AIR FILM RESISTANCE (R<sub>si</sub> AND R<sub>so</sub>).

Surface resistance, the reciprocal of surface coefficient or conductance, is commonly designated R<sub>si</sub> and R<sub>so</sub> referring to indoor and outdoor conditions respectively. The values of the resistances decrease with both increasing roughness of a surface and rate of air movement over the surface. With increasing emittance of the surface (e) there is a lowering of the surface resistance. For most building materials (e) is about 0.9 but for polished aluminium, the commonly used value is 0.05.

For still air, the convection coefficient used for calculating resistance is dependent on the orientation of the surface, and the emittance of the surface assumes more importance. However, air movement due to wind, convection currents and mechanical ventilation

mean that still air conditions do not apply in many situations.

In air conditioned buildings air is mechanically circulated within the building and released so internal air movement will result. In naturally ventilated buildings air flows in and out of the building through openings, causing internal air movement along the wall and roof surfaces. An internal air movement of  $>0.3\text{m/s}$  has been adopted for these situations.

In this case there is no distinction between surfaces of high and low emissivity. The surface resistance  $R_{si}$  is composed of a radiation and a convection coefficient. It is convenient here to talk in terms of convection and radiation coefficients which are the reciprocals of the corresponding resistances. The convection coefficient may be derived from:

$$h_c = 5.8 + 4.1v$$

where  $h_c$  = convection coefficient ( $\text{W/m}^2\text{K}$ )

$v$  = air speed along the surface ( $\text{m/s}$ )

For moving air the convection coefficient becomes the dominating factor in the surface resistance which may be expressed as:

$$R_s = 1/(h_c + h_r)$$

where  $R_s$  = surface resistance ( $\text{m}^2\text{K/W}$ )

$h_r$  = radiation coefficient ( $\text{W/m}^2\text{K}$ )

At a mean surface temperature of  $20^\circ\text{C}$ ,  $h_r$  has a value of  $5.7 \text{ W/m}^2\text{K}$  and at  $0^\circ\text{C}$  this becomes 4.6.

The surface air film resistance of an exposed reflective foil under a roof will depend on the air velocities encountered, due to climate and the building usage. Experimental findings over a range of air velocities recommend a surface R-Value of  $0.2 \text{ m}^2\text{K/W}^*$  be adopted for the internal air film. This foil R-Value is adopted for typical buildings without ceilings. The reflective foil will normally be adhered to a bulk insulation blanket and the foil R0.2 will be added to the R-Value of the bulk insulation.

For building calculations in this guide standard values for external wind speed of 6 and 3  $\text{m/s}$  have been adopted for winter and summer conditions respectively. Table 2 details internal and external surface air film resistances for the standard air movement cases.

**TABLE 2. THERMAL RESISTANCE OF SURFACE AIR FILMS.**

Surface Air Film	Air Speed ( $\text{m/s}$ )	Thermal Resistance ( $\text{m}^2\text{K/W}$ )
Internal $R_{si}$	0.3	0.20*
External $R_{so}$ (winter)	6	0.03
External $R_{so}$ (summer)	3	0.04

\*Source: BRANZ.

## AIRSPACE RESISTANCE.

The thermal resistance of an airspace is dependent on the position of the airspace and on the direction of heat flow, i.e. horizontal, up or down.

It is also highly influenced by the emittance of the surface bounding the airspace as well as the mean temperature of the space. For horizontal and upward heat flow the temperature difference across the space also influences the resistance. Table 3 gives some values of resistance for situations commonly encountered in buildings with various combinations of boundary surfaces of high and low emittance (0.9 and 0.05 respectively).

The calculation of U values for a roof-ceiling combination requires a knowledge of the resistance of the airspace between the ceiling and the roofing material. Experimentally found values for the roof space for four cases, namely, ventilated and non-ventilated roof spaces for (i) high emittance surfaces and (ii) low emittance sarking beneath the roofing material are given in Table 4.

## Added R-Value vs Overall R-Value.

The added R-value is the thermal resistance R-Value contributed by the insulating material alone, this is the term often used when buying insulation. For example, R1.5 for walls and R2.5 for ceilings refers to the R-value of the insulation only.

The overall R-value is the total resistance from a building element such as the floor, wall or roof-ceiling. The overall R-value takes into account the thermal resistance provided by each building material, air spaces, insulation materials and the air films next to solid materials.

The **added** R-value from Bradford Rockwool Wall Batts is R1.5. In the case of a brick veneer wall the **overall** R-value taking into account all thermal resistances from the brickwork, air films, cavity airspace, insulation and internal wall lining is R1.95. Refer to Table 5 and to Appendix B for further examples.



**TABLE 3. THERMAL RESISTANCE OF AIRSPACE.**

Values of resistance for situations commonly encountered in buildings with various combinations of boundary surfaces of high and low emittance (0.9 and 0.05 respectively).

Nature of Bounding Surfaces	Position of Airspace	Direction of Heat	Thermal Resistance (m <sup>2</sup> K/W)	
			20mm Width	100mm Width
High Emittance Surfaces (non-reflective)	Horizontal	Up	0.15	0.17
	Horizontal	Down	0.15	0.17
	45° Slope	Up	0.17	0.17
	45° Slope	Down	0.15	0.16
	Vertical	Horizontal	0.15★	0.16
One Surface of Low Emittance (reflective)	Horizontal	Up	0.39	0.48
	Horizontal	Down	0.57	1.42
	45° Slope	Up	0.49	0.53
	45° Slope	Down	0.57	0.77
	Vertical	Horizontal	0.58★	0.61
Two Surfaces of Low Emittance (reflective)	Horizontal	Up	0.41	0.51
	Horizontal	Down	0.63	1.75
	45° Slope	Up	0.52	0.56
	45° Slope	Down	0.62	0.85
	Vertical	Horizontal	0.62★	0.66

★ For vertical air spaces greater than 20mm, with horizontal heat flow, the value of resistance for 100mm should be used.  
Source: AIRAH Handbook.

**TABLE 4. THERMAL RESISTANCE OF PITCHED ROOF SPACE.**

Experimentally found U values for roof spaces for four cases, namely, ventilated and non-ventilated spaces for:

- (a) High emittance surfaces; and
- (b) Low emittance sarking beneath the roofing material.

	Direction of Heat Flow	Thermal Resistance (m <sup>2</sup> K/W)	
		High Emittance Surfaces (non-reflective)	Low Emittance Sarking (reflective)
Ventilated roof space	Up	Nil	0.34
	Down	0.46	1.36
Non-ventilated roof space	Up	0.18	0.56
	Down	0.28	1.09

Source: AIRAH Handbook.

**TABLE 5. THERMAL RESISTANCE OF WALL – TIMBER FRAMED – BRICK VENEER.**

	R-Value (uninsulated)	R-Value (R1.5 insulation)	R-Value (R2.0 insulation)
1. Outside air film	0.03	0.03	0.03
2. Brick work	0.08	0.08	0.08
3. Airspace	0.16	0.16	0.16
4. <b>Insulation R1.5</b>	n/a	<b>1.50</b>	n/a
5. <b>Insulation R2.0</b>	n/a	n/a	<b>2.00</b>
6. Gyprock® plasterboard 10mm	0.06	0.06	0.06
7. Inside air film	0.12	0.12	0.12
<b>Total R-Value (m<sup>2</sup>K/W)</b>	<b>0.45</b>	<b>1.95</b>	<b>2.45</b>

## Energy Conservation in Housing.

The role of insulation in climate controlled living spaces is to maintain indoor air temperatures at a more constant level resulting in greatly reduced energy requirement to maintain the thermostat temperature. Installing levels of insulation in accordance with AS2627.1 to walls and ceilings results in potential savings in heating bills of 45 to 50% in cold and temperate climates. For warmer climates using air-conditioning, the reduction is 35 to 50%.

For buildings used as dwellings and which require heating in winter, AS2627 : Part 1, 'Thermal Insulation of Roof/Ceiling in Dwellings which Require Heating' recommends the thermal resistance (R-value) of insulation that can be justified financially in domestic roof/ceilings and walls.

The Standard gives a financial analysis of the cost effectiveness of insulation in dwellings. The method for deriving levels of insulation is based on an evaluation of the costs of insulation and the cost of energy saved compared with the return upon an alternative investment. Factors that are taken into account include the local cost of fuels, the typical efficiencies of various types of heaters and the costs of supplying and installing the thermal insulation required to reduce energy use while maintaining thermal comfort levels in the dwellings.

The Standard contains the recommended R-values for a comprehensive list of Australian cities and towns. A summary is given in Table A5 in Appendix A of this Guide.



### ENERGY SMART HOUSE DESIGN.

(Bradford Insulation acknowledges input from the Sustainable Energy Development Authority's Energy Smart Home policy).

Energy Smart homes save energy by clever design. A significant part of the energy can be saved in the design phase. There are three critical factors that influence the energy efficiency of the building:

1. The site location, orientation and layout.
2. The use of passive solar designs to reduce the need for heating and cooling.

3. The thermal integrity of its shell (how well the house keeps the heat out in summer and retains the heat in winter).

### SITE, LOCATION, ORIENTATION AND LAYOUT.

The site should be planned so that the sun from the north east to the north west is available, preferably to the longitudinal axis of the block. This will mean that direct sunlight is available between 9.00am and 3.00pm on June 21st, the shortest day of the year in the southern hemisphere.

The living zones (family, living, play rooms) should be located on the northern side. Bedrooms can be on the southern side and utility and store rooms on the southern or western side.

### PASSIVE SOLAR DESIGNS.

Clever design means that the house will trap heat in winter, and shading and breezes will keep the house cool in summer. This means that the house will be more comfortable and the homeowner can reduce the amount spent on heating and cooling the house.

**Thermal Mass:** On a warm day a full brick house is cool inside in the morning and by evening it is warm inside. This is because materials such as brick, concrete, stone and earth take a long time to heat up and a long time to cool down. They have a high thermal mass. In winter, the sun should shine into the house so that the heavy materials can absorb the heat from the sun. In the evening this material will slowly give off heat. In summer it will absorb excess heat during the day to reduce overheating and release it during the night when the temperature is cooler. A concrete slab floor surfaced with dark coloured tiles is most effective. Carpet or other insulating materials on the concrete slab prevent the floor from absorbing heat. Thermal mass can also be provided by walls and fireplaces.

**Shading Eaves:** In summer the sun is high in the sky and it should be prevented from shining through the windows. On the northern side the eaves' overhang needs to be about 65° above horizontal. This is measured from the lowest point on the window glass to the outside edge of the guttering. The winter sun will still shine in the windows since it is much lower in the sky in winter but the high summer sun will be blocked out. East and west facing windows need to be kept to a minimum and fitted with external shading for summer. Trees and shrubs can also be used to shade windows but for the northern windows they need to be deciduous.

**Wall and Roof Colour:** It is better to have a light colour for both roof and external walls since dark colours absorb a lot of summer heat.

**Ventilation:** Air movement is needed in summer to provide fresh air and to cool the house interior. Windows and doors need to be designed to take advantage of prevailing wind direction. Openings in rooms are best placed in opposite walls to create effective cross ventilation. This will take advantage of daytime breezes and allow the house to cool down for the next day.

**Zoning the House:** In winter it is important to create zones in the house, as not every area will need heating. This means that a zone can be open plan, for example, kitchen and family room but it needs to be separated from other zones (bedrooms and formal rooms) by doors.

## THERMAL INTEGRITY.

Another important aim of Energy Smart Design is to stop heat escaping in winter and stop heat coming into the house in summer. This 'tightness' of the building is called its thermal integrity. A high thermal integrity of the house can be achieved by using CSR Bradford Insulation as detailed throughout this Building Design Guide.

**Seals:** Draught stoppers need to be fitted to doors, and weather seals to windows. Without seals the comfortable conditions within the house can be lost.

**Windows:** A lot of heat can escape through windows. Single glass windows without curtains or blinds have an R-value of only R0.17 and are a significant cause of heat loss. Heat losses can be reduced by fitting heavy curtains or blinds close to the wall. A box pelmet will further reduce heat losses. Double glazing will reduce heat loss by 50% compared to single glass, and greatly reduce noise. It is particularly appropriate in houses which are occupied and heated during the day when curtains will not be drawn.

## Energy Conservation in Commercial Buildings.

It is possible to calculate the optimum thermal resistance, and hence the optimum amount of insulation for the building envelope, on the basis of life cycle costs. This will ensure that the building remains 'energy efficient' for its projected life. One of the costs which is taken into account in the calculation of optimum thermal resistance is 'installed' cost of the insulation system. Since this is generally lower for insulation installed during construction than when installed later insulation should be carefully considered during the design phase, and an appropriate system installed during construction.

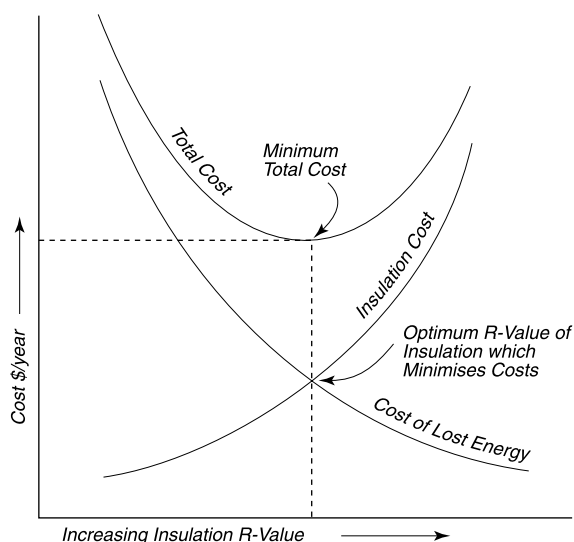
The insulation system for the roof is typically installed immediately below the roof cladding. This will increase thermal resistance, provide condensation control, aid with reverberation noise control and reduce sound transmission caused by rain and airborne sound.

For buildings which are heated or air conditioned, consideration should also be given to an insulation system which is suspended below the roof. This reduces the volume of air to be heated and cooled at the required rate of air change, or ventilation, and so reduces the energy consumed for temperature control.

Buildings which are neither heated nor air conditioned will also benefit from insulation. The temperature profiles of the interior space will be flatter than for the exterior. Given a desired ambient internal temperature requirement the optimum thermal resistance can also be calculated by computer programmes provided by Bradford. Where natural ventilation is used to attain comfortable working conditions the installation of adequate insulation will contribute significantly to its effectiveness.

The determination of what is 'adequate' insulation will vary depending on a number of factors including a building's usage, location, orientation and materials used in construction. The following base levels of insulation can be used as a guide for buildings incorporating Metal Deck roofs and/or walls.

FIG 2. ECONOMIC THICKNESS OF INSULATION.



### Optimum Thermal Resistance of Insulation.

The optimum thermal insulation is calculated by balancing the initial installed cost of the insulation with the ongoing energy savings over the life of the project. At this point, total costs are minimised.



**TABLE 6.**  
**RECOMMENDED INSULATION**  
**R-VALUES FOR COMMERCIAL**  
**APPLICATIONS.**

Location	Ceiling	Walls
<b>Australia</b>		
Adelaide	R2.0	R1.5
Brisbane	R1.5	R1.5
Canberra	R2.5	R2.0
Darwin	R2.5	R2.0
Hobart	R2.5	R2.0
Melbourne	R2.5	R1.5
Perth	R2.0	R1.5
Sydney	R1.5	R1.5
New Zealand	R2.5	R2.0
<b>Asia</b>		
China	R2.5	R2.0
Singapore	R2.5	R2.0
Thailand	R2.5	R2.0
Indonesia	R2.5	R2.0
Taiwan	R2.5	R2.0
Malaysia	R2.5	R2.0

## Effects of Solar Radiation.

Heat can be transferred through the building envelope in three ways;

- Radiation, caused by solar radiation incident on a building
- Conduction, due to temperature differentials outside and inside a building
- Convection, heat transfer from air movement through a building

Solar radiation contributes significantly to the total heat gain experienced in a building. Analysis of the spectral distribution of the energy flow from solar radiation shows that:

- 46% of solar radiation is in the visible range
- 47% is in near infra-red and
- 7% is in the ultra-violet

### THEORETICAL EXCESS TEMPERATURE OVER SHADE AIR TEMPERATURE.

Solar radiation absorbed by a material will cause the material to attain a temperature in excess of that of the air close to it. The maximum excess (°C) that is theoretically possible at the surface of the material can be assessed from the equation:

$$\text{Excess temperature} = \frac{\alpha I}{2k}$$

where:

$\alpha$  = surface absorption coefficient (Table 8)

$k$  = surface coefficient. (This coefficient has a value of approximately 50 to 70 kJ/m<sup>2</sup> for surfaces exposed to light to moderate breezes respectively)

$I$  = intensity of solar radiation. (The value of  $I$  varies with the elevation of the sun and other factors, but representative maximum values are 3500 for horizontal surfaces and 2500 for vertical surfaces, both expressed as kJ/m<sup>2</sup>/h).

Actual temperatures attained will usually be substantially less than those computed, because the simplified formula makes no allowance for heat that is conducted inwards from the surface of the material in service, or for the roughness of the material, which affects the loss of heat to the air. In practice, walls of dwellings might attain a temperature of 55°C while sunlit, and pitched roofs might heat to about 65°C during hot summer days when the dry bulb temperature of the air is about 33°C to 43°C. Thus, the rate of flow of heat into a dwelling which is proportional to the temperature differences prevailing, can be increased several times when walls are sunlit. The principal effects are twofold: firstly, the temperatures of internal surfaces will rise, and secondly, heat will be transferred to the air in contact with them.

### WINDOW EFFECTS.

Windows are a good conductor of heat and therefore can be a primary source of heat gain into a building. Limiting the heat gain from solar radiation into buildings through windows is a fundamental method of improving a building's thermal efficiency.

The shading coefficient shown in Table 7 is a measure of the effectiveness of shading devices such as blinds and louvres in reducing solar heat transmittance. The correct design and use of shading devices is essential to get the maximum benefit from wall and roof insulation in buildings.

**TABLE 7. EFFECTIVENESS OF WINDOW  
SHADING DEVICES.**

Type of shading device	Transmission compared with unshaded window
Internal curtains	80 to 90%
Internal roller blinds, fully drawn★	40 to 80%
Internal venetian blind, slats at 45°	45 to 75%
External canvas awning	25 to 30%
External louvred blind or shutter	15 to 20%

★ Transmission increases as the colour of the blind darkens.

**TABLE 8. ABSORPTIVITY TO SOLAR RADIATION OF VARIOUS BUILDING MATERIALS.**

Material	Absorptivity
Aluminium paint	0.18
Aluminium (dull)	0.55
Asphalt	0.86
Black cellulose lacquer	0.94
Blue vitreous enamel on steel	0.80
Brickwork, buff)	0.55
Brickwork, cream	0.36
Brickwork, red common and unglazed facing brick	0.68
Brickwork, red facing (glazed)	0.77
Brickwork, Stafford blue	0.89
Brickwork, glazed white	0.26
Brickwork, light fawn stock	0.57
Brickwork, lime clay	0.46
Brown cellulose lacquer	0.79
Clay, dark	0.82
Concrete	0.65
Fibre cement (new)	0.45
Fibre cement (old)	0.75
Fibre cement (old and dirty)	0.83
Galvanised Steel (dull)	0.55
Galvanised/Zincalume Steel Roof (white)	0.40
Galvanised/Zincalume Steel Roof (red/brown)	0.75
Glass	0.83
Granite	0.55
Gravel	0.29
Light yellow oil paint	0.45
Limestone	0.53
Marble (white)	0.44
Mortar	0.73
Roofing felt, bituminised	0.88
Sand	0.76
Slate (dark grey)	0.90
Tiles (red)	0.60
Timber (smooth planed)	0.78
Tinplate	0.05
White cellulose lacquer	0.12
White vitreous enamel on steel	0.63
Whitewash on top of galvanised steel	0.21
Zinc oxide oil paint	0.30

## Condensation Control

Atmospheric water vapour will condense when it, or the air containing it, comes in contact with a surface at or below the dew point. The dew point is the temperature at which the water vapour reaches saturation, or 100% relative humidity. Condensation becomes a problem when it occurs either:

- On interior surfaces of walls, ceilings, windows, etc.
- On the interior of building cavities, in roof or attic spaces etc.

The consequences of condensation vary with its severity and other factors, but include:

- Staining of painted surfaces by dust, mould and mildew;
- Corrosion of fixing screws, cladding or structural steels;
- Rotting of timber;
- Water damage to stock and equipment.

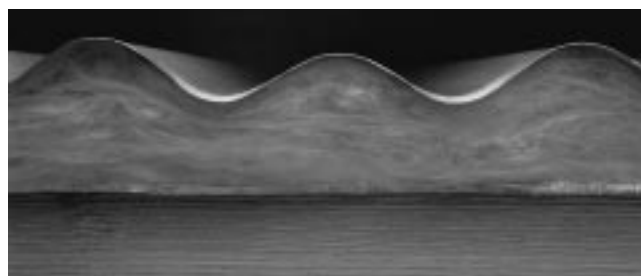
The short or long term costs of damage caused by condensation justify consideration of means of avoiding it.

Suitable ventilation will assist in controlling water vapour (humidity) within a building but cannot be solely relied upon to protect against condensation. The solution to the problem is ensuring that air within the building cannot come into contact with a cold surface where the water vapour will condense. Therefore, condensation on interior surfaces may be avoided by controlling the temperature of interior surfaces.

This can be achieved by the proper use of an appropriate and adequate insulation system such as Bradford Anticon Roofing Blanket. The system incorporates a bulk glasswool or rockwool insulation which raises the temperature of the surface to above the dew point temperature, and a Bradford Thermofoil vapour barrier facing installed on the warm side of the insulation, which will ensure the water vapour cannot penetrate the insulation system.

The occurrence of condensation is dependant on the relative humidity of the inside air and the surface temperature of the vapour barrier.

**FIG 3. BRADFORD ANTICON™ UNDER METAL DECK ROOFING.**



## VAPOUR BARRIERS.

The vapour barrier system should have a permeance no more than 0.1 perm as determined by ASTM E-96-53T (dry cup) or ASTM C355 59T (dry cup) where little or no ventilation of the space on the 'cold' side of the cavity can be predicted.

For building elements such as walls, roof/ceiling etc. the vapour barriers should be continuous and should be installed on the 'warm' side of the insulation. In tropical regions the direction of the vapour pressure is reversed and therefore a vapour barrier is placed on the outside of the building.

In addition there should be no membrane (such as external cladding) on the 'cold' side of the vapour barrier/insulation system, which has a lower permeance than the vapour barrier itself.

Reference should be made to manufacturers literature for the permeance data for the vapour barrier systems under consideration.

## RELATIVE HUMIDITY.

Under normal circumstances air is not saturated with water. Rather a certain percentage only of the maximum possible humidity is contained in air. This percentage is called the relative humidity.

$$\text{relative humidity} = \frac{\text{humidity content}}{\text{max. possible humidity content (at saturation)}} \times 100$$

## TEMPERATURE CALCULATIONS.

When considering condensation control, it is necessary to calculate the temperature of the internal wall or ceiling surface when the outside temperature is

at the lowest level anticipated. The appropriate formula is:

$$t_s = t_i - QR_{si} \\ = t_i - \frac{Q}{f_i}$$

where

$t_s$  = internal surface temperature (°C)

$t_i$  = inside air temperature (°C)

$Q$  = calculated heat flow per square metre per second (W/m<sup>2</sup>)

$R_{si}$  = resistance on inside air film (m<sup>2</sup> K/W)

$f_i$  = inside surface heat transfer coefficient (W/m<sup>2</sup>K)

If the internal surface temperature calculated in this manner is less than the anticipated dew point temperature, there is a risk of condensation forming on the surface. This can promote mould growth and the accumulation of dust and stains, and lead to the eventual breakdown of paint and paper finishes.

It is therefore recommended that sufficient insulation material be added to raise the surface temperature of the wall or ceiling above the dew point. Under cold conditions, the use of a vapour barrier should be considered. This is located immediately behind the facing sheet with the objective of preventing the migration of moisture vapour from within the living space into the wall and ceiling cavities. If this happens, the thermal resistance of the insulation can be seriously reduced and structural damage can result.

Table 9 can be used as a guide in establishing the lowest anticipated dew point temperature. It lists the dew point temperatures for a range of inside air temperatures and relative humidities.

**TABLE 9. DEW POINT TEMPERATURE °C.**

Using the appropriate formula for condensation control the calculated temperature can be compared against Dew Point Temperatures in Table 9. This table lists the dew point temperatures for a range of inside air temperatures and relative humidities.

Ambient Air Temperature (Dry Bulb) °C	Relative Humidity, Percent (R.H.%)							
	20	30	40	50	60	70	80	90
5	-14.4	-9.9	-6.6	-4.0	-1.8	0	1.9	3.5
10	-10.5	-5.9	-2.5	0.1	2.7	4.8	6.7	8.4
15	-6.7	-2.0	1.7	4.8	7.4	9.7	11.6	13.4
20	-3.0	2.1	6.2	9.4	12.1	14.5	16.5	18.3
25	0.9	6.6	10.8	14.1	16.9	19.3	21.4	23.3
30	5.1	11.0	15.3	18.8	21.7	24.1	26.3	28.3
35	9.4	15.5	19.9	23.5	26.5	29.0	31.2	33.2
40	13.7	20.0	24.6	28.2	31.3	33.9	36.1	38.2



Bradford Thermofoil has an extremely low moisture permeability. This property makes it the ideal product to place under Glasswool Blanket to prevent moisture entering insulation installed under a metal deck roof and causing condensation under severe conditions.

The vapour barrier properties of Bradford Thermofoil can be used in brick veneer walls in cold areas where foil can be used next to Gyprock Plasterboard or over lining material materials on cathedral ceilings.

For information on the different performance characteristics of the Bradford Thermofoil range, consult the Bradford Thermofoil Data Bulletin.

## Sound Control.

Bradford Glasswool and Rockwool Insulation can be used to effectively control sound in residential and commercial buildings.

The objectives of sound control may be considered in the categories:

### Noise Control -

concerned with the quantity of noise.

### Room Acoustics -

concerned with the quality of noise.

### Speech Privacy -

concerned with the confidentiality of conversations.

## NOISE CONTROL.

Noise is, by definition, unwanted sound. It may be unwanted because it is damaging, dangerous, annoying, or detracts from wanted sounds.

Noise can have a detrimental affect on conversation and communication, particularly where telephones are concerned. This can result in misunderstandings with subsequent work inefficiencies. Difficulty in communicating also causes annoyance which interferes with concentration.

Annoyance tends to be a subjective response. Accepted sounds of quite high levels do not cause annoyance, while unwanted sound of a much lower level can evoke strong annoyance. Nowhere is this more apparent than in the performing arts. Very low levels of intrusive noise have a very marked effect on the enjoyment of listeners.

The desired noise levels will depend on what activity is being conducted. While legislation sets noise limits for industrial exposure, it is left to the architect or consultant to set appropriate noise levels for other premises. A guide to suitable background sound levels

is given in Table 10. A more comprehensive list of recommendations is given in AS2107-1987 : Acoustics - Recommended design sound levels and reverberation times for building interiors.

Glasswool and rockwool insulation provide excellent reduction in sound transmission levels when used in ceilings, external walls and internal partition systems.

For residential buildings and hotels, the Building Code of Australia details minimum sound transmission class (STC or  $R_w$ ) requirements for walls and floors between dwellings.

For additional information on controlling noise and the selection of acoustic insulation products, please refer to the Bradford Insulation Acoustic Design Guide.

**TABLE 10. RECOMMEND DESIGN SOUND LEVELS.**

Type of Activity	Recommended Ambient Sound Level (dB(A))
Board and conference rooms	30-35
Computer rooms	45-55
General office areas	40-45
Private offices	35-40
Small retail stores	45-50
Supermarkets	50-55
Hotel lounges	45-55
Libraries - reading areas	40-45
Restaurants	40-45
Airport lounges	45-60
Places of worship	30-35
Court rooms	25-30
Surgery and consulting rooms	40-45
Hospital wards	30-40
Classrooms	35-40
Laboratories - Teaching	35-40
Laboratories - Working	40-50
Lecture theatres - up to 250 seats	30-35
Lecture theatres - more than 250 seats	25-30
Bowling alleys	50-55
Squash courts	50-55

## ROOM ACOUSTICS.

The room acoustics objective is to create a suitable acoustic environment for the activity being conducted in any particular room.

Of prime importance here is the reverberation time. Rooms used for different purposes need different reverberation times. Churches, concert halls and music studios may require reverberation times of up to 2 or 3 seconds, while for broadcasting studios and open plan offices appropriate reverberation times may be below 0.5 seconds.

Room volume also affects the optimum reverberation time. Sound decays more slowly in large rooms than in small rooms. Modifying a large room to reduce its reverberation time to that of a small room used for the same purpose will often result in a deadening of the acoustic environment. This is particularly relevant for concert halls and theatres.

Glasswool and rockwool insulation materials provide excellent sound absorption, and when installed behind an acoustically transparent lining will significantly reduce reverberant sound.

## SPEECH PRIVACY.

The need to preserve confidentiality of conversation arises in many situations. Discussions in conference rooms and executive offices should not be overheard. People waiting in airport lounges or hotel lobbies wish to converse freely. Intimate diners do not wish to share their conversation with the rest of the restaurant. In residential situations where walls or floors abut adjoining residences the need for acoustical privacy is paramount. Bedrooms in one residence need to be acoustically isolated from rooms in other residences to avoid irritation to residents. Similarly impact noise on polished floor-boards can irritate people in rooms below.

The level of speech privacy required will depend on the particular situation. Three categories may be considered:

1. Partial coherence – small portions of the conversation may be intelligible to an uninvolved listener, but he/she will not be able to follow the conversation as a whole,
2. Incoherent – an uninvolved listener can hear the sound of conversation but it is not intelligible,
3. Inaudibility – no sound whatever can be heard by an uninvolved listener.

Speech privacy is a two-way consideration. It may be required to protect the confidentiality of conversation or, on the other hand, to avoid distraction of uninvolved listeners.

Modern buildings are typically constructed from lightweight materials which individually can have poor noise reduction properties, so achieving adequate acoustic performance often requires a systems approach. This includes consideration of covering materials, cavity insulation, structural isolation and control of flanking noise.

For further information on acoustic insulation products and systems please refer to the Bradford Insulation Acoustic Design Guide.

## Fire Protection.

The two main aspects of fire in buildings are:

- Early Fire Hazards
- Fire Resistance

## FIRE INDICES.

Early Fire Hazard relates to the behaviour of materials in the early stages of fire. The objectives of both Fire Resistance and Early Fire Hazards are:

- to ensure as much time as possible for occupants to leave the premises and for fire fighting personnel to deal with the situation;
- to minimise the spread of the fire and the amount of smoke generated.

Australian Standards AS1530 : Part 3 – Early Fire Hazard Indices – provides a standard testing procedure to measure.

- ignitability
- spread of flame
- heat evolved
- smoke developed

Ignitability is rated on a scale of 0-20 while the other factors are rated from 0-10. The lower the number the smaller the risk. Both glasswool and rockwool are made from incombustible natural materials and will not contribute to the propagation of fire, achieving the best possible result when tested to AS1530.3. Table 11 shows some typical Early Fire Indices for various glasswool and rockwool insulation products.

**TABLE 11.**  
**EARLY FIRE HAZARD INDICES.**

	Ignitability (0-20)	Spread of Flame (0-10)	Heat Evolved (0-10)	Smoke (0-10)
Bradford Glasswool Ceiling Batts	0	0	0	0
Bradford Rockwool Ceiling Batts	0	0	0	0
Bradford Glasswool Anticon Blanket	0	0	0	0
Bradford Glasswool Building Blanket	0	0	0	0
Bradford Rockwool Building Blanket	0	0	0	0
Bradford Rockwool Granulated	0	0	0	0
Bradford Glasswool Wall Batts	0	0	0	0
Bradford Rockwool Wall Batts	0	0	0	0

## FIRE RESISTANCE.

Bradford Glasswool and Rockwool Insulation products are made from incombustible natural materials with excellent fire performance. They will not contribute to the propagation of a fire, nor affect the established fire resistance level of fire rated wall, ceiling, floor or roofing systems.

Bradford Rockwool Fireseal products are purpose designed rockwool suitable for sealing gaps in construction where smoke or fire may penetrate. Common applications include the top perimeter of party walls between houses and isolation between building levels in curtain wall applications. Bradford Rockwool Fireseal products can provide fire resistance levels of up to 4 hours.

Bradford Fireseal Damper Strips or Fireseal Loose are used as an incombustible insulation around metal ductwork or other services at penetrations in fire rated walls and ceilings.

Bradford Fireseal Curtain Wall Systems using Bradford Spanseal™ board can achieve up to a 2 hour fire rating for vertical fire separation in multi-story buildings.

For additional information on fire protection insulation product and systems, please refer to the Bradford Insulation Fire Protection Design Guide, and the Bradford Insulation Fireseal Curtain Wall Systems brochure.

## Building Sarking.

Bradford Thermofoil and Thermotuff range of Reflective Foil Laminates are available in three grades, light, medium and heavy. All grades are flame retardant and comply to all requirements of Australian Standard AS4200-1: 1994 for foil laminates.

**FIG 4. CSR BRADFORD THERMOTUFF™**  
**LIGHT DUTY ON TIMBER FRAMING.**



## ROOF SARKING.

Bradford Medium Duty Thermofoil and Thermotuff Foil are used extensively as sarking materials under the tile roof to protect the inside of the structure from water damage in the event of broken or dislodged tiles. Thermofoil sarking products are also of assistance in preventing 'tile lift' in high wind areas.

## WALL WRAP FOR TIMBER FRAMING.

Bradford Thermotuff Light Duty consists of a durable, tear resistant high strength woven plastic fabric laminated to aluminium foil. It is ideally suited to high wind areas where foil may be in place for up to two months before the external cladding is installed. An installed thermal resistance of R1.3 is achieved installing Thermotuff Wall Wrap around timber framing of brick veneer construction.

Some constructions require the use of products that allow moisture to permeate through themselves and thus avoid condensation potential in cold climatic areas.

Bradford Breather Foil 799 or Thermotuff Light Duty Breather Grade should be used on the outside of timber frames for brick veneer constructions to limit the potential for condensation in walls. This is also applicable for fibre cement or Weathertex™ cladding.

In the case of timber sided homes, Thermokraft Building Paper should be used next to the timber in order to avoid timber cupping or blow-outs.

## **RADIANT THERMAL BARRIER.**

Bradford Thermofoil products have been designed specifically for use as radiant barriers in domestic cavity walls and roofs. They perform best in summer when the reflective surface is close to horizontal and heat flow is downwards. They are also effective in cavity walls which have limited space for bulk insulation. Thermofoil relies on trapping a reflective airspace so they work best in still air or when they enclose an air cavity of at least 20mm thickness.

The ability to ensure a practical degree of reflective airspace performance depends to a large extent on the durability and ruggedness of the foil product.

The presence of tears or breaks in reflective foil severely reduces their usefulness as insulants and as barriers to prevent moisture migration.

## **Environmental Design.**

Bradford is committed to producing ecologically sustainable materials for the long term benefit of the environment.

Bradford Glasswool and Bradford Fibertex Rockwool products are manufactured using highly abundant, naturally occurring raw material including a significant proportion of recycled matter. The molten mixtures are spun into fibres and bonded together with organic resin.

Bradford's world leading plant technologists have developed the latest advancements in manufacturing processes to meet the most stringent government environmental regulations.

Utilising world's best energy efficiency practice ensures the embodied energy in all Bradford Glasswool and Bradford Fibertex Rockwool products is minimal. This energy conservation also contains plant emission levels and helps achieving greenhouse gas commitments.

## **Durability.**

Bradford Glasswool and Bradford Fibertex Rockwool insulation materials are made from durable fibres which are unaffected by their exposure in the building environment. They will perform efficiently without deterioration or need of maintenance for the life of the building.

Unlike some alternative insulation materials, Bradford Glasswool and Bradford Fibertex Rockwool will not settle after they are installed. This is essential for insulation as the thermal resistance is dependant on the products retaining the installed thickness throughout its life. Also, because Bradford Insulation products are made from inorganic materials, they will not support fungus growth or sustain vermin.

Bradford Thermofoil aluminium foil laminates have excellent physical properties such as tensile strength and puncture resistance.

## **Installation.**

In order that the benefits of insulation may be realised most cost effectively, its inclusion in the building should be considered from the initial design stage. This is essential to ensure that the installation of the insulation is scheduled for the most appropriate stage of the construction program.

Consideration should be given to ensuring adequate accessibility to all areas requiring insulation to be installed and to minimise interference with other trades during building construction. In applications such as wall or under roof insulation, access for installation is only available during construction. Correct insulation specification and planning will prevent costly retrofitting of insulation to overcome thermal and acoustic problems encountered in the building once occupied.

To guarantee maximum in-situ performance of an insulation system it is important to ensure the insulation is installed in accordance with the manufacturers recommendations. Refer to the Systems Specification in this guide for detailed installation guidelines or consult the Bradford Insulation office in your region.

## **Health & Safety.**

Bradford Fibertex™ Rockwool and Bradford Glasswool products have been widely used in industry for several generations. There is no evidence to demonstrate any long term health effects from these products when used in accordance with the simple procedures of the Australian National WorkSafe Standard and Code of Practice for the Safe Use of Synthetic Mineral Fibres (1990, Reprinted with Amendments 1994).

Full health and safety information is provided in the Bradford Material Safety Data Sheets.



# Design Calculations.

## Thermal and Condensation Control.

### Example 1:

A proposed factory building is to have a low pitched metal deck roof insulation with 55mm thickness of Bradford Glasswool or Bradford Fibertex Rockwool building blanket with a vapour barrier of aluminium foil laminate on the underside. All components are to be in close contact. Calculate the thermal resistance and transmittance of the proposed system for winter conditions.

The individual resistances are summed as follows:

Outside air surface, $R_{so}$	: 0.03
Metal Deck	: Negligible
Glasswool blanket	: 1.30
Inside air surface (reflective, $R_{si}$ )	: 0.20
Total Resistance, $R$	: $1.53 \text{ m}^2 \text{ K/W}$

$$\text{Transmittance, } U = \frac{1}{R} : 0.65 \text{ W/m}^2\text{K}$$

### Example 2:

Determine whether condensation will occur in the assembly of Example 1, assuming winter conditions with an outside air temperature of  $0^\circ\text{C}$  and an inside atmosphere of  $20^\circ\text{C}$  temperature and relative humidity up to 90%.

Heat flow:

$$\begin{aligned} Q &= U(t_i - t_o) \\ &= 0.65 (20 - 0) \\ &= 13.0 \text{ W/m}^2 \end{aligned}$$

The rate of heat flow is the same through all resistances. Therefore:

$$Q = \frac{t_i - t_h}{R_{si}}$$

Where  $t_h$  is the temperature on the warm (internal) side, and  $R_{si}$  is the inside surface resistance.

$$\text{ie. } = \frac{20 - t_h}{0.20}$$

from which  $t_h = 17.4^\circ\text{C}$

Referring now to Table 9, air at  $20^\circ\text{C}$  and 90% R.H. has a dew point of  $18.3^\circ\text{C}$ .

Therefore, there is some risk of condensation occurring under these conditions and the thickness of the insulation blanket should be increased to 75mm as a safeguard. This will increase the thermal resistance of the insulation to  $1.8 \text{ m}^2\text{K/W}$ .

The new values for total resistance and transmittance now become:

$$R = 2.03 \text{ m}^2\text{K/W}$$

$$U = 0.49 \text{ W/m}^2\text{K}$$

Recalculating the heat flow and inside surface temperatures as before gives:

$$Q = 9.8 \text{ W/m}^2\text{K}$$

$$t_h = 18.0^\circ\text{C}$$

This is the above dew point for the worst anticipated inside atmosphere conditions and condensation should not occur.

### Example 3:

The walls of a proposed air conditioned process building are to achieve a  $U$  value less than  $0.6 \text{ W/m}^2\text{K}$  (summer conditions). The outside wall cladding and internal wall lining will both be metal. What thickness of Bradford Glasswool and Bradford Fibertex Rockwool blanket will be necessary to achieve the desired  $U$  value, assuming one airspace in the assembly?

The minimal total Resistance required,

$$\begin{aligned} R &= \frac{1}{0.6} \\ &= 1.67 \text{ m}^2\text{K/W} \end{aligned}$$

The sum of resistances without insulation are:

Outside surface, $R_o$	: 0.04
Metal cladding	: Negligible
Air space	: 0.15
Metal lining	: Negligible
Inside surface, $R_i$	: 0.12
Overall Resistance without insulation	: $0.31 \text{ m}^2\text{K/W}$

Therefore the minimum resistance required from the batt insulation =  $1.36 \text{ m}^2\text{K/W}$ .

The thermal resistance of an R1.5 Bradford Fibertex Rockwool or R1.5 Bradford Glasswool blanket is  $1.5 \text{ m}^2\text{K/W}$ .

Thus an R1.5 value blanket will be necessary to achieve a  $U$  value of  $0.6 \text{ W/m}^2\text{K}$ .

# System Specifications.

These samples are supplied to assist you in preparing your project specifications. Select or insert the required data where words are shown in *italic font* to prepare appropriate specifications.

## APPLICATIONS DETAILED.

- Metal Deck Roof.
- External Walls – Commercial and Industrial Buildings.
- Internal Partitions – Framed Construction.
- Suspended Concrete Slab.
- Commercial Ceiling.
- Curtain Walls
- Party Wall Fire Protection.
- Timber Floor and Floor/Ceiling Systems.
- External Wall (Brick Veneer/Weatherboard).
- Pitched Roof/Raked Ceiling.
- Pitched Roof/Horizontal Ceiling.
- Thermofoil Installation to Timber Studs.
- Thermofoil Under Tiled Roof.
- Thermofoil Under Metal Roofing.

## Metal Deck Roof.

1. The insulation material shall be *Glasswool or Fibertex™ Rockwool Anticon™ R1.5, R2.0, R2.5 or Glasswool Acousticon™* as manufactured by CSR Bradford Insulation.
2. The insulation material shall be dry when installed and shall be kept dry.
3. a) **For timber purlins up to 900mm centres:**  
The insulation material shall be rolled out over the purlins allowing an even sag between them to provide sufficient space for the thickness of the insulation. Ensure that adjacent edges are tightly butted together. Foil facing shall be on the under side for cold and temperate climates, or on the upper side for tropical climates.

### Where maximum resistance to the penetration of water vapour is required – add:

The 150mm wide foil overlap shall be sealed to the underside of the foil on the adjacent insulation by means of an approved contact adhesive or vapour impermeable pressure sensitive tape, applied in accordance with the manufacturer's recommendations.

### b) For steel purlins, and for timber purlins above 900mm centres:

Install wire safety mesh across the purlins. The wire shall be dished in accordance with the following:

- R1.5 – dish minimum 55mm
- R2.0 – dish minimum 75mm
- R2.5 – dish minimum 95mm

and sufficient to accommodate the insulation

allowing it to perform to the specified value of the insulation. The edge wires of adjacent runs shall be twitched together at approximately 450mm centres.

4. The insulation material shall be rolled out over the wire mesh, ensuring that adjacent edges are tightly butted together. Foil facing shall be on the under side for cold and temperate climates, or on the upper side for tropical climates.

### Where maximum resistance to penetration of water vapour is required – add:

The 150mm wide foil overlap shall be sealed to the underside of the foil on the adjacent insulation by means of an approved contact adhesive or vapour impermeable pressure sensitive tape applied in accordance with the manufacturers recommendations.

**TABLE 12. RECOMMENDED INSULATION R-VALUES FOR COMMERCIAL APPLICATIONS.**

Location	Ceiling	Walls
Australia		
Adelaide	R2.0	R1.5
Brisbane	R1.5	R1.5
Canberra	R2.5	R2.0
Darwin	R2.5	R2.0
Hobart	R2.5	R2.0
Melbourne	R2.5	R1.5
Perth	R2.0	R1.5
Sydney	R1.5	R1.5
New Zealand	R2.5	2.0
Asia		
China	R2.5	R2.0
Singapore	R2.5	R2.0
Thailand	R2.5	R2.0
Indonesia	R2.5	R2.0
Taiwan	R2.5	R2.0
Malaysia	R2.5	R2.0

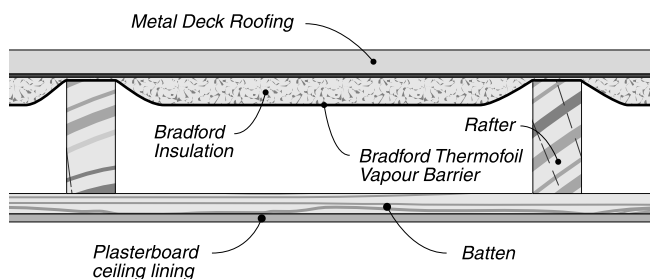
## INSULATION/PROFILE MATCHING.

Most profiles have been installed with all R. Values of Anticon™, without distortion of the roof line. Refer to Table 13 for a guide to fixing screw length or refer to the Metal Deck manufacturer for further information.

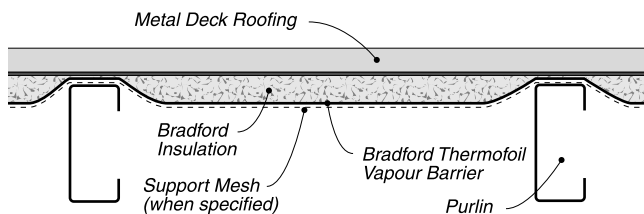
If Klip-Lok™ is to be specified with R2.5 Glasswool Anticon™, the use of a roofing spacer such as Bradford ThermoDeck™ is recommended, subject to engineer's agreement, to allow for recovery of the insulation and ensure roof profile is even.

For surfaces where premium resistance to mechanical damage is required, specify *Anticon™ R1.5, R2.0 or R2.5, incorporating Heavy Duty 750 Thermofoil™*.

**FIG 5.**  
**FLAT METAL DECK WITH CEILING LINING.**



**FIG 6.**  
**FLAT METAL DECK WITH NO CEILING LINING.**



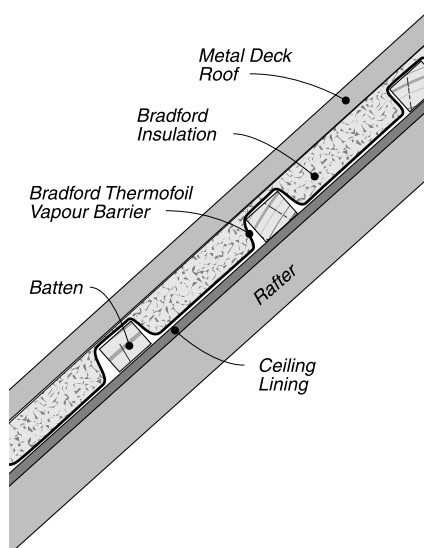
**TABLE 13. BRADFORD ANTICON™ ROOF SCREW LENGTHS REQUIRED FOR FIXING METAL DECK ROOFING.**

	R Value	Purlin T=Timber S=Steel	Custom orb 16mm rib with Insulation	Trimdek Hi-Ten 29mm rib with Insulation	Klip-Lok Hi-Ten 41mm rib with Insulation
Fibertex™ Rockwool ANTICON™	1.5	T	12-11* x 65mm Type 17	12-11* x 65mm Type 17	*14 x 75mm Type 17
		S	12-14* x 65mm Tek	12-14* x 65mm	12* x 75mm Tek
Glasswool ANTICON™	1.5	T	12-11 x 50mm Type 17	12-11 x 50mm Type 17	10-12 x 25mm Type 17
		S	12-14 x 45mm Tek	12-14 x 55mm Tek	10-16 x 16mm Tek
Fibertex™ Rockwool ANTICON™	2.0	T	12-11* x 65mm Type 17	12-11* x 65mm Type 17	*14 x 75mm Type 17
		S	12-14* x 65mm Tek	12-14* x 65mm Tek	*12 x 75mm Tek
Glasswool ANTICON™ Glasswool ACOUSTICON™	2.0	T	12-11 x 65mm Type 17	12-11 x 55mm Type 17	10-12 x 45mm Type 17
		S	12-14 x 45mm Tek	12-14 x 55mm Tek	10-16 x 16mm Tek
Glasswool ANTICON™	2.5	T	14-11 x 65mm Type 17	14-11 x 55mm Type 17	10-12x 45mm Type 17
		S	12-14 x 45mm Tek	12-14 x 55mm Tek	10-16 x 22mm Tek

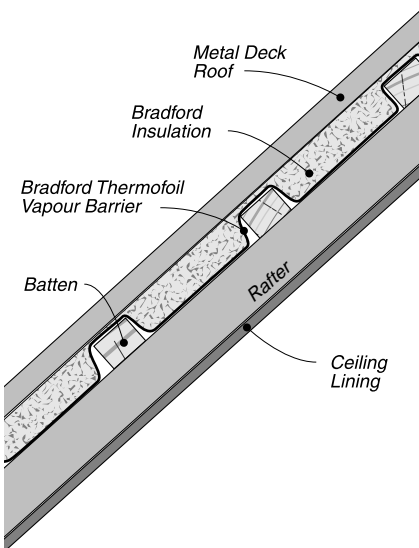
\* Subject to engineer's approval.

Note: The above table is to be used as a guide only.  
Custom orb™, Trimdeck™ and Klip-Lok™ are registered trademarks of BHP Building Products.

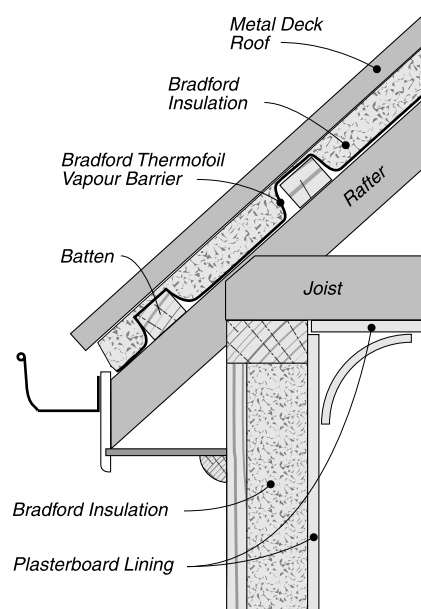
**FIG 7.**  
**METAL DECK WITH CATHEDRAL  
(OR RAKED) CEILING AND  
FULLY EXPOSED RAFTERS.**



**FIG 8.**  
**METAL DECK WITH CATHEDRAL  
(OR RAKED) CEILING AND  
FULLY ENCLOSED RAFTERS.**



**FIG 9.**  
**PITCHED METAL DECK WITH  
HORIZONTAL CEILING  
(NO INSULATION IN CEILING).**



NOTE: Foil Vapour Barrier shown facing down for cold and temperate climates. Foil to be placed facing up for tropical climates.

## External Wall – Commercial and Industrial Buildings.

### EXTERNAL WALLS.

1. The insulation shall be *Glasswool Anticon™ R1.5, R2.0, R2.5* as manufactured by CSR Bradford Insulation.
  - Where there is no internal lining add:  
*The Thermofoil™ vapour barrier shall be fully adhered to the Glasswool blanket.*
  - Where an architectural finish is required add:  
*The vapour barrier shall be Thermoplast™ 980 - white.*
  - Where a perforated foil is required for superior sound control replace with:  
*The facing shall be Thermofoil™ (750 - Heavy duty, Thermoplast™ 980 - White) Perforated Foil.*

NOTE: Perforated foil does not provide a suitable vapour barrier for condensation control requirements.
2. The insulation should be dry when installed and shall be kept dry.

#### For Metal Cladding

3. Galvanised woven wire netting (50mm opening) or approved support mesh shall be rolled out over the outside of the horizontal girts, with the long edge of the netting vertical. Allow sufficient slack in the netting to accommodate the thickness of the insulation. The edge of wires of adjacent runs shall be twitched together at approximately 450mm centres.
4. The insulation material shall be rolled out over the outside of the wire netting with all adjacent edges butted together. The Thermofoil™ vapour barrier shall face internally for cold and temperate climates, and externally for tropical climates. Where maximum protection is sought, the 150mm overlap shall be sealed to the facing of the adjacent insulation by means of an approved adhesive.
5. The ..... external cladding material shall be applied directly over the insulation and secured to the girts in accordance with the manufacturer's directions.

FIG 10.  
EXTERNAL WALL WITHOUT INTERNAL LINING.

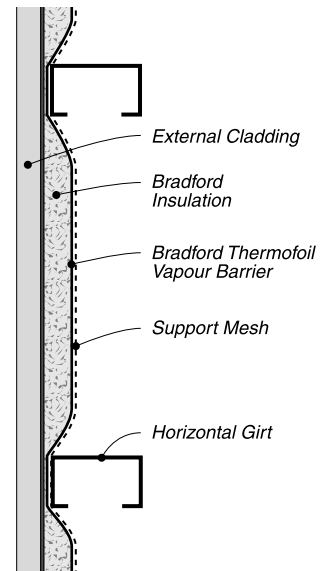
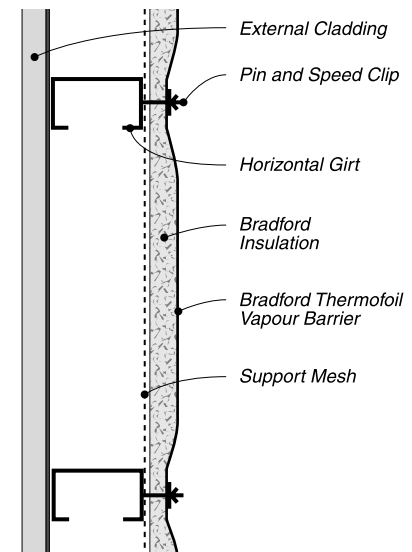


FIG 11.  
EXTERNAL WALL WITHOUT INTERNAL LINING  
(ALTERNATIVE METHOD).



#### For Brickwork and Concrete with Internal Metal Frame.

6. Steel pins no less than 3mm in diameter and 10mm longer than the specified thickness of the insulation, shall be welded to the horizontal girts at no greater than 450mm centres.
7. Galvanised woven wire netting (50mm opening) or approved support mesh shall be installed over the pins with the long edge of the netting vertical. The wire netting shall be tensioned vertically and the adjacent long edges shall be tied together with galvanised steel wire at no greater than 450mm centres.
8. The insulation shall be impaled over the pins, pushed flat against the wire netting, with all adjacent edges butted tightly together.

9. The insulation shall be retained in position by means of washers, 100mm square, of galvanised steel not less than 0.6mm thick, placed on the pins and secured by a galvanised speed clip.
10. The Thermofoil™ vapour barrier shall face internally for cold and temperate climates, and externally for tropical climates. Where maximum protection is required the 150mm overlap shall be sealed to the facing of the adjacent insulation by means of a pressure sensitive vapour impervious tape such as reinforced foil tape. The area over the fixing pins shall also be sealed by covering the area with 200mm square piece of foil and adhesive.

## Internal Partitions – Framed Construction.

1. The frame of the internal wall and one side of the Gyprock® plasterboard wall lining shall be constructed before the insulation can be installed.
2. The insulation shall be *Bradford Glasswool Partition Batts or Fibertex™ Rockwool Partition Batts* as manufactured by CSR Bradford Insulation.  
The insulation thickness shall be .....mm (*select based on the thickness of insulation necessary to achieve the required thermal and/or acoustic performance*).
3. Install the insulation by friction fitting it into the space between adjacent wall framing, ensuring that edges of insulation are butted tightly together.
4. Where it is necessary to cut the insulation, it shall be cut so as to be not less than 5mm oversize to ensure a good fit.
5. Once the insulation is in place the wall construction can be completed as normal with the Gyprock® plasterboard fixed to the frame as per manufacturer's recommendations.

## Suspended Concrete Slab.

Insulation installed on underside of slab

1. (a) If a suspended ceiling will be installed:
  - i) The insulation material shall be *Glasswool or Fibertex™ Rockwool R1.5, R2.0 or R2.5 building blanket* as manufactured by CSR Bradford Insulation.

### or when a vapour barrier is required

- ii) The insulation material shall be *Glasswool or Fibertex™ Rockwool Anticon™ R1.5, R2.0 or R2.5 blanket* as manufactured by CSR Bradford Insulation.

- (b) If no suspended ceiling will be installed and a board finish is required:

- i) The insulation material shall be *Glasswool Supertel™ board with a thickness of 50mm = R1.6, 75mm = R2.3, 100mm = R3.1 or Fibertex™ Rockwool* as manufactured by CSR Bradford Insulation.

### or when a vapour barrier is required

- ii) The insulation shall be *Glasswool Supertel™ board or Fibertex™ Rockwool 350* with a thickness of .....mm, faced on the underside with fire retardant *Thermofoil™* (*specify grade - light, medium or heavy*) with a 150mm overlap on the longitudinal edge as manufactured by CSR Bradford Insulation. Where maximum protection is required the foil overlap shall be sealed to the facing of the adjacent insulation by means of a pressure sensitive vapour impervious tape such as reinforced foil tape.
2. The insulation material shall be dry when installed, and shall be kept dry.
3. The soffit shall be cleaned of loose concrete, formwork, parting agents, and other protruding materials so as to provide a clean, dry surface free from contamination.
4. (a) An approved adhesive may be used to hold the insulation in place. Then a plastic insulation fastener (or metal where fire resistance is required) of the type: Hilti IDP, IN or IDMS (metal), or equal, shall be installed at no greater than 450mm centres in accordance with the manufacturer's recommendations.
- (b) Alternatively Hilti X-IE fasteners, or equal, shall be fixed by power fixing to the soffit, in accordance with the manufacturer's recommendations at no greater than 450mm centres.
5. Blanket and board insulation shall be butted at all joints to avoid gaps or voids.

### Where maximum protection against water vapour is required:

6. (a) The 150mm wide foil overlap shall be sealed to the underside of the foil of the adjacent insulation by means of an approved contact adhesive or vapour impermeable pressure sensitive tape applied in accordance with the manufacturer's recommendations.

- (b) The insulation fastener shall be covered by a piece of Thermofoil™ which shall be cut so as to surround the fastener by no less than 75mm on all sides. The covering piece shall be adhered to the underlaying Thermofoil™ surface by means of an approved contact adhesive or vapour impermeable pressure sensitive tape applied in accordance with the manufacturer's recommendations.

Note: In areas where moisture through the slab is a particular concern, such as in exposed condition or snow effected areas, waterproofing the slab is recommended. Contact the Bradford Insulation office in your region for alternative details.

## Commercial Ceilings.

### SUSPENDED EXPOSED GRID CEILING.

1. The ceiling shall consist of an exposed metal grid (*specify steel/aluminium, colour of exposed flange, manufacturer*) on a 1200mm x 600mm module supporting 13mm Gyprock® lay-in panels or similar. The suspension system and ceiling panels shall be installed in accordance with the manufacturer's recommendations, at a height as specified.
2. The insulation shall be Glasswool Ceiling Panel Overlays as manufactured by CSR Bradford Insulation.
3. The insulation thickness shall be 50mm = R1.2, 75mm = R1.8.
4. The insulation shall be installed over the ceiling panels progressively so that installation may be achieved by access through the adjacent spaces in the suspension grid. Care shall be taken to ensure that the insulation panels are tightly butted against each other.  
The insulation shall be dry when installed and shall be kept dry.
5. The insulation shall be cut to fit around sprinkler pipes. It shall be cut back from air conditioning diffusers and fluorescent lights. The insulation shall not be installed in contact with downlights mounted above the ceiling. A clearance not less than 25mm shall be provided around the light fitting unless otherwise approved by the light manufacturer. Similarly with ceiling fans and other appliances that may generate heat, a clearance not less than 25mm shall be allowed for the dispersal of heat.
6. The finished ceiling shall be clean and free from defects.

### SUSPENDED CONCEALED GRID CEILING:

1. The ceiling shall consist of a concealed metal grid (*specify steel/aluminium, manufacturer*) onto which 13mm sheets of Gyprock® plasterboard or similar are fixed and finished in accordance with the manufacturer's recommendations.
2. The insulation shall be Glasswool Building Blanket/ Rockwool Building Blanket/ Glasswool Ceiling Panel Overlays as manufactured by CSR Bradford Insulation.
3. The insulation shall have an R-value of R1.5, R2.0 or R2.5.  
The insulation shall be installed dry when installed and shall be kept dry.
4. The insulation shall be installed over the channels of the support grid in contact with the ceiling lining. All joins between the insulation shall be tightly butted together to ensure that there are no air gaps.
5. The insulation material shall be cut to fit around sprinkler pipes. It shall be cut back from air conditioning diffusers and fluorescent lights. The insulation shall not be installed in contact with downlights mounted above the ceiling, a clearance of not less than 50mm provided around such light fittings unless otherwise approved by light manufacturer. Similarly with ceiling fans and other appliances that may generate heat a clearance of not less than 50mm shall be allowed for the dispersal of heat.
6. Care shall be taken not to cover electrical wiring with the insulation material. Hardboard or similar spacer, not less than 5mm thick, shall be placed between the insulation and the wire in order to maintain an air space between the insulation and the wire.
7. The ceiling shall be left free of off-cuts and packaging material.



## Curtain Walls.

### SPANDREL PANELS.

1. Insulation shall be installed to fully cover the non-vision areas of the curtain wall exterior cladding system.

The insulation shall be *Spanseal™ Rockwool Boards* as manufactured by CSR Bradford Insulation, to achieve an FRL 60/60/60 in accordance with AS1530.4. (refer to Bradford Fireseal System FS001). In Asia, FRL 120/120/120 is required.

Where spandrel fire protection is to be provided by a fire rated masonry spandrel wall, the insulation shall be *Bradford Glasswool Supertel Boards* or *Bradford Spanseal™ Rockwool Boards*.

2. The thickness of insulation shall be .....mm. For determination of thermal resistance refer to Table 14.

**TABLE 14. THERMAL RESISTANCE.**

Description	Thickness	Thermal Resistance
Bradford Spanseal™ Rockwool fire rated Boards	50mm	R1.5
Bradford Glasswool Supertel™	75mm	R2.3
	100mm	R3.0
Where Aluminium Foil is used on one (or both) faces and an airspace is present:		
Vertical Reflective Airspace	20mm	R0.58
Vertical Reflective Airspace	>20mm	R0.61

3. Where the insulation shall be installed behind tinted glass, the exterior surface of the insulation shall have a black tissue facing (BMF) adhered to reduce light reflection.
4. Where a vapour barrier is required to prevent condensation, the internal surface of the insulation shall be faced with *Thermofoil™ (light/medium/ heavy duty)* reinforced foil laminate.
5. The insulation shall be supported by flanges fixed to the metal framing of the spandrel at .....mm centres.

### FIRE SAFING.

1. Fire Safing insulation shall be installed continuously at all exterior cladding beam/column edge separations around the complete perimeter of each floor and at the roof line. The insulation shall be Fireseal™ Curtain Wall Batts as manufactured by CSR Bradford Insulation
2. The minimum effective depth of the fire safing insulation shall be 135mm. The Batts shall be

compressed by 15% of the original width when installed to provide a minimum 2 hour fire resisting period.

3. The fire safing shall be installed in conjunction with a smoke seal of continuous galvanised steel sheet 1.2mm thick sealed to back pan and floor slab.

NOTE: For further details refer to the Bradford Fireseal™ Curtain Wall Systems brochure and the Bradford Insulation Fire Protection Design Guide

## Party Wall Fire Protection.

1. The fireproofing insulation shall be Fireseal™ Rockwool Party Wall Batts as manufactured by CSR Bradford Insulation.
2. The top of the internal party wall must be constructed so that it provides enough depth to fit the party wall batts below the underside of the roofing. The width of the batt is determined by the fire rating requirement.
3. The roof battens or sarking must not cross the party wall batt line.
4. The party wall batts shall be cut to fit tightly into the prepared opening.
5. Lengths of galvanised hoop iron, 500 x 25 x 1.3mm are then nailed to the battens to bridge the gap. This effectively holds the batt in position and fulfils the role of the battens in supporting the tiles across the gap. The weight of the roof tile puts the Party Wall Batts under compression and assists in retaining it in position.
6. There should be no penetrations through the party wall batts.

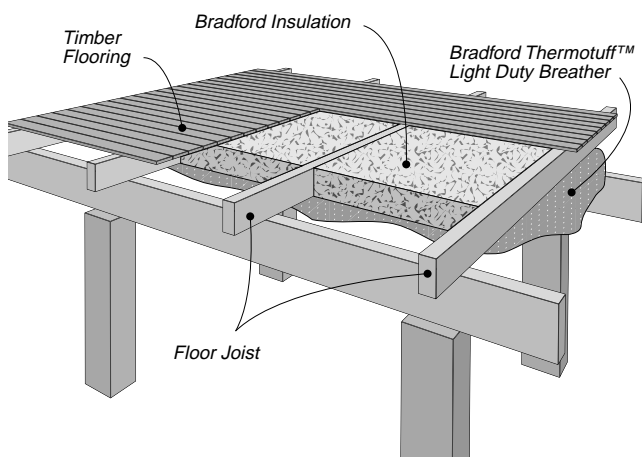
## Timber/Particleboard Floors.

### UNDER HOUSE.

1. The insulation shall be water repellent *Glasswool Wall and Floor Batts* or *Fibertex™ Rockwool Wall and Floor Batts R1.5 or R2.0* as manufactured by CSR Bradford Insulation.
2. The insulation shall be dry when installed and shall be kept dry.
3. The insulation shall be supplied/cut to width to fit tightly between the joists and shall be pressed in place ensuring there are no gaps between insulation and joists, or between abutting edges of the insulation.

- The insulation shall be retained in position by stapling polypropylene string or tape to the timber joists across the under side of the insulation.
- Staple *Thermofoil™/Thermotuff™* Light Duty breather foil to underside of timber joists.

**FIG 12. INSULATION UNDER  
TIMBER/PARTICLEBOARD FLOORING  
(LOWER STOREY).**



## FLOOR/CEILING SYSTEM. (TIMBER FLOOR IN TWO STOREY HOUSE).

- The insulation system shall be *Glasswool Ceiling Batts/Fibertex™ Rockwool Ceiling Batts R2.0, R2.5 or R3.0* as manufactured by CSR Bradford Insulation.
- The insulation shall be dry when installed and shall be kept dry.
- The insulation shall be supplied/cut to width to fit tightly between the joists and shall be pressed in place ensuring there are no gaps between insulation and joists, or between abutting edges of insulation. Refer to Table A7, page 40, CSR Gyprock® Timber Framed Floor/Ceiling Systems.

## Insulation of Framed Walls (Brick Veneer & Weatherboard).

- The insulation shall be *Glasswool or Fibertex™ Rockwool R1.5 or R2.0 Wall Batts* as manufactured by CSR Bradford Insulation.

The appropriate R-value shall, where applicable, comply with minimum standards set by building regulations and/or government legislation. For a comprehensive R-value analysis of Australia and Asia, refer to Appendix A, Table A5 and A6.

- All steps shall be taken to ensure that the cavity between the outside of the frame and the inside of

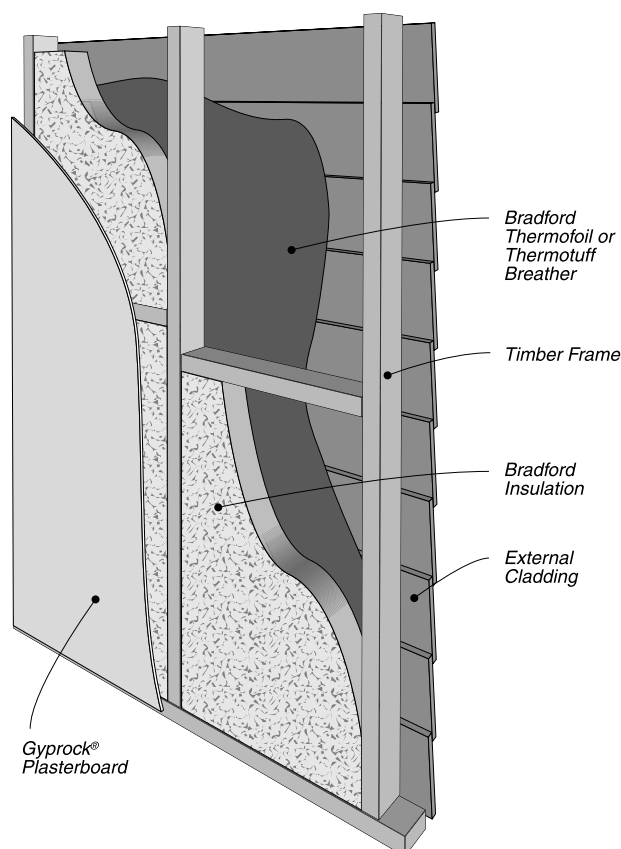
the brickwork is maintained after the installation of the insulation material where the brickwork is laid first. This includes the removal of excess mortar from brickwork and studwork to prevent transmission of moisture from the brickwork to the insulation.

- The insulation shall be dry when installed and shall be kept dry.
- Batts shall be friction fitted between 450mm or 600mm stud centres ensuring that they cannot breach the cavity. For Glasswool wall batts, this is best achieved by incorporating a mechanical support as described below.
- For stud centres up to 600mm, polypropylene string or tape shall be stapled to the bottom plate, noggings and the top plate as near as practicable parallel to the studs.

For standard stud centres (up to 600mm) the string shall run between 75mm to 100mm from the adjacent stud (two strings per space between studs). Where studs are less than 300 apart, one string only shall be installed. Stringing is also recommended for Rockwool wall batts where stud centres exceed 600mm.

Alternatively – to prevent batts breaching the cavity, wrap the outside of the timber frame with *Bradford Thermofoil™ Breather Foil, Thermotuff™ Light Duty Breather* or *building paper*. This will also prevent water

**FIG 13. INSULATION IN FRAMED WALL  
WITH PLANK CLADDING.**



which may be driven through the external cladding from wetting the insulation. Cover the entire vertical frame from the base plate to top plate and secure to the frame with approved fasteners at approximately 450mm centres.

6. Where batts are cut to fit non-standard centres they shall be pressed in place to ensure there are no gaps between the insulation and studs or between abutting edges of insulation.
7. Where a vapour barrier is required, fire retardant *Thermofoil™* (specify grade) shall be secured to the frame with approved fasteners at approximately 450mm centres on the warm side of the insulation.
8. Care should be taken not to cover the existing electrical wiring with the insulation material. Hardboard or similar spaces, no less than 5mm thick shall be placed between the insulation material and the wire, in order to maintain an air space between the insulation and the wire.
9. Where a premium acoustic system is required, (including internal partition walls) the use of 13mm Glasswool Quietel™ board, fixed between the plasterboard and timber studs, is recommended. For details, refer to the Bradford Insulation Acoustic Design Guide or contact the Bradford Insulation office in your region.

## Insulation of Houses with Pitched Roof and Raked Ceiling.

Note: The installation of insulation in existing construction will require the removal and replacement of as much of the tiles and roof structure as is necessary to gain access.

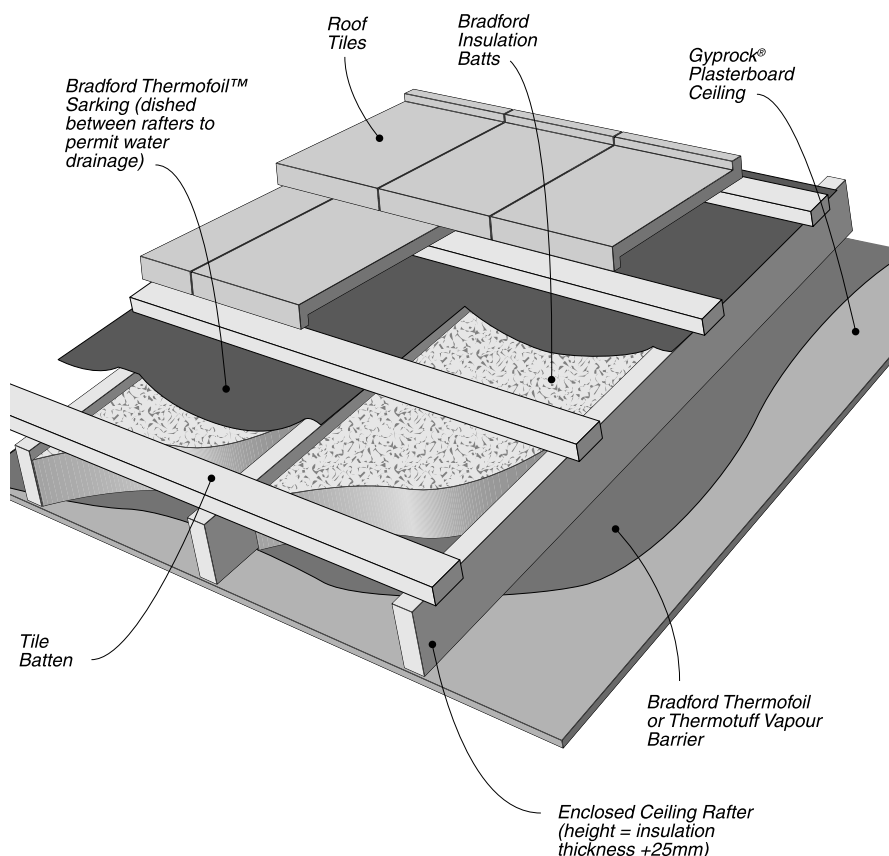
1. The insulation material shall be *Glasswool* or *Fibertex™ Rockwool Ceiling Batts R2.0 to R4.0* as manufactured by CSR Bradford Insulation;

The appropriate R-value shall, where applicable, comply with minimum standards set by building regulations and/or government legislation. For a comprehensive R-value analysis of Australia and Asia refer to Appendix A, Table A5 and A6.

For cold and temperate climates a vapour barrier is recommended to be installed underneath the insulation. When required add:

Laminated reinforced aluminium *Thermofoil™ /Thermotuff™* (light or medium duty) as manufactured by CSR Bradford Insulation shall be installed directly behind the ceiling lining so as to provide an anti-condensation vapour barrier.

FIG 14.  
INSULATION LAYOUT FOR PITCHED ROOF  
WITH RAKED CEILING AND ENCLOSED RAFTERS.



2. The insulation material shall be dry when installed and shall be kept dry.
3. Laminated reinforced aluminium *Thermofoil™* / *Thermotuff™* (medium or heavy duty) shall be installed directly under the tile batten so as to provide a waterproof sarking. Sarking materials shall comply with the requirements of AS4200.
4. In new and existing constructions the roof structure shall be dimensioned so as to provide adequate space for the insulation material to fully recover its manufactured thickness.

**For enclosed rafters add:**

The insulation material shall be cut where necessary and installed between the rafters. The batts shall sit neatly on the ceiling lining allowing no less than 25mm ventilation space between the top of the batt and the underside of the Thermofoil™ sarking.

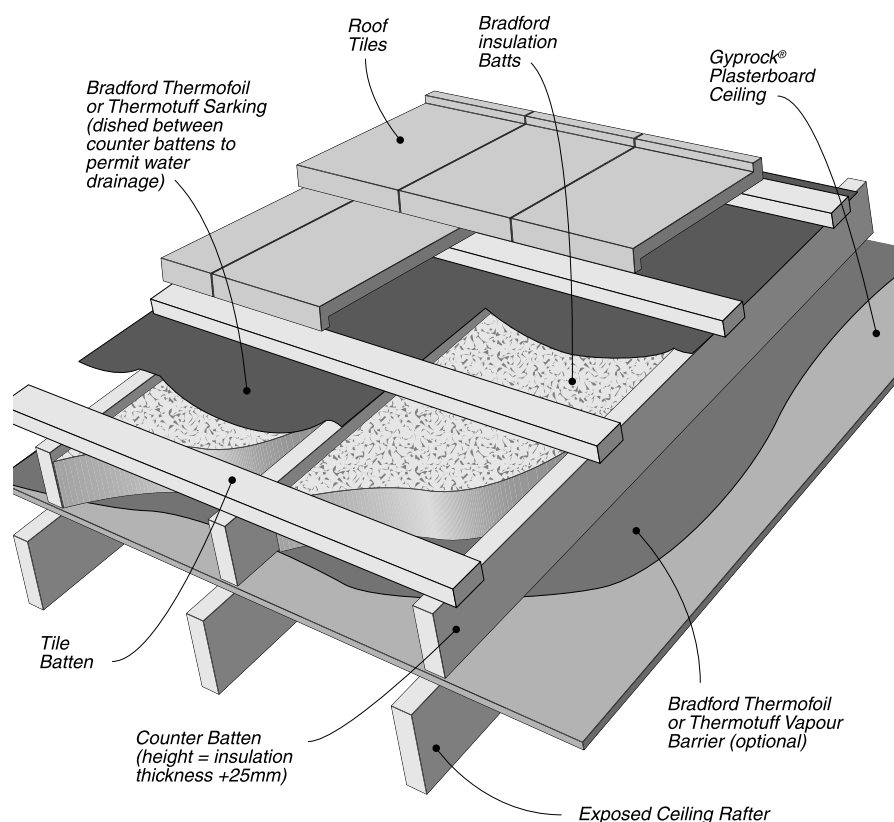
**For exposed rafters add:**

This shall require the addition of counter battens, above the ceiling, along the top of the rafters. The counter battens shall be at least 25mm thicker than the non-compressed thickness of the insulation to ensure a 25mm ventilation space between the top of the batts and the underside of the Thermofoil sarking. The insulation material shall then be laid on top of the ceiling between the counter battens. Tile battens shall then be fixed to the counter battens, over the sarking.

5. Where maximum resistance to penetration of water vapour is required – the vapour barrier shall be made vapourproof by sealing the 150mm overlap by means of an approved contact adhesive or vapour impermeable pressure sensitive tape.

6. Provide adequate ventilation at eaves and ridges of all sections of the roof to ensure air circulation.
7. The insulation material shall be cut where necessary to ensure an adequate fit. All joins between the insulation material shall be tightly butted together to ensure that there are no air gaps. The insulation material shall be cut back around hot flues from stoves and water heaters, recessed light, ceiling fans and other appliances that may generate heat leaving an air space no less than 50mm wide to provide for cooling of the hot surface.
8. The insulation material shall be installed to the outer edge of wall plates around the perimeter of the building.
9. All ventilation apertures in the ceiling shall be closed off, so that there can be no passage of moist air into the insulated space.
10. Care shall be taken not to cover existing electrical wiring with the insulation material. Hardboard or similar spacers, no less than 5mm thick shall be placed between the insulation material and the wire, in order to maintain an air space between the insulation and the wire.
11. The ceiling space shall be cleared of all off-cuts and packaging material, etc. before installation of the membrane.

**FIG 15.  
INSULATION LAYOUT FOR PITCHED ROOF  
WITH RAKED CEILING AND EXPOSED RAFTERS.**



## Insulation of Houses with a Pitched Roof and Horizontal Ceiling.

1. The insulation material shall be *Glasswool or Fibertex™ Rockwool Ceiling Batts R2.0 to R3.5* as manufactured by CSR Bradford Insulation.

The appropriate R-value shall, where applicable, comply with minimum standards set by building regulations or government legislation. For a comprehensive R-value analysis of Australia refer to Appendix A, Table A5 and A6.

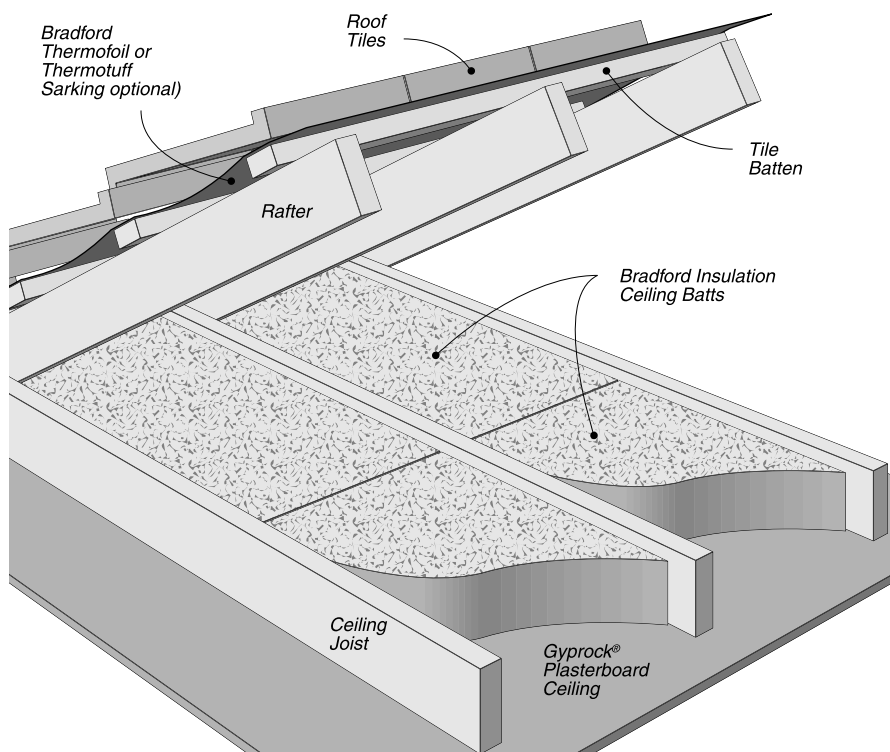
2. The insulation material shall be dry when installed and shall be kept dry.
3. Laminated reinforced aluminium *Thermofoil™ /Thermotuff™* (light, medium or heavy duty) shall be installed directly under the tile batten so as to provide a waterproof sarking.
4. The insulation material shall be cut where necessary to ensure a tight fit between ceiling joists. All joins between the insulation material shall be tightly butted together to ensure that there are no air gaps. Insulation shall be installed such that it may recover to its manufactured thickness.

### Where a vapour barrier is required:

Fire resistant *Thermofoil™ /Thermotuff™* (specify grade) shall be laid on the warm side of the insulation.

5. The insulation materials shall be cut back around flues from stoves and water heaters, recessed lights, ceiling fans and other appliances that may generate heat, leaving an air space no less than 50mm wide to provide for cooling of the hot surface.
6. The insulation material shall be installed to the outer edge of wall plates around the perimeter of the building, leaving a vertical space between the top surface of the insulation and the roof membrane to permit ventilation to the roof space.
7. The insulation material shall be cut back around ventilation apertures in the ceiling by 50mm.

FIG 16.  
INSULATION LAYOUT FOR PITCHED ROOF WITH HORIZONTAL CEILING.



8. Care shall be taken not to cover existing electrical wiring with the insulation material. Hardboard or similar spacers, no less than 5mm thick shall be placed between the insulation material and the wire in order to maintain an air space between the insulation and the wire.
9. Drop ceilings and bulkheads should be insulated with the same R-value insulation on all sides.
10. The ceiling space shall be left free of off-cuts and packaging material.
11. Fire properties of the insulation shall comply with building regulations and additional requirements as may be deemed necessary by government regulation.

FIG 17. INSTALLATION OF INSULATION ADJACENT TO ELECTRICAL WIRING.

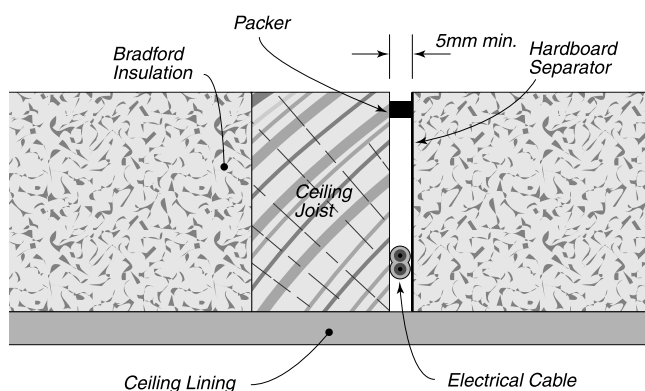


FIG 18. INSTALLATION OF INSULATION ADJACENT TO ELECTRICAL WIRING.

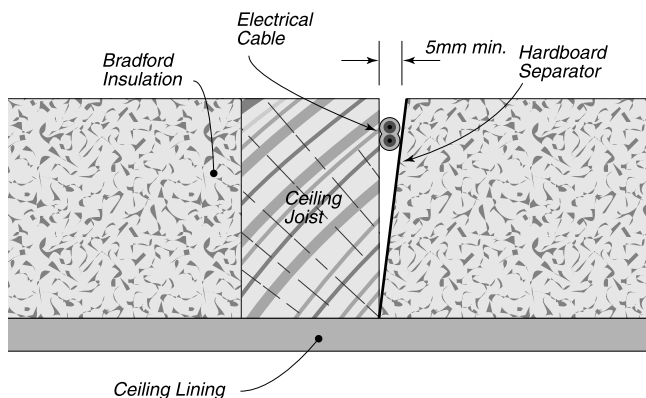


FIG 19. INSTALLATION OF CSR BRADFORD BATTS IN TIMBER WALL FRAMING.



## Installing Thermofoil™ to Brick Veneer/Timber Stud Walls.

The installation procedures outlined in AS4200.2 : 1994 'Pliable Building Membranes and Underlays Part 2: Installation Requirements' sets out the recommended installation procedure.

1. Install Bradford *Thermotuff™ Light Duty Breather* or *Thermofoil™ 799 Breather* to the outer face of the framing members, an air space of at least 25mm should be provided between the external cladding and the laminate. The membrane should be run horizontally across the timber studs and lapped a minimum of 150mm at all joints. *Thermofoil™ /Thermotuff™* should be fixed to the top and bottom plates with the Antiglare side facing outwards.
2. Fix to timber studs using Bradfix foil tacks or by staples, screws or pop rivets with broad head washers of equivalent holding power. Fasteners should be spaced at not more than 300mm centres.
3. Where *Thermofoil™ /Thermotuff™ Light Duty* is used as a vapour barrier the overlaps should be sealed with a suitable adhesive or tape complying with AS1599.
4. Ensure gaps created where pipes or brick ties penetrate the *Thermofoil™ /Thermotuff™* are sealed with reinforced foil tape; it is important that any tears in the foil are taped to prevent air movement past the penetration or tear.
5. *Thermofoil™* and *Thermotuff™* should not contact with lime based products. Do not leave *Thermofoil™* exposed to the weather for greater than one week. *Thermotuff™* is suitable for exposure to the weather for up to two months.

## Installing Thermofoil™ Under a Tiled Roof.

AS4200.2 'Pliable Building Membranes and Underlays Part 2: Installation Requirements' sets out complete details for installation of Thermofoil for use under tile roofs.

1. Use Bradford *Thermofoil™ Medium or Heavy Duty Sarking* or Bradford *Thermotuff™ Medium, Extra Heavy Duty or Safety Sarking*. Face the anti-glare side facing upwards.
2. The *Thermofoil™* or *Thermotuff™* should be draped across rafters or trusses and fixed under battens with sufficient sag to facilitate drainage caused by a broken or displaced roofing tile, but not more than the depth of the supporting battens and in no case to exceed 40mm and not less than 25mm.
3. Avoid tearing or puncturing the membrane during installation, eg. by contact with back edges of gutters. Care should be taken to carefully cut the *Thermofoil™* around obstacles and openings.
4. The first course of *Thermofoil™ /Thermotuff™* should override the facing by at least 25mm but should not restrict the flow of water into the gutter.
5. Successive courses of *Thermofoil™ /Thermotuff™* should overlap the next lower course by a minimum of 150mm to ensure continuity of water flow and flashing. All such overlaps should be stapled at each purlin or rafter crossing.



6. For rafter construction jointing of lengths of *Thermofoil™/Thermotuff™* shall be done by overlapping the ends of the Thermofoil one rafter space and fastening it to the rafters. In the case of purlin construction, the ends of the membrane shall be overlapped not less than 600mm.
7. At eaves *Thermofoil™/Thermotuff™* should be installed in such a manner which will ensure that the membrane can drain into eaves gutter any water which collects and that no ponding will occur.
8. For tile roofs with slopes between 1:3.7 and 1:4.5 the perimeter of the roof should be provided with an anti-ponding board or a device giving similar results to ensure that water collected by the sarking shall be discharged into the eaves gutter. For further details on this subject, consult AS4200 : 2.
9. At valleys, *Thermofoil™/Thermotuff™* should be installed in such a way that it can drain into eaves gutters any water that it collects and that no ponding will occur. Thermofoil should be carried beyond the inside vertical face of the valley raking batten and shall be turned down into the edge of the valley gutter drip.
10. At ridges *Thermofoil™/Thermotuff™* should continue over the ridge. Where ventilation is required to the roof space this can be achieved by the use of venting eaves and using ridge ventilators.

## Installing Thermofoil™ Under Metal Roofing.

1. Thermofoil™ Light Duty Foil should be used with the anti-glare side facing upwards with an airspace above and below the Thermofoil™.
2. For spans exceeding 900mm, a support mesh should be used below the Thermofoil™.
3. Courses of Thermofoil™ should be lapped at least 150mm at all joints.
4. Thermofoil™ should be dished over purlins or rafters with a sag of not less than 25mm and not more than 65mm except at eaves.
5. Avoid tearing or puncturing Thermofoil™ during installation ensuring that the Thermofoil™ is cut properly around obstacles or penetrations. All openings should be sealed with a reinforced foil tape.
6. At ridges the Thermofoil™ should be installed over the ridge.

Note: For climatic conditions under which condensation may occur a properly designed and installed insulation system using Bradford Anticon™ Roofing Blanket should be adopted to protect against condensation forming on internal surfaces. Refer to the Design Considerations section earlier in this guide for further details.

**FIG 20. INSTALLATION OF CSR BRADFORD THERMOTUFF™ SAFETY SARKING ON ROOF.**



**FIG 21. INSTALLATION OF CSR BRADFORD ANTICON™ ROOFING BLANKET.**



## APPENDIX A.

# Design Tables.

**Table A1.**

Thermal Resistance of Surface Air Films.

**Table A2.**

Thermal Resistance of Pitched Roof Space.

**Table A3.**

Thermal Resistance of Airspace.

**Table A4.**

Dew Point Temperature °C.

**Table A5.**

Recommended R-Values – Australian cities and regional centres.

**Table A6.**

Recommended Minimum Additional Thermal Resistance (R-Value) requirements for Asian localities by country.

**Table A7.**

CSR Gyprock Fire & Acoustic Ceiling Systems summary.

**TABLE A1. THERMAL RESISTANCE OF SURFACE AIR FILMS.**

For orientations appropriate for buildings with high and low emittance surfaces (0.9 to 0.05).

Wind Speed (m/s)	Position of Surface	Direction of Heat Flow	Thermal Resistance (m <sup>2</sup> K/W)	
			High Emittance Surface (Non-reflective)	Low Emittance Surface (Reflective)
Still Air	Horizontal	Up	0.11	0.23
		Down	0.16	0.80
	45° Slope	Up	0.11	0.24
		Down	0.13	0.39
	22½° Slope	Up	0.11	0.24
		Down	0.15	0.60
	Vertical	Horizontal	0.12	0.30
6 (winter)	Any position	Any direction	0.03	
3 (summer)	Any position	Any direction	0.04	
0.5 (internal air movement)	Any position	Any direction	0.08	

Source: AIRAH Design Data Manual

**TABLE A2. THERMAL RESISTANCE OF PITCHED ROOF SPACE.**

Typical U-values for roof spaces for four cases, namely, ventilated and non-ventilated spaces for:

(a) High emittance surfaces; and

(b) Low emittance sarking beneath the roofing material.

	Direction of Heat Flow	Thermal Resistance (m <sup>2</sup> K/W)	
		High Emittance Surfaces (non-reflective)	Low Emittance Sarking (reflective)
Ventilated roof space	Up	Nil	0.34
	Down	0.46	1.36
Non-ventilated roof space	Up	0.18	0.56
	Down	0.28	1.09

Source: AIRAH Handbook.

**TABLE A3. THERMAL RESISTANCE OF AIRSPACE.**

Values of resistance for situations commonly encountered in buildings with various combinations of boundary surfaces of high and low emittance (0.9 and 0.05 respectively).

Nature of Bounding Surfaces	Position of Airspace	Direction of Heat	Thermal Resistance (m <sup>2</sup> K/W)	
			20mm Width	100mm Width
High Emittance Surfaces (non-reflective)	Horizontal	Up	0.15	0.17
	Horizontal	Down	0.15	0.17
	45° Slope	Up	0.17	0.17
	45° Slope	Down	0.15	0.16
	Vertical	Horizontal	0.15★	0.16
One Surface of Low Emittance (reflective)	Horizontal	Up	0.39	0.48
	Horizontal	Down	0.57	1.42
	45° Slope	Up	0.49	0.53
	45° Slope	Down	0.57	0.77
	Vertical	Horizontal	0.58★	0.61
Two Surfaces of Low Emittance (reflective)	Horizontal	Up	0.41	0.51
	Horizontal	Down	0.63	1.75
	45° Slope	Up	0.52	0.56
	45° Slope	Down	0.62	0.85
	Vertical	Horizontal	0.62★	0.66

★ For vertical air spaces greater than 20mm, with horizontal heat flow, the value of resistance for 100mm should be used. Source: AIRAH Handbook.

**TABLE A4. DEW POINT TEMPERATURE °C. (This Table is a repeat of Table 9 from Design Considerations).**

Using the appropriate formula for condensation control the calculated temperature can be compared against the Dew Point Temperatures in the table. This table lists the dew point temperatures for a range of inside air temperatures and relative humidities.

Ambient Air Temperature (Dry Bulb) °C	Relative Humidity, Percent (R.H.%)							
	20	30	40	50	60	70	80	90
5	-14.4	-9.9	-6.6	-4.0	-1.8	0	1.9	3.5
10	-10.5	-5.9	-2.5	0.1	2.7	4.8	6.7	8.4
15	-6.7	-2.0	1.7	4.8	7.4	9.7	11.6	13.4
20	-3.0	2.1	6.2	9.4	12.1	14.5	16.5	18.3
25	0.9	6.6	10.8	14.1	16.9	19.3	21.4	23.3
30	5.1	11.0	15.3	18.8	21.7	24.1	26.3	28.3
35	9.4	15.5	19.9	23.5	26.5	29.0	31.2	33.2
40	13.7	20.0	24.6	28.2	31.3	33.9	36.1	38.2

**TABLE A5. RECOMMENDED R-VALUES FOR DOMESTIC & COMMERCIAL APPLICATIONS.**

Recommended minimum additional thermal resistance requirements for Australian localities. Values taken as a result of surveys by EMET Consulting P/L utilising ESPii Thermal Modelling Programme, and methodology taken from AS2627 including winter and summer conditions. NOTE: If roof construction is metal deck with ceiling space, then insulation should also be installed on the ceiling.

Locality	Ceiling	Walls	Locality	Ceiling	Walls	Locality	Ceiling	Walls
<b>New South Wales &amp; ACT</b>			Brewarrina	3.0	2.0	Dubbo	3.5	2.0
Albury	3.0	2.0	Broken Hill	3.0	2.0	Dungog	3.0	2.0
Armidale	3.5	2.0	Camden	2.5	1.5	Forbes	3.5	2.0
Badgerys Creek	2.5	2.0	Campbelltown	2.5	1.5	Glen Innes	3.5	2.0
Bankstown	2.5	1.5	Canberra	3.5	2.0	Goulburn	3.5	2.0
Bathurst	3.5	2.0	Casino	2.5	1.5	Grafton	2.5	1.5
Bega	3.5	2.0	Cessnock	2.5	1.5	Gundagai	3.5	2.0
Bellingen	2.5	1.5	Coffs Harbour	2.5	1.5	Holsworthly	2.5	1.5
Bourke	3.0	2.0	Condobolin	3.0	2.0	Inverell	3.0	2.0
Bowral	3.5	2.0	Cooma	3.5	2.0	Jenolan Caves	3.5	2.0

Locality	Ceiling	Walls
Jervis Bay	3.0	2.0
Kempsey	2.5	1.5
Kyogle	3.0	2.0
Lismore	2.5	1.5
Lithgow	3.5	2.0
Liverpool	2.5	1.5
Lucas Heights	2.5	1.5
Maitland	2.5	1.5
Moree	3.0	2.0
Mudgee	3.5	2.0
Muswellbrook	3.0	2.0
Nambucca	2.5	1.5
Narrabri	3.5	2.0
Nelson Bay	2.5	1.5
Newcastle	2.5	1.5
Nowra	3.0	2.0
Orange	3.5	2.0
Parramatta	2.5	1.5
Port Macquarie	2.5	1.5
Raymond Terrace	2.5	1.5
Scone	3.0	2.0
Sydney	2.5	1.5
Taralga	3.5	2.0
Taree	2.5	1.5
Thredbo	3.5	2.0
Ulladulla	2.5	1.5
Wagga Wagga	3.5	2.0
Walgett	3.0	2.0
Wauchope	3.5	2.0
Wentworth Falls	3.5	2.0
White Cliffs	2.5	1.5
Williamstown	2.5	1.5
Wollongong	2.5	1.5
Yass	3.5	2.0
Young	3.5	2.0

## Victoria

Aberfeldie	3.5	2.0
Aspendale	3.0	2.5
Ballarat	3.5	2.0
Bendigo	3.0	2.0
Bright	3.5	2.0
Camperdown	3.5	2.0
Castlemaine	3.0	2.0
Dandenong	3.0	2.0
Echuca	3.0	2.0
Essendon	3.0	2.0
Frankston	3.0	2.0
Hamilton	3.0	2.0
Hotham Heights	3.5	2.0
Lakes Entrance	3.0	2.0
Lismore	3.5	2.0
Maffra	3.0	2.0
Maryborough	3.0	2.0
Melbourne	3.0	2.0
Mr Dandenong	3.5	2.0
Noojee	3.5	2.0
Portsea	3.0	2.0
Queenscliff	3.0	2.0
Rutherglen	3.5	2.0
Seymour	3.0	2.0
Stawell	3.0	2.0

Locality	Ceiling	Walls
Tidal River	3.5	2.0
Warnambool	3.0	2.0
Wodonga	3.0	2.0
Yarrawonga	3.0	2.0

## Queensland

Applethorpe	3.5	2.0
Birdsville	3.5	2.0
Bowen	3.0	2.0
Brisbane	2.5	1.5
Cairns	3.0	1.5
Charleville	3.0	2.0
Charters Towers	3.0	2.0
Cooktown	3.0	1.5
Dalby	2.5	1.5
Emerald	3.0	2.0
Gladstone	3.0	1.5
Goondiwindi	3.0	2.0
Gympie	2.5	1.5
Ipswich	3.0	2.0
Kingaroy	2.5	1.5
Mackay	3.0	1.5
Mareeba	3.0	2.0
Miles	2.5	1.5
Nambour	2.5	1.5
Rockhampton	3.0	1.5
Roma	3.0	2.0
St George	3.0	2.0
Stanthrope	3.5	2.0
Texas	3.0	2.0
Toowoomba	3.0	2.0
Townsville	3.0	1.5
Warwick	3.0	2.0
Weipa	3.5	2.0

## South Australia

Adelaide	3.0	2.0
Belair	3.5	2.0
Bundaleer	3.0	2.0
Cape		
Northumberland	3.5	2.0
Cape Willoughby	3.0	2.0
Clare	3.5	2.0
Coober Pedy	3.5	2.0
Euduna	3.0	2.0
Fowlers Bay	3.0	2.0
Georgetown	3.0	2.0
Kapunda	3.0	2.0
Kingscote	3.0	2.0
Lameroo	3.0	2.0
Maitland	3.0	2.0
Meningie	3.0	2.0
Mount Barker	3.5	2.0
Mount Gambier	3.5	2.0
Nildottie	3.0	2.0
Northfield	3.0	2.0
Port Augusta	3.0	2.0
Port Lincoln	2.5	1.5
Roseworthy	3.0	2.0
Stirling	3.5	2.0
Strathalbyn	3.5	2.0
Turretfield	3.0	2.0
Victor Harbour	3.0	2.0

Locality	Ceiling	Walls
Warooka	2.5	1.5
Woomera	3.5	2.0
Yudnapinna	3.5	2.0

## Western Australia

Albany	2.5	1.5
Bedford Harbour	2.5	1.5
Boyup Brook	3.0	1.5
Broome	3.5	2.0
Bunbury	2.5	1.5
Carnarvon	3.0	1.5
Collie	2.5	1.5
Denmark	3.0	1.5
Eclipse Island	3.0	1.5
Esperance Downs	2.5	1.5
Fremantle	2.5	1.5
Geraldton	3.0	1.5
Kalgoorlie	3.0	1.5
Laverton	2.5	1.5
Manjimup	3.0	1.5
Margaret River	2.5	1.5
Moora	2.5	1.5
Mount Barker	3.0	1.5
Narembreen	3.0	2.0
Ongerup	3.0	2.0
Perth	2.5	1.5
Port Headland	3.5	2.0
Ravensthorpe	2.5	1.5
Southern Cross	2.5	1.5
Walebing	2.5	1.5
Wyndham	3.5	2.0
York	2.5	1.5

## Tasmania

Bronte Park	3.5	2.0
Cape Bruny	3.5	2.0
Cape Sorell	3.5	2.0
Cradle Valley	3.5	2.0
Devonport	3.5	2.0
Flinders Island	3.5	2.0
Georgetown	3.5	2.0
Hobart	3.5	2.0
Kingston	3.5	2.0
Launceston	3.5	2.0
Marawah	3.5	2.0
Mount Barrow	3.5	2.0
New Norfolk	3.5	2.0
Preolenna	3.5	2.0
Redpa	3.5	2.0
Risdon	3.5	2.0
Ross	3.5	2.0
Scottsdale	3.5	2.0
Smithton	3.5	2.0
Stanley	3.5	2.0
Swansea	3.5	2.0
Tasman Island	3.5	2.0
The Springs	3.5	2.0
Whitemark	3.5	2.0
Wynyard	3.5	2.0

## Northern Territory

Alice Springs	3.5	2.0
Darwin	3.5	2.0
Katherine	3.5	2.0

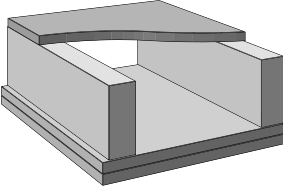
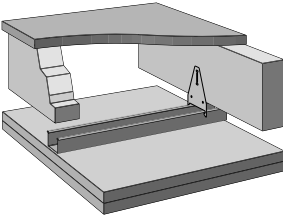
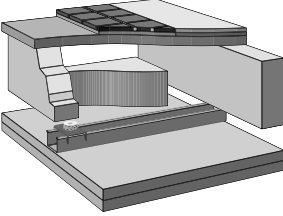
**TABLE A6. RECOMMENDED MINIMUM ADDITIONAL THERMAL RESISTANCE (R-VALUE) REQUIREMENTS FOR ASIAN LOCALITIES BY COUNTRY.**

Country	R – Ceiling	R – Walls	Country	R – Ceiling	R – Walls
China	3.5	2.0	Singapore	3.5	2.0
Malaysia	3.5	2.0	Taiwan	3.5	2.0
Indonesia	3.5	2.0	Thailand	3.5	2.0

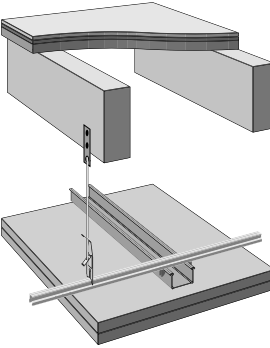
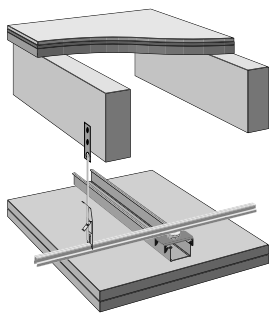
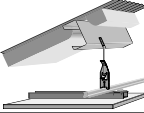
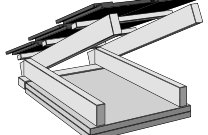
NOTE: If roof construction is metal deck with ceiling space, then insulation should also be installed on the ceiling.

**TABLE A7.  
FIRE AND ACOUSTIC CEILING SYSTEMS  
UTILISING CSR BRADFORD INSULATION AND CSR GYPROCK PLASTERBOARD.**

Detailed information on these and alternative CSR Fire and/or Acoustic Rated Ceiling Systems and Wall Systems is published in the CSR Gyprock Fire and Acoustic Design Guide, N°GYP500.

Framing Method	System N°	Fire Resistance Level FRL	Weighted Sound R <sub>w</sub>	Impact Insulation Class	BRADFORD Insulation Material GYPROCK® Plasterboard Ceiling Lining
	CSR 800	– / – / –	27	–	No insulation No plasterboard
	CSR 801	– / – / –	38	–	R2.0 Bradford GOLD BATTS 1 x 13mm GYPROCK Plasterboard CD
	CSR 802	– / – / –	42	–	R2.0 Bradford GOLD BATTS 2 x 13mm GYPROCK Plasterboard CD
	CSR 805	30/30/30 + BCA FPC	36	–	No insulation 1 x 13mm Gyprock FYRCHEK Plasterboard
	CSR 806	60/60/60 + RISF 30	44	–	R2.0 Bradford GOLD BATTS 2 x 13mm Gyprock FYRCHEK Plasterboard
	CSR 809	60/60/60 + RISF 60	48	–	R2.0 Bradford GOLD BATTS 1x13mm+1x16mm Gyprock FYRCHEK Plasterboard
	CSR 807	90/90/90 + RISF 60	48	–	R2.0 Bradford GOLD BATTS 2 x 16mm Gyprock FYRCHEK Plasterboard
	CSR 808	120/120/120 + RISF 60	47	–	R2.0 Bradford GOLD BATTS 3 x 16mm Gyprock FYRCHEK Plasterboard
	CSR 811	– / – / –	44	–	R2.0 Bradford GOLD BATTS 1 x 13mm GYPROCK Plasterboard CD
	CSR 815	30/30/30 + BCA FPC	46	–	R2.0 Bradford GOLD BATTS 1 x 13mm Gyprock FYRCHEK Plasterboard
	CSR 816	60/60/60 + RISF 30	47	–	R2.0 Bradford GOLD BATTS 1 x 16mm Gyprock FYRCHEK Plasterboard
	CSR 819	60/60/60 + RISF 60	50	–	R2.0 Bradford GOLD BATTS 1x13mm+1x16mm Gyprock FYRCHEK Plasterboard
	CSR 817	90/90/90 + RISF 60	52	–	R2.0 Bradford GOLD BATTS 2 x 16mm Gyprock FYRCHEK Plasterboard
	CSR 818	120/120/120 + RISF 60	55	–	R2.0 Bradford GOLD BATTS 3 x 16mm Gyprock FYRCHEK Plasterboard
	CSR 821	– / – / –	53	67	R2.0 Bradford GOLD BATTS 1 x 13 GYPROCK Plasterboard CD
	CSR 823	– / – / –	53	67	R2.0 Bradford GOLD BATTS 1 x 10 SOUNDCHEK Plasterboard
	CSR 824	– / – / –	57	70	R2.0 Bradford GOLD BATTS 2 x 10 SOUNDCHEK Plasterboard
	CSR 825	30/30/30 + BCA FPC	53 – 56	48 – 67	R1.5 Bradford GOLD BATTS 1 x 13mm Gyprock FYRCHEK Plasterboard
	CSR 826	60/60/60 + RISF 30	54	49 – 68	R1.5 Bradford GOLD BATTS 1 x 16mm Gyprock FYRCHEK Plasterboard
	CSR 829	60/60/60 + RISF 60	57	50 – 70	R1.5 Bradford GOLD BATTS 1x13mm+1x16mm Gyprock FYRCHEK Plasterboard
	CSR 827	90/90/90 + RISF 60	57	51 – 70	R1.5 Bradford GOLD BATTS 2 x 16mm Gyprock FYRCHEK Plasterboard

RISF = Resistance to Incipient Spread of Fire. BCA FPC = Building Code of Australia Fire Protective Covering.

Framing Method	System N°	Fire Resistance Level FRL	Weighted Sound R <sub>w</sub>	Impact Insulation Class	BRADFORD Insulation Material GYPROCK® Plasterboard Ceiling Lining
	<b>CSR 831</b>	– / – / –	48	–	R2.0 Bradford GOLD BATTS 1 x 13 GYPROCK Plasterboard CD
	<b>CSR 833</b>	– / – / –	48	–	R2.0 Bradford GOLD BATTS 1 x 10 SOUNDCEK Plasterboard
	<b>CSR 832</b>	– / – / –	53	–	R2.0 Bradford GOLD BATTS 2 x 13 GYPROCK Plasterboard CD
	<b>CSR 834</b>	– / – / –	53	–	R2.0 Bradford GOLD BATTS 2 x 10 SOUNDCEK Plasterboard
	<b>CSR 835</b>	30/30/30 + BCA FPC	48	–	R2.0 Bradford GOLD BATTS 1 x 13mm Gyprock FYRCHEK Plasterboard
	<b>CSR 836</b>	60/60/60 + RISF 30	51	–	R2.0 Bradford GOLD BATTS 1 x 16mm Gyprock FYRCHEK Plasterboard
	<b>CSR 839</b>	60/60/60 + RISF 60	55	–	R2.0 Bradford GOLD BATTS 1x13mm+1x16mm Gyprock FYRCHEK Plasterboard
	<b>CSR 837</b>	90/90/90 + RISF 60	55	–	R2.0 Bradford GOLD BATTS 2 x 16mm Gyprock FYRCHEK Plasterboard
	<b>CSR 838</b>	120/120/120 + RISF 60	58	–	R2.0 Bradford GOLD BATTS 3 x 16mm Gyprock FYRCHEK Plasterboard
	<b>CSR 841</b>	– / – / –	54	67	R2.0 Bradford GOLD BATTS 1 x 13mm GYPROCK Plasterboard CD
	<b>CSR 845</b>	30/30/30 + BCA FPC	54	67	R2.0 Bradford GOLD BATTS 1 x 13mm Gyprock FYRCHEK Plasterboard
	<b>CSR 846</b>	60/60/60 + RISF 30	58	70	R2.0 Bradford GOLD BATTS 1 x 16mm Gyprock FYRCHEK Plasterboard
	<b>CSR 849</b>	60/60/60 + RISF 60	62	70	R2.0 Bradford GOLD BATTS 1x13mm+1x16mm Gyprock FYRCHEK Plasterboard
	<b>CSR 847</b>	90/90/90 + RISF 60	62	73	R2.0 Bradford GOLD BATTS 2 x 16mm Gyprock FYRCHEK Plasterboard
	<b>CSR 848</b>	120/120/120 + RISF 60	62	75	R2.0 Bradford GOLD BATTS 3 x 16mm Gyprock FYRCHEK Plasterboard
	<b>CSR 860</b>	– / – / –	50	–	R1.5 Bradford Glasswool ANTICON over purlins 1 x 13mm GYPROCK Plasterboard CD R2.0 Bradford GOLD BATTS on ceiling
	<b>CSR 865</b>	90/90/90 + RISF 60	49	–	R2.0 Bradford GOLD BATTS 2 x 16mm Gyprock FYRCHEK Plasterboard
	<b>CSR 870</b>	60/60/60 + RISF 60	44	–	R2.0 Bradford GOLD BATTS 1x13mm+1x16mm Gyprock FYRCHEK Plasterboard
	<b>CSR 871</b>	90/90/90 + RISF 60	44	–	R2.0 Bradford GOLD BATTS 2 x 16mm Gyprock FYRCHEK Plasterboard
	<b>CSR 875</b>	60/60/60 + RISF 60	49	–	R2.0 Bradford GOLD BATTS 1x13mm+1x16mm Gyprock FYRCHEK Plasterboard
	<b>CSR 876</b>	90/90/90 + RISF 60	49	–	R2.0 Bradford GOLD BATTS 2 x 16mm Gyprock FYRCHEK Plasterboard

RISF = Resistance to Incipient Spread of Fire. BCA FPC = Building Code of Australia Fire Protective Covering.

## NOTE: Bradford FIBERTEX™ Rockwool Batts.

When using Bradford FIBERTEX™ Rockwool Batts in the systems detailed in Table A7, R<sub>w</sub> or STC rating is generally increased by 1 to 3 units. Please refer to the Bradford Insulation Acoustic Design Guide or contact your regional Bradford Insulation office for more information.



## APPENDIX B.

# Performance of Typical Building Elements.

The following examples are a close guide to the thermal insulation performance of Bradford products in the typical assemblies shown. Slight variations will occur in practice depending on the product and the influence of the fixing method.

In calculating the R values, no allowance has been made for the effect of support members such as timber studs or joists. If greater accuracy is required calculations can be made using Tables in Appendix A of this design guide

for the cross sectional area involved and a proportional correction made to the calculated values shown. As a general rule the maximum that should be allowed for timber joists is 10% of the total system R-value.

The following assumptions have been made in preparing these figures:

1. The resistance of the mineral wool insulation is that shown by the product at a mean temperature of 20°C (68°F).
2. The resistance of an air space is equivalent to that of a non-

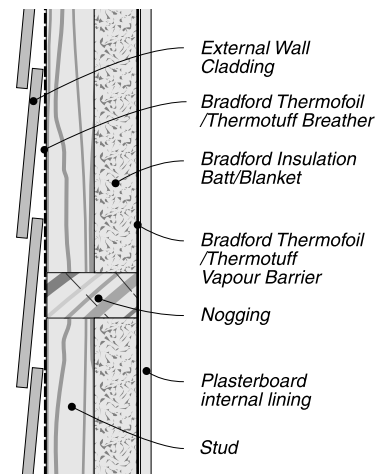
ventilated space 100mm in thickness.

3. The temperature difference across an air space is 5°C (9°F).
4. In the case of roof and ceiling structures, the direction of heat flow is downwards in summer and upwards in winter.

The accuracy of the values shown will be sufficient for most purposes. If greater accuracy is required, calculations should be based on data listed in Appendix A of this design guide.

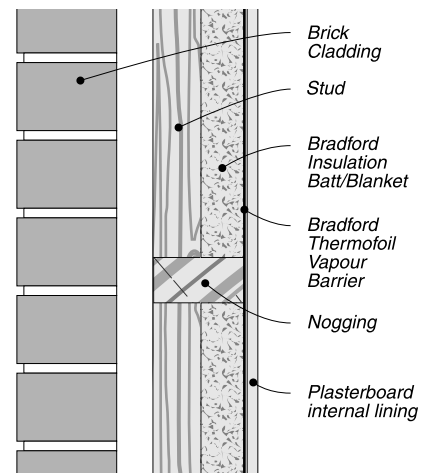
**TABLE B1.**  
**WALL – TIMBER FRAMED – LIGHTWEIGHT CLADDING.**

	R-Value (uninsulated)	R-Value (R1.5 insulation)	R-Value (R2.0 insulation)
1. Outside air film	0.03	0.03	0.03
2. Weatherboard 12mm	0.09	0.09	0.09
3. Airspace	0.16	0.16	0.16
4. <b>Insulation R1.5</b>	n/a	<b>1.50</b>	n/a
5. <b>Insulation R2.0</b>	n/a	n/a	<b>2.00</b>
6. Gyprock™ plasterboard 10mm	0.06	0.06	0.06
7. Inside air film	0.12	0.12	0.12
<b>Total R-Value (m²K/W)</b>	<b>0.46</b>	<b>1.96</b>	<b>2.46</b>



**TABLE B2.**  
**WALL – TIMBER FRAMED – BRICK VENEER.**

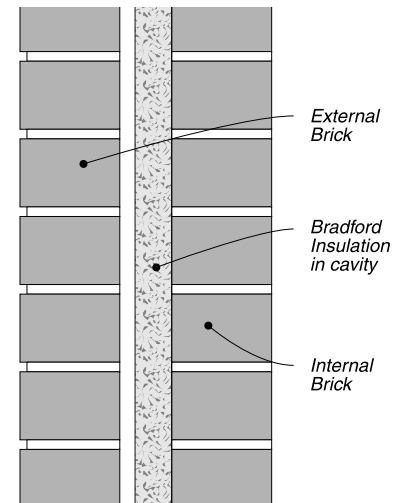
	R-Value (uninsulated)	R-Value (R1.5 insulation)	R-Value (R2.0 insulation)
1. Outside air film	0.03	0.03	0.03
2. Brick work	0.08	0.08	0.08
3. Airspace	0.16	0.16	0.16
4. <b>Insulation R1.5</b>	n/a	<b>1.50</b>	n/a
5. <b>Insulation R2.0</b>	n/a	n/a	<b>2.00</b>
6. Gyprock™ plasterboard 10mm	0.06	0.06	0.06
7. Inside air film	0.12	0.12	0.12
<b>Total R-Value (m²K/W)</b>	<b>0.45</b>	<b>1.95</b>	<b>2.45</b>



NOTES TO TABLES B1 AND B2: Where a vapour barrier is considered necessary, CSR Bradford Thermofoil aluminium foil laminates are the preferred type. Where winter conditions dominate, they should be located on the inside of the studs between the plasterboard and the mineral wool insulation. When the vapour barrier is used in that position, there is no change in thermal performance from the values shown in Tables B1 and B2.

**TABLE B3.**  
**WALL – DOUBLE BRICK WITH CAVITY.**

	R-Value (uninsulated)	R-Value (Thermofoil Board)	R-Value (Rockwool cavity wall)
1. Outside air film	0.03	0.03	0.03
2. Outside Brick work	0.08	0.08	0.08
3. Airspace	0.16	0.58	n/a
4. <b>25mm Thermofoil polystyrene board</b>	n/a	<b>0.60</b>	n/a
5. <b>50mm Rockwool cavity wall insulation</b>	n/a	n/a	<b>1.20</b>
6. Inside Brick Work	0.08	0.08	0.08
7. Inside air film	0.12	0.12	0.12
<b>Total R-Value (m²K/W)</b>	<b>0.47</b>	<b>1.49</b>	<b>1.51</b>



NOTE: The use of moisture resistant polystyrene products should be considered in these applications

**TABLE B4**  
**ROOF – TILED WITH CEILING.**

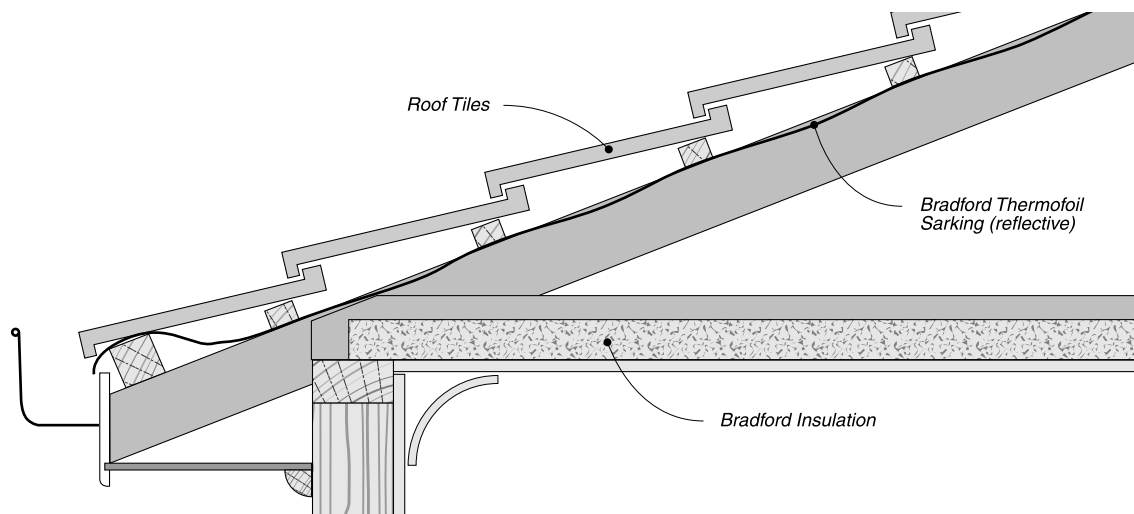
	No Insulation or Sarking		Sarking Only		R2.0 Batts Only		R2.0 Batts & Sarking	
	Wint.	Summ.	Wint.	Summ.	Wint.	Summ.	Wint.	Summ.
1. Outside air film	0.03	0.04	0.03	0.04	0.03	0.04	0.03	0.04
2. Roof tiles	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
3. Roof space★		0.46	0.34	1.36		0.46	0.34	1.36
4. <b>R2.0 Insulation</b>	n/a	n/a	n/a	n/a	<b>2.00</b>	<b>2.00</b>	<b>2.00</b>	<b>2.00</b>
5. Gyprock™ ceiling	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
6. Internal air film	0.11	0.16	0.11	0.16	0.11	0.16	0.11	0.16
<b>Total R-Value (m²K/W)</b>	<b>0.22</b>	<b>0.74</b>	<b>0.56</b>	<b>1.64</b>	<b>2.22</b>	<b>2.74</b>	<b>2.56</b>	<b>3.64</b>

**NOTES:**

Normal pitched roof of burnt clay tiles with horizontal ceiling of 10mm Gyprock™ plasterboard, roof space ventilated.

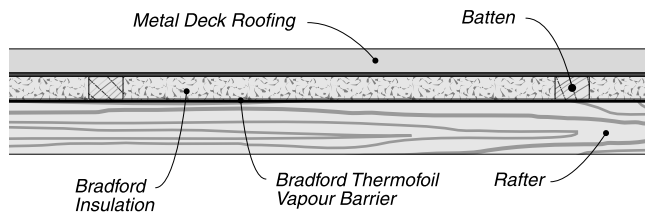
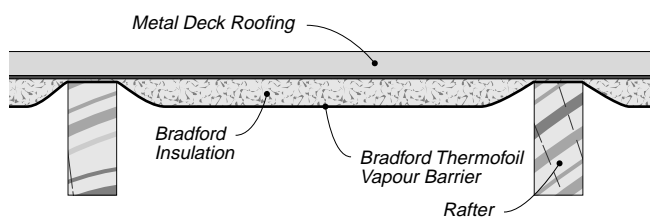
★ Values are theoretical only and assume sarking is correctly installed without damage. Experimental results show that in practice the values assigned to foil should be discounted in the order of 15%. The above examples also assume a ventilated attic space even when sarking is installed.

★ Assumes still internal air film.



**TABLE B5.**  
**ROOF – METAL DECK WITHOUT CEILING.**

	No Insulation	R1.5+		R2.0+		R2.5+	
		Winter	Summer	Winter	Summer	Winter	Summer
1. Outside air film	0.03	0.03	0.04	0.03	0.04	0.03	0.04
2. Metal Deck							
3. <b>Insulation</b>		<b>1.30</b>	<b>1.30</b>	<b>1.80</b>	<b>1.80</b>	<b>2.30</b>	<b>2.30</b>
4. Inside air film (reflective)		0.20	0.80	0.20	0.80	0.20	0.80
5. Inside air film	0.16						
<b>Total R-Value (m<sup>2</sup>K/W)</b>	<b>0.19</b>	<b>1.53</b>	<b>2.14</b>	<b>2.03</b>	<b>2.64</b>	<b>2.53</b>	<b>3.14</b>



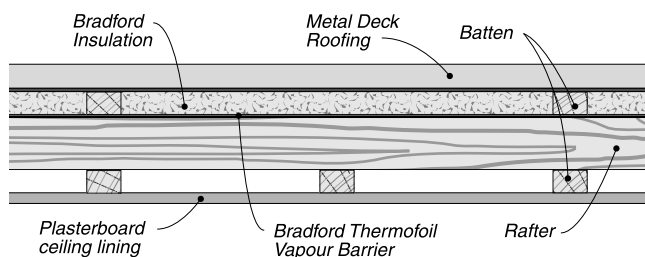
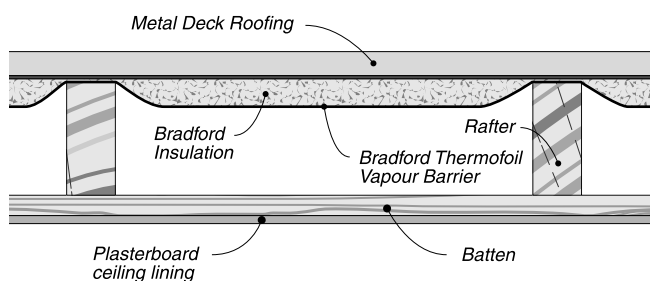
**TABLE B6.**  
**ROOF – METAL DECK WITH CEILING.**

	No Insulation	R1.5+		R2.0+		R2.5+	
		Winter	Summer	Winter	Summer	Winter	Summer
1. Outside air film	0.03	0.03	0.04	0.03	0.04	0.03	0.04
2. Metal Deck							
3. Insulation		1.30	1.30	1.80	1.80	2.30	2.30
4. Reflective air space (100mm)		0.48	1.42	0.48	1.42	0.48	1.42
5. Non-reflective air space (100mm)	0.17						
6. Gyprock® ceiling	0.06	0.06	0.06	0.06	0.06	0.06	0.06
7. Inside air film	0.16	0.11	0.16	0.11	0.16	0.11	0.16
<b>Total R-Value (m<sup>2</sup>K/W)</b>	<b>0.42</b>	<b>1.98</b>	<b>2.98</b>	<b>2.48</b>	<b>3.48</b>	<b>2.98</b>	<b>3.98</b>

NOTES: Roof assumed to be low pitched with ceiling of 10mm Gyprock plasterboard.

Roof space classed as non-ventilated for heat transfer calculations.

Calculations assume still air spaces and internal air film. If these conditions do not apply the value of thermal resistance due to the foil will be reduced.



## APPENDIX C.

# Frequently Asked Questions and Answers.

### R-VALUE OF METAL DECK ROOF STRUCTURES.

**Q. What factors influence the R-value of a metal deck roof?**

A. The installed R-value of the glasswool and foil are dependant on the thickness of insulation and the degree of compression of the blanket under the metal deck. The R-value used for reflective foil surfaces varies between summer and winter, for heating and cooling, and for different internal air currents. For design purposes, an R-value of  $0.2\text{m}^2\text{K/W}$  can be reasonably assumed. The addition of bulk thermal insulation can significantly improve thermal performance.

eg. Installed R-values for 3 thicknesses of Anticon with a ceiling installed underneath for summer conditions are:

55mm Anticon™ R2.98

75mm Anticon™ R3.48

100mm Anticon™ R3.98

### WALL INSULATION.

**Q. Can ceiling batts be used in walls?**

A. Glasswool ceiling batts are too thick and not rigid enough to be fitted into studs without compression (and subsequent loss of R-value). Wall batts have a water repellent added whereas ceiling batts don't. Where higher R-values are required, the use of an R2.0 Bradford Glasswool or Bradford Fibertex Rockwool Wall Batt is required along with Thermofoil fixed to the outside of the stud.

**Q. Is stringing of timber studs necessary when installing wall batts?**

A. Yes, unless Thermofoil or Thermokraft are used as a sarking membrane on the outside of the studs

### CONDENSATION CONTROL.

**Q. Can insulation reduce condensation and mould growth on ceilings of a bedroom?**

A. When correctly installed, insulation can assist in reducing condensation and mould problems by keeping internal surfaces warmer. Other factors

contributing to condensation which should also be considered are, ventilation, low room temperatures and high humidity levels in the house.

### NOISE REDUCTION.

**Q. Will insulation fitted into timber studs eliminate noise transfer between rooms?**

A. Glasswool and rockwool assist in muffling noise. To eliminate airborne noise transfer between rooms requires attention also to the appropriate layers of CSR Gyprock® plasterboard and close attention to eliminating flanking noise. It is the overall system, not just the insulation that should be considered.

### FIRST FLOOR NOISE REDUCTION.

**Q. What are the best options for reducing noise being transferred from the first floor to ground floor of a house?**

A. Two types of noise need to be considered here: airborne noise and impact noise.

Airborne noise is reduced by increased mass of the system, such as 2 layers of 16mm Gyprock® Fyrchek™ plasterboard fixed to the ceiling joists. R2.5 or R3.0 Bradford Glasswool or Bradford Fibertex Rockwool Batts installed between the joists will also improve the floor/ceiling noise reduction by absorbing airborne sound.

Impact noise, eg. footstep noise, is best reduced by the use of carpet and underlay and the use of CSR Gyprock® resilient mounts and furring channel to structurally isolate the ceiling from the joists.

### OUTSIDE NOISE REDUCTION.

**Q. Will cavity wall rockwool insulation installed in a wall eliminate outside noise from entering a house?**

A. Rockwool will absorb noise in the cavity but for better results it should be incorporated with heavy mass materials such as bricks and CSR Gyprock® plasterboard. Suitable window glazing should also be considered.

## INSULATION OF WEATHERBOARD EXTERIORS.

### *Q. Can reflective foil be used behind weatherboard siding on a house?*

- A. Reflective foil products can cause a heat build up if used directly behind weatherboards, and also increases the potential for condensation or retention of weather driven moisture under some conditions. The use of a fire retardant building paper such as Bradford Thermokraft or breather foil is recommended.

## ANTICON

### *Q. What is the correct position of the foil when laying Anticon?*

- A. In temperate areas, the foil vapour barrier should be to the inside (closest to the warm interior of the building). In tropical climates, a foil vapour barrier should be installed closest to the outside (hot) environment.

### *Q. Do foil laps need to be taped on Anticon?*

- A. This is important in areas where high humidity conditions are likely to be encountered in the building and there is a chance of moisture vapour then travelling through the insulation to the cold metal roof, eg. swimming pools. Also recommended in colder climates and in air conditioned buildings in tropical climates.

### *Q. A specification for a metal deck roof with ceiling under the purlins calls up R2.5 for a roof system. Is this feasible with 55mm Anticon in winter?*

- A. The theoretical winter value achieved by this system would be R1.98 at the midpoint where full recovery of the 55mm Anticon thickness has occurred. Anticon 75mm installed correctly would give R2.48 for this system.

## BREATHER FOIL

### *Q. Why is breather foil used?*

- A. Breather foil can be used on the outside of brick veneer timber frames in areas experiencing very cold conditions where there may be concern about moisture condensing against plain foil within the cavity space. It is also suitable for use behind lightweight cladding systems such as fibre cement and Weathertex™.

## ENERGY CONSERVATION

### *Q. How much money will insulation save on heating and cooling bills?*

- A. Insulation to the correct level has the potential to save 20-30% on heating and cooling bills if ceilings are insulated and a further 15-20% if external walls are also insulated.

## THERMOFOIL THERMAL PERFORMANCE

### *Q. Does reflective insulation have an R-value by itself?*

- A. Reflective foil insulation does not have an R-value by itself, it works in conjunction with other materials and air spaces, ie; to be effective, reflective insulation needs a still airspace next to it. Foil installed horizontally or on sloping surfaces may be subject to dust build up which reduces its reflectivity and effectiveness.

However, Thermofoil Antiglare installed in the usual manner with the shiny surface facing into a roof space does contribute to the R-value of the roof system since dust does not deposit on the reflective surface.

## FITTING OF GLASSWOOL AND ROCKWOOL

### *Q. Installation of batts requires careful attention to sealing gaps between insulation and studs or joists. Why is this so important?*

- A. Even if only 5% of an area of wall or ceiling is left uninsulated then up to 50% of the potential benefits may be lost. Similarly holes, tears or joins in reflective insulation should be taped.

## HEALTH AND SAFETY

### *Q. Are Glasswool and Rockwool insulation materials a health hazard?*

- A. Glasswool and rockwool are safe to handle and medical research has failed to show any link between typical occupational exposures to glasswool and rockwool and adverse health effects. By following procedures set out on Bradford packaging and the material safety data sheets, which are reflected in the Worksafe Australia guidelines, any risk is eliminated.

## APPENDIX D.

# Terminology.

### ACOUSTIC.

absorption coefficient ( $\alpha$ ):	The ratio of the sound absorbed by a surface to the total incident sound energy.
attenuation:	The reduction in intensity of a sound signal between two points in a transmission system.
decibel (dB):	An acoustic unit of sound level based on 10 times the logarithm to the base 10 of the ratio of two comparable sound intensities.
flanking transmission:	The transmission of sound between two points by any indirect path.
frequency:	The number of vibrations per second. The unit is the Hertz (Hz), equivalent to one complete oscillation per second.
reverberation:	The persistence of sound within a space due to repeated reflections at the boundaries.

### THERMAL.

British thermal unit (Btu):	Heat required to raise the temperature of 1 lb of water 1°F.
calorie (cal):	Heat required to raise the temperature of 1 gram of water 1°C.
capacity, thermal or heat::	Heat required to raise the temperature of a given mass of a substance by one degree This equals the mass times the specific heat in the appropriate units (metric or imperial)
conductance, thermal:	Time rate of heat flow per unit area between two parallel surfaces of a body under steady conditions when there is unit temperature difference between the two surfaces.
surface heat transfer coefficient (f):	Time rate of heat flow per unit area under steady conditions between a surface and air when there is unit temperature difference between them.
conduction	Heat transfer from one point to another within a body without appreciable displacement of particles of the body.
conductivity, thermal (k):	Time rate of heat flow per unit area and unit thickness of an homogeneous material under steady conditions when unit temperature gradient is maintained in the direction perpendicular to the area.
convection:	Heat transfer from a point in a fluid by movement and dispersion of portions of the fluid.
dewpoint	Temperature at which a sample of air with given water vapour content becomes saturated when cooled at constant pressure.
emissivity	Capacity of a surface to emit radiant energy; defined as the ratio of the energy emitted by the surface to that emitted by an ideal black body at the same temperature.
humidity, absolute:	Mass of water vapour per unit volume of air.
humidity, relative:	Ratio of the partial pressure of water vapour in a given sample of air to the saturation pressure of water vapour at the same temperature.
Kelvin K:	The unit of thermodynamic temperature. For the purpose of heat transfer, it is an interval of temperature equal to 1°C.
permeance:	Time rate of transfer of water vapour per unit area through a material when the vapour pressure difference along the transfer path is unity.
permeability:	Permeance for unit thickness of a material.
radiation:	Heat transfer through space from one body to another by electromagnetic wave motion.
resistance, thermal:	Reciprocal of thermal conductance, or ratio of material thickness to thermal conductivity
resistivity, thermal:	Reciprocal of thermal conductivity.
specific heat:	Ratio of the thermal capacity of a given mass of a substance to that of the same mass of water at 15°C.
transmittance, thermal or overall heat transfer coefficient	Time rate of heat flow per unit area under steady conditions from the fluid on one side of a barrier to the fluid on the other side when there is unit temperature difference between the two fluids.





## Bradford Insulation

CSR Building Solutions Web Site.  
[www.csr.com.au/bradford](http://www.csr.com.au/bradford)

### Manufacturing Facilities.

CSR Bradford Insulation is a leading insulation manufacturer in Australia and Asia with manufacturing facilities located throughout the region.

#### AUSTRALIA.

Glasswool factory, Ingleburn NSW.  
 Rockwool factory, Clayton VIC.  
 Thermofoil factory, Dandenong VIC.

#### ASIA.

Glasswool factory, Zhuhai, China.  
 Rockwool factory, Dongguan, China.  
 Rockwool factory, Rayong, Thailand.  
 Rockwool factory, Kuala Lumpur, Malaysia.  
 Flexible Duct Factory, Singapore.

### Sales Offices.

#### AUSTRALIA.

State	Phone	Fax
Head Office	61 2 9765 7100	61 2 9765 7029
NSW	(02) 9765 7100	(02) 9765 7052
ACT	(02) 6239 2611	(02) 6239 3305
VIC	(03) 9265 4000	(03) 9265 4011
TAS	(03) 6272 5677	(03) 6272 2387
QLD	(07) 3875 9600	(07) 3875 9699
SA	(08) 8344 0640	(08) 8344 0644
NT	(08) 8984 4070	(08) 8947 0034
WA	(08) 9365 1666	(08) 9365 1656

#### INTERNATIONAL.

Country	Phone	Fax
New Zealand	64 9579 9059	64 9571 1017
Hong Kong	852 2754 0877	852 2758 2005
China (Glasswool)	86 756 551 1448	86 756 551 1447
China (Rockwool)	86 769 611 1401	86 769 611 2900
Thailand	66 2736 0924	66 2736 0934
Malaysia	60 3 3341 3444	60 3 3341 5779
Singapore	65 861 4722	65 862 3533

### Health and Safety Information.

Information on any known health risks of our products and how to handle them safely is displayed on the packaging and/or the documentation accompanying them. Additional information is listed in product Material Safety Data Sheets available from your regional Bradford Insulation office or visit our website.

### Warranty.

CSR Limited warrants its Bradford Insulation products to be free of defects in materials and manufacture. If a CSR Bradford Insulation product does not meet our standard, we will, at our option, replace or repair it, supply an equivalent product, or pay for doing one of these. This warranty excludes all other warranties and liability for damage in connection with defects in our products, other than those compulsorily imposed by legislation.

CSR Bradford Insulation is a business of CSR Limited A.B.N. 90 000 001 276.  
 CSR Limited is the owner of the following trade marks. Acousticladd™, Acousticon™, Anticon™, Bradfix™, Bradford™, Comfort Plus™, Ductel™, Fibermesh™, Fibertex™, Fireseal™, Flexitel™, Flex-skin™, Multitel™, Quietel™, SoundScreen™, Spanseal™, Supertel™, Thermoacclad™, Thermatrel™, Thermodock™, Thermofoil™, Thermoplast™, Thermotuff™, Ultratel™.