Geoff,

Here it is. I would like this tabled as my last document to my oral testimony.
It is very powerful and I hope so much that the Senators act upon it when they formulate their conclusions.
Foil must be part of any government insulation program as well as the BCA for new houses.

I have also come up with a new formula to make all insulations safe for use in houses and emailed Greg Combet and Greg Hunt today with my proposals.
My submission here formed part of my correspondences to them both.

Thankyou again for your assistance.

Regards,

Tim Renouf (Affil. AIRAH - Aust' Airconditioning&Heating Inc.)
Wren Industries P/L

THERMAL PERFORMANCE COMPARISON BETWEEN FIBREGLASS BATTS AND REFLECTIVE FOIL INSULATION IN CEILINGS IN QUEENSLAND HOUSES – 1981

GENERAL OVERVIEW by Tim Renouf – Wren Industries 3 March 2010

***SECRETARY OF AFIA – ALUMINIUM FOIL INSULATION ASSOCIATION**

Examination of Research Project
Thermal Performance of Housing Units in Queensland
Phase 1: a study by the Department of Architecture and Building, University of Melbourne.
AHRC Project 58 - 1981.

Research Funding: The Australian Housing Research Council (AHRC).
Research Team: A. Coldicutt (Team Leader), T. Isaacs, T. Williamson, S. Coldicutt, E. Coldicutt, F. Moschini. The Project Committee included a member of CSIRO Division of Building Research.

The 1981 Australian Housing Research Council federally funded research report examined the thermal performance of ceiling insulation in housing units across Queensland. Four locations were selected: Brisbane, Rockhampton, Townsville, Longreach.

Two types of ceiling insulation were compared:
(i) **75mm fibreglass** directly on the ceiling, and
(ii) **a single layer of reflective foil insulation** across the top of ceiling joists with a reflective airspace beneath.

The Report (275 pages in total) concluded that for non-airconditioned houses, foil insulation should be used and fibre-based insulation should not be used.
The central reason was that fibrous insulations had a greater resistance to heat flow up than foils, causing houses to stay hotter longer by trapping heat in the often difficult to ventilate 'stagnant heat zone' between the top of door heads and ceilings. Foil, on the other hand, stopped heat penetration successfully during the day and released accumulated heat beneath the ceiling during night time because of the foil's inherently lower resistance to heat flow up compared to bulk insulation.
If these houses are airconditioned, RFL at least should be used as ceiling insulation in all four locations.

Concluding comments by Tim Renouf
In warm to hot climates where winter heating is very low or non-existent, houses using foil insulations combined with natural ventilation can reduce or avoid the costs of airconditioning.

SPECIAL NOTE: The Building Code of Australia (BCA) Building Energy Efficiency Provisions (2007), **takes no account of the implications of the 1981 Report** – implications being that bulk insulations should not be used in ceilings of houses, in dominant hot climates of Australia.

External commentary by Prof. Richard Aynsley (not part of the 1981 report):
"Horizontal reflective foil airspaces in roofs have the unique characteristic of having a greater resistance to heat flow down than up. They act as one-way values for summer heat flow, restricting daytime heat gain while facilitating night time heat loss. This is important because indoor discomfort in the evening which inhibits sleep can be very debilitating".
"If energy efficiency regulations, as a matter of convenience, ignore the beneficial effects of horizontal reflective airspaces in roofs of houses in warm climates, then the situation could be actionable under trade practices legislation. Ignoring these effects would be detrimental to a wide range of aluminium foil insulation products and favour bulk insulation products in spite of the demonstrable consumer benefits of reflective insulation in Australia's warm climates."
Richard Aynsley: B.Arch (Hons I), MS (Arch Eng), PhD, Member ASHRAE
Former UNESCO Professor of Tropical Architecture, James Cook University, QLD
Dean, College of Technology, Southern Polytechnic State University, Marietta GA, USA
*Quotation date: August 2000

AHRC PROJECT 58
Thermal Performance of Housing Units in Queensland
(Brisbane, Longreach, Rockhampton, Townsville)
Phase 1 - 1981

KEY POINT EXTRACTS
FOIL INSULATION COMPARED TO FIBREGLASS INSULATION IN CEILINGS
(prepared by Tim Renouf 3 March 2010)

Page 2
Recommendations - 1.1.2
Use of reflective foil laminate for the ceiling of non air-conditioned houses *and as a minimum for the walls and ceiling of air-conditioned houses.*

Page 116 & 117
Types of Insulation - 9.1.2
There are two basic types of insulation – bulk insulation, which is lightweight material usually containing many pores of still air, and reflective insulation (RFL) which is sheet material covered on one or both sides with a layer of shiny aluminium foil, which, as in a thermos flask, reflects, most of the low temperature radiation which falls on it.

In this study two ceiling insulations were examined – 75mm fibreglass on the ceiling, and double-sided RFL draped over the rafters(in the basic case with its 'flat' roof) or over the ceiling joists in attic roofs.

For walls, the only type of insulation type which was considered was double-sided RFL dished between studs to give two reflective air spaces.

The RFL ceiling insulation has a particular advantage for summer performance in hot climates: *TableA3.2 shows that its resistance to downwards heat flow is much greater than its resistance to upwards heat flow. This means that it is effective at keeping heat out in the daytime, but impedes outward flow much less e.g.* ***the building is cooling down at night****.*

Page 123
Summer performance of un-airconditioned dwellings - 9.2.1
The present value of energy savings and the capital cost of insulation are given in Table 9.2. Both insulation alternatives give large nett savings, but the RFL being cheaper to install, gives greater savings than the 75mm fibreglass. If air-conditioning was common for these types of house a more detailed study of many alternative insulation(would be necessary). Taking into account where necessary winter heating cost, would be warranted. However this study brief places little emphasis on airconditioning, therefore it suffices to say that, ***if these houses are airconditioned*****,** ***RFL at least should be used as ceiling insulation in all four locations.***

Page 174
CONCLUSIONS & RECOMMENDATIONS
INTRODUCTION -13.1
We have examined Tempal simulations of summer and winter performance of living and sleeping zones, with and without cooling and heating. It has been shown that improvements which are beneficial for one of these situations often have negative effects in others: for example, ***mineral wool ceiling insulation*** *greatly improves daytime performance in summer,* ***but keeps unconditioned houses hotter on summer nights****.*

Page A2.10

EFFECTS OF INSULATION ON THERMAL PERFORMANCE

Effect of each alternative

Insulation reduces the rate of heat flow through a building element. It can therefore be beneficial when it is too cool, but it can have the ***unwanted effect of keeping heat in on summer evenings when rapid cooling of the house is desirable****, and keeping heat out on sunny winter days when the extra heat gain would be useful. A compromise must be made between these conflicting requirements.*

Reflective foil laminate (RFL) over the ceiling was the first potential improvement studied. It is a practically suitable type of insulation for summer performance, as its resistance to downward heat flow is much greater than its resistance to upward heat flow, so that rapid cooling in summer evenings is facilitated.

Page A2.11

If the buildings are cooled in summer, the RFL ceiling insulation gives a very marked advantage, cutting the hot-fortnight cooling requirements for the living zone by between one third & one half. *Sleeping zone cooling requirements are only reduced slightly (by about 0.1GJ), as the RFL reduces heat losses through the roof due to radiation to the night sky.*

Page A2.12 & A2.13

Mineral wool ceiling insulation (75mm) was the third insulation option examined. For the hot fortnight, this has a ***generally bad effect on performance when compared with RFL ceiling insulation…….***

If the buildings are cooled in summer, mineral wool gives little or no benefit when compared with RFL ceiling insulation.

Choice of insulation for the living zones

Summing up these findings, ***reflective foil laminate to the ceiling gives the greatest overall improvement in the living zone thermal performance, with marked improvement in summer daytime conditions*** *and only a very slight rise in night-time temperatures.*
It also gives major energy savings if the buildings are cooled. *In winter, it improves comfort substantially, but does not reduce heating energy requirements for the cold fortnights.*

*Similar comments apply to the 75mm mineral wool insulation to the ceiling****. On balance. it may not be a desirable improvement, because of its negative effect on comfort in the hot fortnight in the unconditioned cases, when compared with RFL ceiling insulation****……*
Compared with RFL ceiling insulation, it (75mm mineral wool insulation) gives little or no reduction in hot fortnight cooling requirements if the buildings are cooled.

RECOMMENDATIONS FOR BASE CASE FOR EACH LOCATION

Brisbane, Longreach, Rockhampton, Townsville

Despite its extra cost, reflective foil laminate to ceilings may be considered as justifiable on the grounds of improved comfort, as it seems to be gaining acceptance in standard low-cost buildings in Queensland.

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*prepared by:
Tim Renouf
Wren Industries, 139 Herald St, Cheltenham VIC 3192 (03) 9532-5855
Secretary AFIA – Aluminium Foil Insulation Association Inc (Vic)

TABLE A2.3 RECOMMENDATIONS FOR BASE CASES

LOCATION	RECOMMENDATION IF DIFFERENT CONSTRUCTION FOR EACH ZONE IS ACCEPTABLE FOR BASE CASE (NOTE: THESE ARE COMPROMISE RECOMMENDATIONS WITH ZONE DIFFERENCES MINIMISED FOR SIMPLICITY AND LOWER COSTS			RECOMMENDATION IF USE OF ONE CONSTRUCTION TYPE THROUGHOUT IS PREFERRED
	ELEMENT	**LIVING ZONE**	**SLEEPING ZONE**	**BOTH ZONES**
BRISBANE	**Floor:**	*Slab on ground*	*Slab on ground*	*Slab on ground*
	Walls:	*Brick veneer or brick cavity (Brick cavity better thermally)*	*Brick veneer (Light weight better thermally)*	*Brick veneer*
	Ceiling Insulation:	*R.F.L*	*R.F.L*	*R.F.L*
LONGREACH	**Floor:**	*Slab on ground*	*Slab on ground (Timber equally appropriate)*	*Slab on ground*
	Walls:	*A.C. clad stud frame (Brick or brick veneer thermally better)*	*A.C. clad stud frame*	*A.C. clad stud frame*
	Ceiling Insulation:	*R.F.L.*	*R.F.L.*	*R.F.L.*
ROCKHAMPTON	**Floor:**	*Slab on ground*	*Timber (Slab on ground also appropriate)*	*Slab on ground*
	Walls:	*A.C. clad stud frame (Brick veneer or brick cavity also appropriate)*	*A.C. clad stud frame*	*A.C. clad stud frame*
	Ceiling Insulation:	*R.F.L.*	*R.F.L.*	*R.F.L.*
TOWNSVILLE	**Floor:**	*Slab on ground*	*Timber (Slab also appropriate)*	*Timber*
	Walls:	*Cavity brick*	*A.C. clad stud frame*	*A.C. clad stud frame*
	Ceiling Insulation:	*R.F.L.*	*R.F.L.*	*R.F.L.*

Geoff,

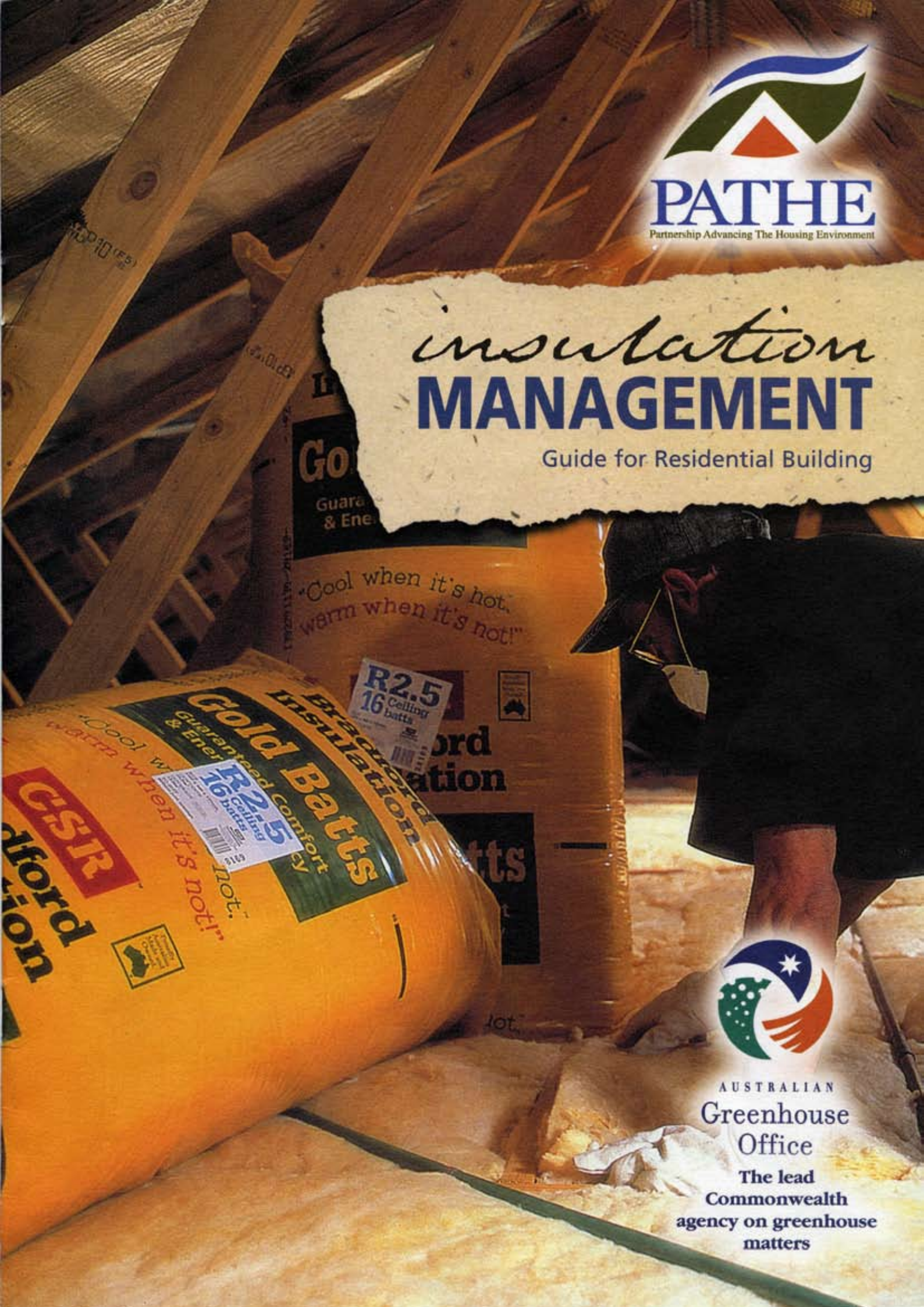
Just realized I have not sent the parent reference document I read from in my Senate testimony. This was what the Chair was referring to and it got actually confused with the AHRC matter that never got raised because time had run out.

I tabled page 8 from the Insulation Guide 2001 – here is the full document so the Senate can see the context of page 8.

Thankyou again.

Regards,

Tim Renouf (Affil. AIRAH - Aust' Airconditioning&Heating Inc.)
Wren Industries P/L


PATHE
Partnership Advancing The Housing Environment
insulation
MANAGEMENT
Guide for Residential Building
"Cool when it's hot,
warm when it's not!"
R2.5
16 Ceiling batts
Gold Batts
Guaranteed comfort
CSR
AUSTRALIAN
Greenhouse
Office
The lead
Commonwealth
agency on greenhouse
matters

HIA (HOUSING INDUSTRY ASSOCIATION)

A major challenge for the building and construction industry is to achieve a sensible balance between the need to build and renovate homes and the need to safeguard the nation's resources. PATHE stands for Partnership Advancing the Housing Environment and is a partnership between industry, government and the community. PATHE is a practical and voluntary program that targets energy efficiency (including insulation), waste reduction, and better environmental management in the building industry.

This PATHE Guide provides builders and trade contractors with information on cost-effective approaches to achieving energy efficiency through insulation management. It provides information that will allow builders and contractors to make informed decisions about insulation options for their clients.

Minimum energy performance requirements are being developed by government for introduction to the Building Code of Australia. Insulation will be an important part of meeting the new code requirements when they are introduced.

The Guide is one in a series of PATHE Guides to assist builders and trade contractors to improve their environmental management practices.

The intent is clear – to produce homes that are naturally more comfortable.

ACKNOWLEDGEMENTS

HIA thanks the Australian Greenhouse Office for providing financial and technical support for this Guide. The Sustainable Energy Authority of Victoria has also given its assistance through its "Insulation Guide" – a practical handbook on insulating new and existing homes. Australian Standard 2627.1 – 1993 Thermal insulation of roof/ceiling and walls on dwellings, SAA HB 63.1994 Home Insulation in Australia, and the BRANZ House Insulation Guide have all been consulted for this Guide. HIA thanks Australia's peak industry insulation body, the Insulation Manufacturers Association of Australia, for its assistance. IMAA represents the manufacturers of cellulose, foil, glasswool, polyester/wool and rockwool insulation.

FURTHER INFORMATION

If you are interested in further information on insulation, please contact HIA. Members can use the Memberline, toll free on 1300 650 620. Others can contact the Consumer Hotline on 1902 973 556.

OTHER GUIDES

This Insulation Management Guide is one in a series produced as part of the PATHE initiative. It focuses on insulation matters first highlighted in the PATHE Energy Management Guide.

Other PATHE guides are available on energy, stormwater and waste management. They are available from your HIA office, or for HIA members from the toll-free HIA Memberline – 1300 650 620 – or by asking for your local HIA Planning and Environment professional.

♻ This document is printed on 100% Australian recycled paper.

introduction & contents

Taking Australia as a whole, insulation is the 'big-ticket' item for achieving energy efficiency in homes.

The Insulation Guide is produced to provide HIA members with practical guidance for the selection and installation of insulation for houses in most Australian climatic zones. Fact sheets will be available for zones not covered in the Guide. The Guide complements the PATHE Energy Management Guide.

It will assist members to select appropriate insulation for the various components of the building envelope, having regard to climatic location, and acceptable design solutions for energy efficiency.

The Guide covers the normal range of circumstances encountered on most domestic building sites, and is directed at improving the energy efficiency of the average house.

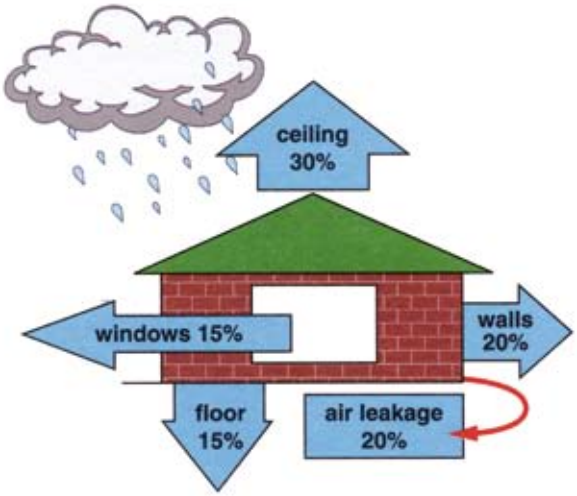
In promoting energy efficiency and insulation, there is a need to emphasise the economic advantages and other benefits that clients can achieve from improved thermal comfort in their home.

The challenge for the housing industry, therefore, is to create designs that include insulation, appeal to the market place, take account of comfort needs, and are energy efficient and cost effective when occupied.

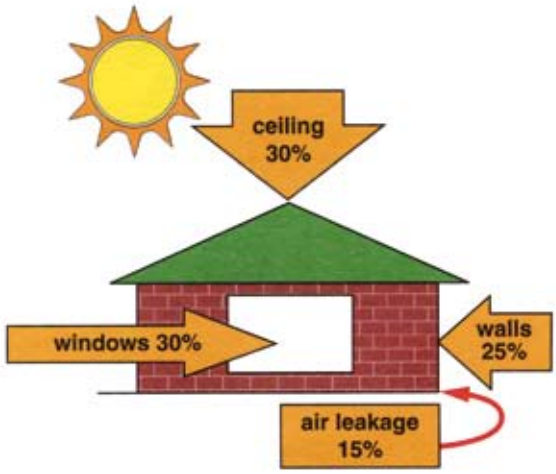
2001
Insulation Management: Guide for Residential Building

Insulation Management

TYPICAL AREAS OF HEAT LOSS IN WINTER



TYPICAL AREAS OF HEAT GAIN IN SUMMER



General

In general, for most climatic zones, no other energy efficiency measure is as effective as insulation.

Insulation is simply a barrier that retards the flow of heat. It helps to keep the heat in or keep it out, whichever is the appropriate solution.

Insulation can be material that is added to complement the building envelope, or it can be the material used to construct the building envelope. In most cases insulation requires a combination of both to achieve the desired results. Insulation can be placed in ceiling spaces, walls, under roofs, under floors and around slabs.

Typically, a modest level of insulation throughout the house is more effective than a high level for one room and nothing in other rooms. It is also preferable to have some insulation in the walls and ceiling spaces rather than nothing in the walls and plenty in the ceiling. Ideally therefore, walls should be insulated when the house is built, as this may be the last practicable opportunity to access the wall spaces. Insulating floors should also be considered for comfort and energy savings.

Insulation works best when supported by appropriate living habits and design. When coupled with energy efficient use of the home, designs that incorporate appropriate roofing materials and window selection, location, sizing and shading are complementary to effective insulation performance.

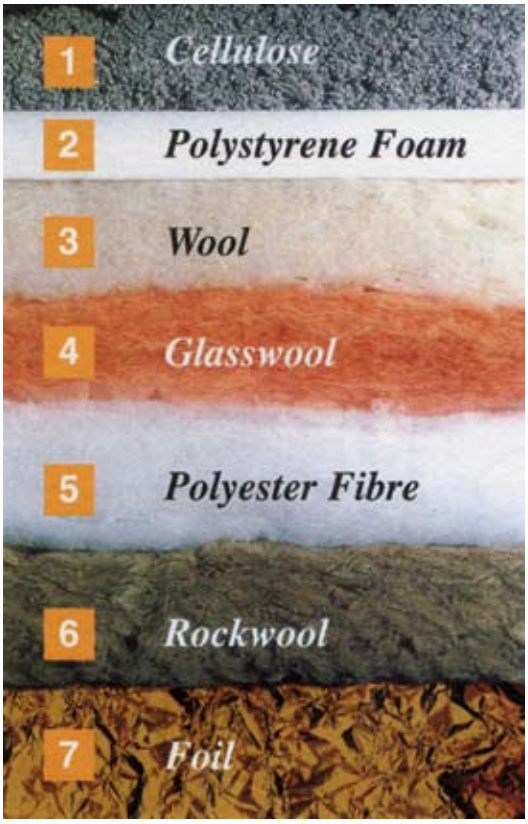
Measuring insulation performance

Insulation values are measured simply on how much the material resists the flow of heat in or out. It is the same measurement for both, and is expressed as an 'R value' – the larger the R value the more insulating properties the material will have. However, as more and more insulation is added, the additional benefits will become progressively less and less. It is not the thickness of the insulation that ensures its effectiveness, it is the R value.

As an example, in most climatic zones, the minimum insulation recommended for typical Australian homes eg, brick veneer, cavity brick and blockwork is roof/ceilings at R2.5 and walls at R1.5. Obviously this is an over-generalisation and is subject to climatic conditions, but it demonstrates the quantum of insulation that should be considered initially.

What types of insulation are available?

The range of insulation types includes batts, blankets, sheets, foils, paper, and building material



Picture extracted from: *Department of Mines & Energy, Energy Efficient Home Designs for Queensland, 1996.*

itself. There are two types of insulation - bulk insulation and reflective foil. Bulk insulation can be further categorised as batts, loosefill, blanket and foamed. Reflective foil insulation produced as double-sided foils have reflective surfaces on both sides, and anti-glare foils have foil on both sides with one surface covered with an anti-glare finish.

How does insulation work?

Insulation works in two ways:

1. in summer, it reduces the heat entering the home through the ceilings, walls and floors, so rooms stay cooler; and
2. in winter, insulation reduces the heat loss from the home through the ceiling, walls and floors so heated rooms stay warmer.

As a result the home is more comfortable and savings of up to 50% can be realised on cooling and heating costs.

Bulk insulation resists the transfer of heat by conduction and convection. It consists generally of thick lightweight material that contains many small air pockets. The trapped air is excellent at resisting the conduction of heat, and because the air is confined to many small pockets that effectively prevent convection currents from developing, it minimises heat transfer.

Reflective insulation resists the flow of radiant heat. It is usually in the form of laminated aluminium foil, and can be installed in walls, and under roofs and timber floors. For maximum effectiveness, reflective insulation should be installed so that the shiny surface is adjacent to a still air gap of 30mm. Full benefits are only achieved when the air gap is sealed to prevent air movement. Foil facing upwards may lose its effectiveness as a reflective surface due to deposition of dust. Similarly, an anti-glare surface is not reflective, and offers minimal thermal benefit.

Why insulate?

Insulation will keep heat in during winter and out during summer, which will improve comfort in the home. For example, in cooler climates, insulation in ceiling spaces (R2.5), and walls (R1.5) can lead to savings for heating and cooling costs of up to 50%.

However, even the highest insulated home may not achieve significant energy savings, particularly where:

- the home owner is not careful with energy use;
- heat is lost through large unprotected glass areas; or
- the potential for the 'glasshouse effect' in summer is not addressed through shading to reduce solar entry.

Insulation is therefore complementary to the overall energy effectiveness of buildings.

Bonuses from using thermal insulation

Added bonuses from using insulation materials include:

A. Weatherproofing Barrier. Reflective foil laminate (RFL) installed directly under roofing (sarking)

does not provide enough insulation on its own, but is a good weatherproofer - especially under tiled roofs of the optimum pitch generally used in the Australian building industry.

B. Vapour Barrier and Condensation. Moisture-laden air that contacts a cold surface can condense. Insulation keeps the wall and ceiling surfaces warm, which prevents the moisture vapour readily condensing on them. There is still a need to keep the insulation dry, particularly when it is in contact with cold surfaces, as any moisture in insulation will reduce its effectiveness significantly. A vapour barrier (eg, foil, painted surfaces) on the warm side of the insulation will prevent moist air from contacting the cold insulation.

C. Soundproofing. Some insulation products have acoustic applications due to fibrous structure, which give them very effective sound absorption and attenuation properties. This can be beneficial in internal walls to reduce sound transfer between rooms and under metal roofs for reducing rain noise. Special insulation types are available which are designed to give both thermal and acoustic benefits.

Fire risk

Fire safety is of paramount importance in homes. All insulation should be tested for fire resistance.

While rockwool and glasswool are the only incombustible insulation material, a number of other insulation materials are naturally resistant to fire and will not spread flame or emit smoke in the event of a fire.

Cellulose and sheepswool are generally treated with fire resistant chemicals to prevent the spread of flames should the material ignite, while petroleum based products such as polyester and polystyrene tend to melt when exposed to flame. Individual products should be checked for independent fire ratings and regard should be given to the appropriateness of the product for the application.

Pest risk

Glasswool, polyester and rockwool insulation are naturally resistant to vermin attack and are not affected by mould, mildew or rot. Wool insulation products require treatment with approved, long-lasting, non-toxic insecticide to prevent insect infestation. Individual products should be assessed for pest resistance.

Health and safety during installation

As with all materials, care should be taken when installing insulation.

With glass and rockwool products, the main issue is physical irritation of skin, eyes, nose and throat. It is recommended that personal protective measures be used when handling these materials. All glasswool manufactured in Australia is made to a bio-soluble formulation which has been assessed as non-hazardous under OHS guidelines.

Cellulose fibre may cause minor eye and respiratory irritation when handled.

Caution with glare and sunburn should be taken with reflective foils.

Product certification

The manufacture, performance and installation of insulation products made of glasswool, rockwool, polyurethane, cellulose, and reflective foil are outlined in various Australian Standards.

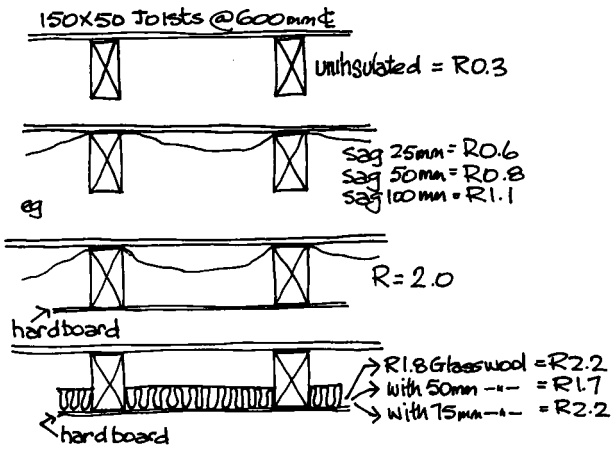
Other products that are available, such as sheepswool, polyester, and foil batt insulation need to be assessed against independent testing data provided by manufacturers.

Particular issues with the insulation standard

AS 2627 – thermal insulation of dwellings – provides recommended insulation levels for all locations in Australia. These recommendations are based on the assumption that all buildings would be heated or cooled to a pre-determined comfort level.

For buildings specifically designed using natural ventilation to maintain comfort levels, additional benefits may be achieved using foil insulation. AS 2627 is currently being reviewed and updated to take into account technological advances since its release in 1993.

Raised Timber Floors



Raised timber floors need insulation if there is significant air movement under the house. To reduce heat loss through floors:

- enclose the under-floor space (leaving the required ventilation); or
- if this is not economical, insulate under the floor; and
- consider wall to wall carpet over underlay, which will halve heat loss through the floor.

Windows and insulation

A significant amount of heat is lost or gained through the windows of a typical house.

Glass is transparent to the sun's short-wave radiation but opaque to long-wave radiation. The sun shines in and heats up the room. The warm room and its contents emit long-wave radiation so the heat is trapped. This is particularly useful in winter months.

If the sun is allowed to shine through the window in summer, insulation in the ceiling and walls would help to keep the heat in. In locations where heating is required, windows should allow winter sun to enter, but be shaded from the summer sun.

Light-coloured external shading such as awnings or plants are more effective than internal devices such as curtains. Some types of glass can also be an effective barrier to heat from the sun.

Control of heat loss in winter can be aesthetically achieved using insulating glazing. A variety of products are available, including double glazing or other energy efficient glass.

An alternative is to use tightly fitting heavy curtains. The curtains should hang from a closed pelmet to the floor or to the sill board. They should cover the window space completely to prevent convection currents of warm air passing behind the curtains.

In temperate climates low-tech solutions such as curtains and pelmets can be used to effectively reduce the amount of heat lost through windows.

The Window Energy Rating Scheme (WERS) is a nationally-applicable software assessment program that assesses windows for their insulation qualities. These windows will be branded with an appropriate sticker showing a star rating for energy efficiency.

insulation design strategy for climate

COOL TEMPERATE CLIMATE

(cross refer to page 10 Energy Management Guide)

insulation strategy

For cool/cold temperate climates the need is to concentrate on winter heating with insulation selected to perform accordingly.

ceiling treatment

- Under roof material install foil insulation with 30mm air gap.
- Ceilings should have a minimum of R3.0. Higher values are applicable in alpine areas, and/or ceilings higher than 3m.
- Higher levels of insulation should be added to homes with both central heating and central refrigerative cooling.

wall treatment

- added R2.0 is the minimum wall insulation to be considered.

floor treatment

- Floor insulation levels of overall R1.0 are adequate for most homes.
- Higher levels of insulation should be used for floors where:
  - slab heating is used, or
  - there is no carpet over timber floors, or
  - the underfloor space is well ventilated, or
  - the home is in cooler regions or alpine areas.
- Consider slab edge insulation.

window treatment (external)

- Consider double glazing, high performance glazing and/or close fitting curtains with pelmets.

shading

- Shade north and west facing windows in summer.

WARM TEMPERATE CLIMATE

(cross refer to page 10 Energy Management Guide)

insulation strategy

For warm temperate climates the need is to insulate for a mix of both heating and cooling.

ceiling treatment

- Under roof material install foil insulation with 30mm air gap.
- Install bulk ceiling insulation in the range of R2.5 to R3.0.
- Install bulk ceiling insulation to at least R3.0 if central heating is used, and/or the home is heated to temperatures above 22 degrees.

wall treatment

- added R1.5 wall insulation should be considered.

floor treatment

- Insulate suspended floors to a system R value of R1.0.
- Higher levels of insulation should be used for floors where:
  - slab heating is used, or
  - there is no carpet over timber floors, or
  - the underfloor space is well ventilated.
- Consider slab edge insulation.

window treatment (external)

- Consider double glazing, high performance glazing and/or close fitting curtains with pelmets.

shading

- Shade north and west facing windows in summer.

insulation design strategy for climate

HOT HUMID CLIMATE (a)

(cross refer to page 12 Energy Management Guide)

insulation strategy
Air-conditioned Homes

In hot humid climates cooling is the dominant requirement for comfort. If the intent is to air condition the house, bulk insulation in ceilings, insulation under roofs and in walls and a well-sealed building shell are paramount.

ceiling treatment

- Ideally use light-coloured roofing material – this can reduce the amount of radiant heat into the home by half.
- Install foil insulation under roofing material with a 30mm air gap.
- Bulk insulation R3.5 should be considered on top of the ceiling.
- For tiled roofs foil is also an advantage and also provides a moisture barrier against driving rains.

wall treatment

- Add wall insulation to achieve a system value of R1.0 to R2.0.

floor treatment

- Install bulk insulation under timber floors – added R1.0.
- For suspended concrete floors bulk insulation should be fixed.

window treatment (external)

- Consider insulating windows with double glazing.
- High performance glazing – low-e or reflective coating internal curtains and blinds as a further element for radiant heat reduction into the home.

HOT HUMID CLIMATE (b)

(cross refer to page 12 Energy Management Guide)

insulation strategy
Naturally Ventilated Homes

In hot humid climates cooling is the dominant requirement for comfort. Sufficient insulation is needed under roofs and/or ceilings and walls to avoid excessive radiant heat gains inside the house. The added insulation will need to be sufficient to allow the building to cool adequately at nights.

ceiling treatment

- For metal roofs install foil under roof battens for an overall R value for heat flow down of R2.0 (Add R1.2).
- 50mm foil backed blanket insulation under roofing material achieves the required R value.
- For tiled roofs foil is also an advantage and also provides a moisture barrier against driving rains.
- ceiling fans are important for ventilation.

wall treatment

- Overall R1.0 is recommended. Permanent shading of the walls can also achieve the same effect as the insulation achieves.

floor treatment

- As there is little difference in air temperature above and below elevated floors insulation is not advantageous.

window treatment (external)

- High performance glazing – low-e or reflective coating may be appropriate.
- Internal curtains and blinds as a further element for radiant heat reduction into the home.

shading

- Reducing radiant heat into the home is the first line of defence – insulation is the second.
- Shading is therefore extremely important to the performance of the building shell. Pergolas with shade-cloth or evergreen vines, verandahs, shading trees, overhangs, and adjustable external blinds are critical in reducing the heat on the wall in the first instance.
- All windows need shading against all sun entry.

achieving R values & best insulation performance

The total insulation value of typical construction is a combination of:

- the inherent R value of the materials the building element is made from;
- the R value of the added insulation; and
- the impact of combining these materials.

Depending on how insulation is added to building elements, thermal bridging can occur and this will result in degradation of the overall R value. For example, if R2.0 batts were placed within a conventionally framed wall of 90mm pine, the bridging effect of the pine would mean that only about R1.7 was added to the overall R value of the wall. Where possible, it is preferable to select insulation techniques which minimise thermal bridging.

With ceilings the following should be noted:

1. For non-pitched roofs, thermal bridging will result in a lesser actual performance than the nominated R value of the insulation material installed, eg to achieve an overall R value of R2.0 insulation material of R2.5 may be needed.

2. For pitched roofs, the result will depend on the optimisation of installation eg with R2.5 bulk insulation between trusses an overall R2.2 results and by adding foil under the roof, bulk insulation of R2.0 can be used to achieve R 2.2.

3. In hot climates the R value of bulk insulation directly under roof cover may be reduced by up to 40% of the advertised value.

Detailed analysis should be undertaken to ensure that the required R value can be achieved and maintained.

Quality control of insulation performance

To be effective, insulation must be installed correctly or most of the benefits will be lost.

To ensure insulation works effectively, particular attention needs to be given to the following:

1. Keep the insulation at its manufactured thickness – do not compress.

2. Insulate right to corners and other difficult spots to get to, extend it at least 50mm beyond the inside face of walls, and avoid gaps.

3. Keep it dry and away from hot flues and exhaust fans, and don't put over or near recessed lights or low-voltage transformers.

4. Keep the density and depth of the insulation consistent.

5. Loose fill insulation in drafty ceiling spaces should be avoided.

6. Reflective foil should be installed with a still-air gap of at least 30mm next to the reflective surface. Tape up any holes, tears or joins in the foil.

Quality control on installing insulation is crucial to achieving the required performance, and even more important if the R value required is mandatory.

how to choose insulation & conclusion

Thermal resistance = R value

R is the value given to thermal resistance, and the higher the R value of a material the greater is its ability to resist the flow of heat.

However, benefits from R levels are not linear. This means that twice the R value does not mean twice the benefit in thermal comfort. Australian Standard 2627.1 recommends minimum R values of insulation. Although benefits can be gained from installing insulation above these levels, the gain in performance may not be great. As with any building material, the cost of different insulation materials and their R values should be compared. In hot climates over-insulating is possible.

Are performance test certificates available?

Materials should comply with recommendations of the relevant Australian Standard and the manufacturer's product information should be based on recognised independent test methods.

Is insulation sensitive to water?

As there may be moisture in the roof space, check if the insulation has soluble chemicals that could corrode nails or cause stains on ceilings and walls. Some insulation when wet will give off an offensive odour.

The thermal resistance of most insulation is reduced if it becomes wet because water is a good conductor of heat.

Is your insulation safe?

Is it non-combustible and does it resist fire spread? It should have the appropriate certificates.

Other considerations

What care is needed in installation for health and safety reasons?
Does it improve sound-proofing?
Does it support vermin or insect life?

Checklist for selecting insulation

To be effective, insulation should not deteriorate, move or settle after installation. It is crucial to select an insulation product that:

1. is appropriate for its intended use;
2. meets Building Code of Australia requirements (if any);
3. will perform consistently for the life of the structure;
4. has the appropriate R value for the application;
5. has been tested and that an Australian Standard, or a recognised testing authority, certifies this test for the material that is commercially available;
6. is installed correctly, remains in place undamaged and will not settle; and
7. is safe to handle and constitutes no safety threat (fire and dust) to the building and the occupants.

CONCLUSION

Taking Australia as a whole, insulation is the "big-ticket" item for achieving energy efficiency in homes.

Energy efficient homes can provide builders and trade contractors with a strong marketing edge through increased home values, and consumer comfort.

Australia's target under the Kyoto Protocol is to limit greenhouse gas emissions to 108% of 1990 levels by the end of 2012. As energy use from Australian homes generates 12% of Australia's greenhouse gases, insulation provides an opportunity to assist in achieving Australia's greenhouse gas reduction targets.

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